

Department of Agriculture, Bombay

**EXPERIMENTS IN MANURING CROPS  
IN THE BOMBAY PRESIDENCY  
1896-1931**

BY

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## PREFACE.

This report was originally prepared in 1931 for the Imperial Council of Agricultural Research. After having abstracted the information they wanted for general use, they have asked the Bombay Government to publish it as a provincial document. It is hence that the report is going out for printing about 30 months after it was first prepared.

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D. L. SAHASRABUDDHE.

POONA, 4th March 1934.



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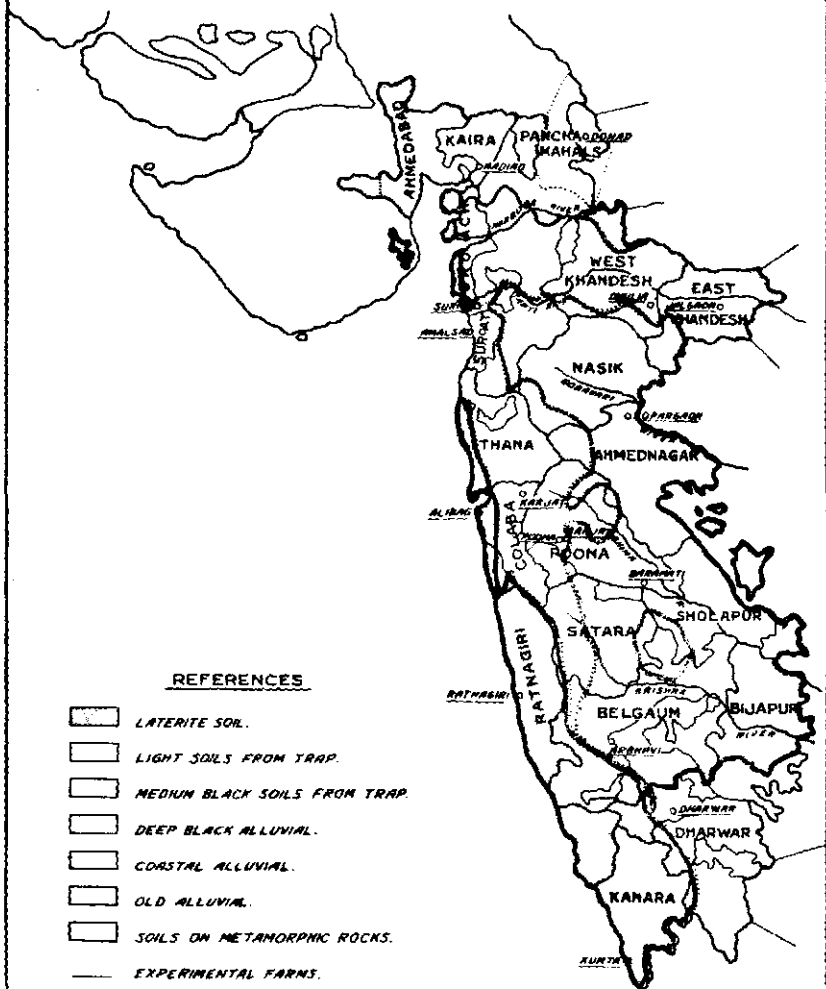
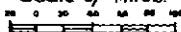


# BOMBAY PRESIDENCY.

(Excluding Sind)

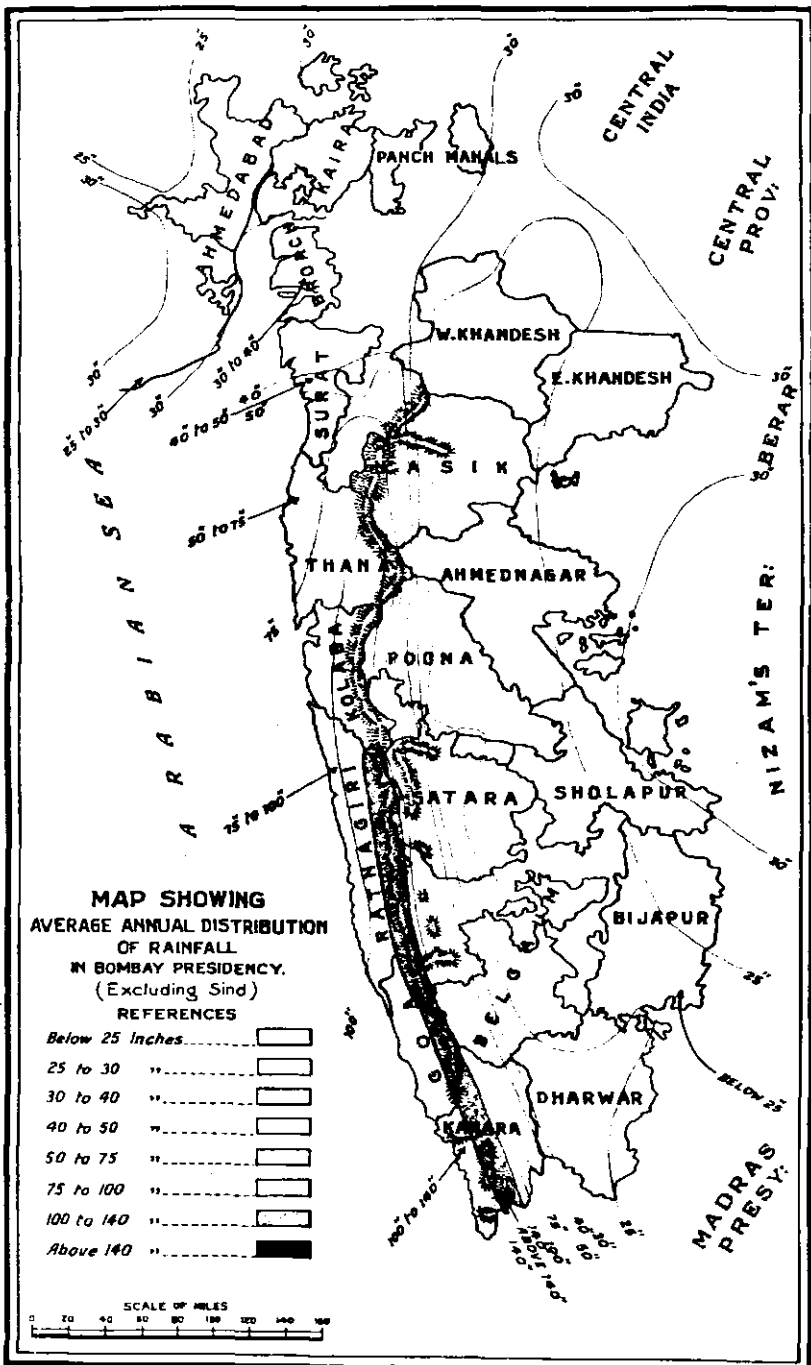
MAP SHOWING THE DISTRIBUTION OF SOILS  
AND  
EXPERIMENTAL FARMS.

Scale of Miles.





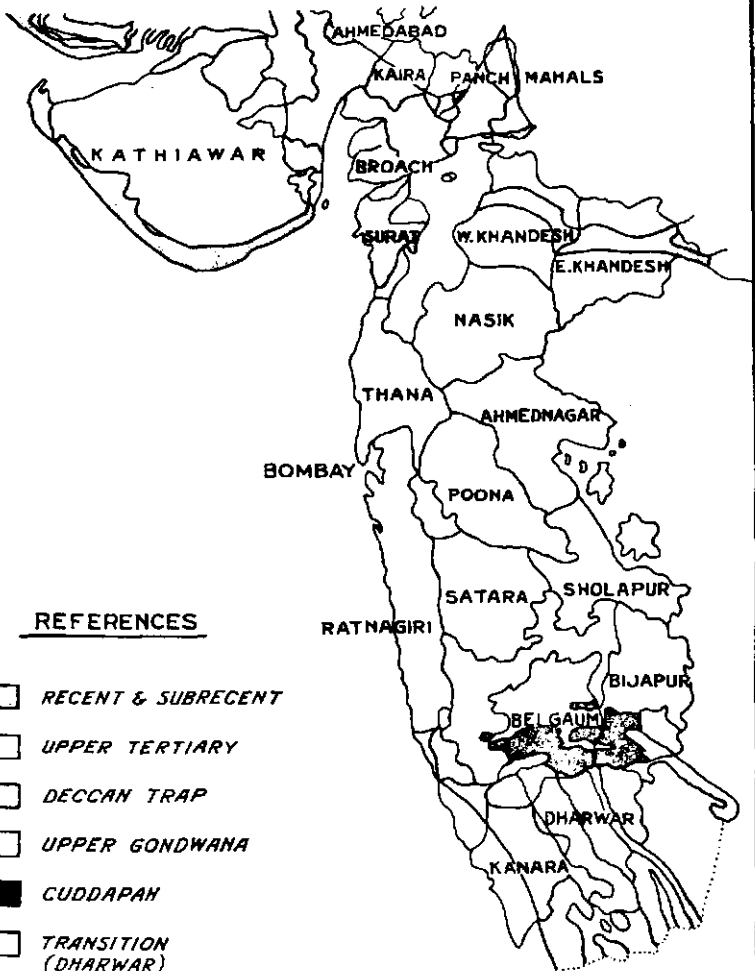
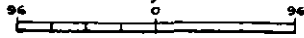
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OF THE  
BOMBAY AGRICULTURAL DEPARTMENT.





BOMBAY PRESIDENCY.  
(Excluding Sind)  
GEOLOGICAL MAP.

Scale of Miles



REFERENCES

- RECENT & SUBRECENT
- UPPER TERTIARY
- DECCAN TRAP
- UPPER GONDWANA
- CUDDAPAH
- TRANSITION  
(DHARWAR)
- CRYSTALLINE  
(GNEISS, GRANITE)



# CHAPTER I.

## Introduction.

The first meeting of the Fertilisers Committee, appointed by the Imperial Council of Agricultural Research, was held at Simla on the 16th, 17th and 18th of June 1930. One of the subjects for discussion at the meeting was "The careful study of the existing data and the correlation of the results hitherto obtained from field trials of manures". It was found out during the discussion that records of experiments carried out in provinces were available but except in Madras they were not collated. The Committee came to the conclusion that the Imperial Council of Agricultural Research should put a suitable grant at the disposal of the Agricultural Departments in each of the Provinces and request them to collate all the data on the manurial experiments done in their provinces up to now. It was also settled that the provinces should be encouraged to give all the information which they considered of any value and include in the data supplied to the Council, particulars of an experiment, though it was considered to be of doubtful utility.

An agreed form was suggested in which particulars with regard to each experiment should be given. It included the following heads :—

1. Object, history and scheme of the experiment.
2. Rotation, whether experimental or normal.
3. Size and shape of plots.
4. Number of repetitions.
5. Method of scatter.
6. Average of yields in pounds per plot.
7. Difference—plus or minus—per cent. on control.
8. Statistical significance.
9. Special reference to any ascertained soil deficiencies or peculiarities.
10. Remarks, e.g., irrigation, maturity, tillering, incidence of disease, if any, and such other points of interest.

It was made clear that the figures of the results should be given to a statistician for finding out significance, that the Statistician of the Imperial Council should be referred to for information and advice as to what statistical methods should be used. This report that is being presented, has been divided into four chapters.

Chapter II deals with the manurial experiments crop by crop. It gives, in short, the results of the experiments at all the farms on every crop in one place. In chapter III experiments are taken up farm by farm. Under each farm situation of the farm, its climatic and soil conditions are described and each of the experiments is discussed separately. Conclusions are then drawn from the results obtained. When all the experiments of one farm are discussed, a general summary of all the experiments of that farm is given. The farms are all taken in their alphabetical order.

In chapter IV all the details of the experiments described in chapter III are given. It contains all the figures of the outturns, net profits and the significance for each of the experiments with statistical notes. The tables for prices of farm products and manures used as also those for rainfall are attached at the ends of the details of the experiments for each farm.

The general process followed in getting material for this report was to get all possible information about each farm and collect figures for outturns and for prices of the farm produce and of the manurial materials used in the experiments and then to calculate net profits, where they were not already calculated, and finally to put all these figures in proper tables and present them to the statistician. The statistician examined the figures by suitable statistical methods to find out the significance. The actual methods used by the statistician are given in the appendix and his notes on all the experiments are included in detail in chapter IV. All the conclusions drawn from the figures are based on significance found by the statistician.

The application of statistical principles to agriculture, especially to field experiments was recognised only very recently in this Presidency. Hence most of the data which are available were not intended for statistical investigations. In fact it is only from the year 1928-29 we have a few experiments with sufficient number of replications of plots and that too only in some of the farms. Almost all the experiments conducted previous to this year are on the basis of a single plot per treatment or at the most two plots per treatment. Even in these cases the information as to the arrangement of plots and other details is not available in some cases.

The statistical importance of these single plot and duplicated experiments may well nigh be taken to be nil, for, nothing can be done to ascertain the error in the former case, and an attempt at finding it in the latter will give very unreliable results. But as the bulk of the data which was available belonged to either of the two categories, it would be neglecting much valuable information if they were to be discarded wholesale. Moreover it can be said that though these experiments may not lead to any important conclusions by themselves, yet a number of such experiments when tried for a series of years give consistently the same results they can lead to some reliable and obvious conclusions, which are lost if the data is neglected wholesale. Apart from this, the volume of the information afforded by these experiments will prove very valuable in directing and regulating any future undertaking with regard to field experiments. Hence an attempt has been made to analyse whatever material was available, weeding out those that were definitely known to be unreliable, due to abnormal weather conditions, disease etc., and to present the trend of the conclusions that may be drawn from the available data.

In the above attempt in eliciting the best information possible from the available data, in some cases it has been found necessary to relax



certain fundamental statistical principles to a certain extent and in those cases sufficient care has been taken to see that this relaxation does not in any way prejudice the conclusions drawn therefrom. For instance, when an experiment is conducted, say for more than half a dozen years, more or less under uniform conditions on single plots it is not possible to compare the yields of the various treatments for one year and deduce their importance because there is no scope for determining the error due to chance variations. Hence the valuable information that may be gained in this case as an experience of more than half a dozen years has to be foregone simply because of non-replicated nature of the experiments. In such cases, weeding out the results of the abnormal years, the results of the various years have been combined together and by the principle of analysis of variance, the variance due to the treatments and due to the fluctuations in the conditions of various years have been separated and the balance of the variance has been ascertained and taken as the variance due to random variation. Naturally in some cases the variance due to the fluctuations in the conditions of years is many times that due to treatments. But yet, it should be said that a comparison of the variances due to treatments and error have given some probable and consistent results in many cases.

Some valuable experiments on the use of sewage were conducted from 1899 to 1905 near Poona. A report on these experiments was published by Professor J. B. Knight. Some important extracts from this report are given at the end of the third chapter and some of the detailed tables of the same at the end of chapter IV.

The manures and fertilisers used in the experiments form a very large number. They may be classified into (I) Bulky manures, (II) Oil cakes, (III) Other organic manures and (IV) Artificial.

### I—BULKY MANURES.

#### (a) *Animal excretory materials—*

- (1) Cattle dung, (2) Cattle folding, (3) Farm yard manure, (4) Stable manure, (5) Sheep dung, (6) Sheep folding, (7) Urine earth, (8) Night soil and (9) Poudrette.

#### (b) *Materials of vegetable origin—*

- (1) Rotted cactus, (2) Green manures, (3) Groundnut husk, (4) Leaves, (5) *Mohua* refuse, (6) Rice husk, (7) Sugar-cane trash and (8) Town sweepings.

### II—OIL CAKES.

#### (a) *Non-edible oil cakes—*

- (1) Castor cake, (2) *Karanj* cake, (3) *Neem* seed crushed, (4) *Mohua* cake and (5) *Undi*-cake.

#### (b) *Edible oil cakes—*

- (1) Cotton seed cake, (2) Crushed cotton seed, (3) Groundnut cake and (4) Safflower cake.

## III—OTHER ORGANIC MANURES.

Include (1) Bone meal and (2) Fish.

## IV—ARTIFICIALS.

(May be sub-divided according to the important constituents they contain.)

(a) *Containing nitrogen only—*

(1) Sulphate of ammonia and (2) Nitrate of soda.

(b) *Containing potash only—*

(1) Sulphate of potash and (2) Chloride of Potash.

(c) *Containing nitrogen and potash—*

(1) Nitre.

(d) *Containing nitrogen and phosphoric acid—*

(1) Nicphos, (2) Ammophos and (3) Leunaphos.

(e) *Containing nitrogen and calcium—*

(1) Calcium cyanamide, (2) Calcium nitrate.

(f) *Containing nitrogen, potash and phosphoric acid—*

(1) Nitrophoska.

(g) *Containing phosphoric acid and calcium—*

(1) Rock phosphate and (2) Superphosphate.

The most prominent results of the experiments with the manures and fertilisers mentioned above, may very briefly be stated as follows:—

All the materials mentioned under the heading "animal excretory materials" have given good results practically for every crop to which these were given. Farm yard manure is by far the most important and has proved to be of advantage singly or as a basic manure with concentrated manures for top-dressing. The only exceptions where F.Y.M. has not proved to be profitable are cotton at Jalgaon and *jowar* on the Manjri Dry Farm. Here proper cultivation seems to be a more important factor than manuring. Night soil and poudrette have shown no advantage with rice at Ratnagiri. But in other cases, where these have been tried, they have given better results than F.Y.M. Poudrette for sugar-cane and maize at Arbhavi, for cotton-*jowar* at Surat, for *jowar-cotton* at Dharwar and for Bananas at Poona has given good results. Practically the same is true of the night soil also.

Some of the other bulky manures have given good results, among them green manuring has shown to be of great advantage. It has proved to be very useful for rice at Dohad, Karjat and Ratnagiri, for sugar-cane at Baramati, Manjri and Kopergaon and for tobacco at Nadiad. Leaves of *Karanj* (*Pongamia glabra*) and other trees have given good results for rice at Alibag and Kumta. Rotted cactus did not show to be of use when it was tried at Dharwar and Surat.

Oil-cakes have proved to be of advantage in most cases. There are differences in the advantage yielded by different cakes. These are given where details are discussed. Oil-cakes have proved their advantage for sugar-cane at Arbhavi, Baramati, Kopergaon, Kumta and Manjri, for rice at Ratnagiri, for cotton at Dhulia, for Maize at Arbhavi, for *jowar* at Kopergaon, for tobacco at Nadiad, and for banana at Poona. The only cases where the oil-cakes have not shown advantage are *jowar-cotton* at Dharwar and rice at Dohad.

Bone-meal and fish are very effective manures and whenever they have been tried they have given good results. Bone-meal has shown distinct advantage for rice at Alibag, Kumta and Ratnagiri and for bananas and figs at Poona. Fish has given good results for rice at Alibag, and Ratnagiri and for sugar-cane at Arbhavi, Kumta and Manjri. These two manures have unfortunately not been tried for other crops. They deserve better attention than has been given to them so far.

A large number of artificials or mineral manures have been tried. Amongst them all, sulphate of ammonia stands foremost. It has proved itself to be of great advantage for rice at Alibag, Karjat, Kumta and Ratnagiri; for sugar-cane at Amalsad (*malbari* variety), Arbhavi, Baramati, Kopergaon and Manjri and for *jowar* at Kopergaon. At Surat sulphate of ammonia gave good results only sometimes for cotton and *jowar*. This artificial manure proved to be of no advantage for cotton at Dhulia, Dharwar and Jalgaon, for rice at Dohad, for wheat at Dhulia, for sugar-cane (red spots variety) at Amalsad and for *jowar* at Manjri and Dharwar. Nitrate of soda has shown itself to be of advantage for sugar-cane at Kopergaon and at Manjri (but not so good as sulphate of ammonia) and for oranges at Modibag, Poona. It has, however, proved a failure for cotton at Arbhavi, Dharwar and Jalgaon and for tobacco at Nadiad. Ammophos gave good results for rice at Kumta and for sugarcane at Arbhavi but it failed when used for cotton at Arbhavi, Dharwar and Jalgaon. Calcium cyanamide showed advantage for rice at Kumta but did not show any advantage for cotton at Arbhavi Dharwar and Surat.

Sulphate of potash showed advantage for chillies and tobacco but not for other crops. Superphosphate and rock phosphate sometimes showed advantage for rice but failed to give any advantage for *jowar-cotton* at Dharwar, for chillies at Dhulia and for sugar-cane at Manjri.

At the Poona Agricultural College Farm experiments with sulphate of ammonia, ammophos, calcium cyanamide, niciphos, leunaphos and nitrophoska were tried for *jowar*, *bajri* and cotton but these artificials have not shown any advantage.

On the whole farm yard manure, sheep dung, urine earth, poudrette and night soil, bone-meal and fish, green manures and leaves, oil-cakes and sulphate of ammonia have proved to be of great advantage. In some particular cases nitrate of soda, sulphate of potash and rock phosphate have given good results. Other manures and fertilisers are either of very little utility or need further experimental trials.

## CHAPTER II.

## Summary of the Manurial Experiments Crop by Crop.

This chapter chiefly aims at putting all the manurial experiments crop by crop. The results of the experiments on each crop are collected from all the farms and are put together. The crops are taken in the alphabetical order so that it is convenient to refer to any crop without much trouble. Under each crop the results are mentioned separately for each farm. The general arrangement is to put the name of the crop first and under it the name of the farm at which the experiments have been carried out. For each farm the various manures used for the experimental work on that crop are mentioned and finally a short summary of the results of the various trials on that crop is given. The crops experimented upon are :—(1) *Bajri*, (2) *Chillies*, (3) *Cotton*, (4) *Fruit trees*, (5) *Groundnut*, (6) *Jowar*, (7) *Maize*, (8) *Sugar-cane*, (9) *Tobacco*, (10) *Vegetables* and (11) *Wheat*.

(N.B.—F.Y.M.=Farm yard manure.)

*Bajri.*

*Poona Agricultural College Farm.*—Manures used :—(1) F.Y.M., (2) Sulphate of ammonia, (3) Nitrate of soda, (4) Calcium cyanamide, (5) Leunaphos, (6) Nitrophoska and (7) Niciphos.

The results of the two experiments were contradictory. On the whole the addition of artificials to F.Y.M. does not show significant advantage over F.Y.M. alone.

## CHILLIES.

(a) *Arbhavi Farm.*—Manures used were :—(1) F.Y.M. and (2) Oil cake.

The experiment was to see the effect of top-dressing. The result was inconclusive.

(b) *Dhulia Farm.*—Manures used were :—(1) Castor cake, (2) Safflower cake, (3) Sulphate of ammonia, (4) Nitrate of potash, (5) Nitre and (6) Superphosphate.

Oil cakes give yields less than no-manure. Potash salts show advantage over no-manure. Potassium nitrate is slightly better than F.Y.M. but F.Y.M. is better than sulphate of potash. On the whole F.Y.M. is the best. Addition of superphosphate to F.Y.M. gives higher yields but less net profits.

(c) *Poona Agricultural College Farm.*—Manures used :—(1) F.Y.M., (2) Poudrette, (3) Sulphate of ammonia, (4) Nitrate of soda, (5) Calcium cyanamide, (6) Leunaphos, (7) Nitrophoska, (8) Niciphos and (9) Thomas slag.

Sulphate of ammonia does not show any advantage. Other nitrogenous artificials along with F.Y.M. give higher yields than F.Y.M. alone.

## COTTON.

(a) *Arbhavi Farm*.—Manures used were :—(1) F.Y.M., (2) Ammophos, (3) Calcium cyanamide, (4) Nitrate of soda.

With basic F.Y.M., or without it the artificials do not show any advantage over F.Y.M. or over no-manure.

(b) *Dhulia Farm*.—Manures used were :—(1) F.Y.M. and (2) Sulphate of ammonia.

Sulphate of ammonia yields are worse than those of no-manure and F.Y.M. treatments. F.Y.M. gives higher yields than no-manure. 7.5 tons of F.Y.M. seems to be the best dose. Higher quantities lower the net profits.

(c) *Jalgaon Farm*.—Manures tried were :—(1) F.Y.M., (2) crude night soil, (3) Sheep foldings, (4) *Mohua* cake, (5) Groundnut husk, (6) Castor cake, (7) Groundnut cake, (8) Sulphate of ammonia, (9) Ammophos, (10) Nitrate of soda and (11) Calcium cyanamide.

Out of the bulky manures used night soil and F.Y.M. increase yields. Castor cake has a good effect. Between castor cake and *mohua* cake the latter proved to be better than the former. Oil-cakes in quantities higher than 400 lbs. have no advantage over 400 lbs. Between ammophos and castor cake, ammophos gives higher yields. Ammophos, sulphate of ammonia and calcium cyanamide sometimes give higher yields than no-manure. When these are given along with castor cake they do not show any advantage over castor cake alone. On the whole manuring to cotton does not pay. Addition of artificials causes losses.

(d) *Poona Agricultural College Farm*.—The manures tried were :—(1) F.Y.M., (2) Sulphate of ammonia, (3) Ammophos, (4) Sulphate of potash and (5) Superphosphate.

Except in rare cases artificials do not show any advantage over F.Y.M. or over no-manure.

(e) *Dharwar Farm*.—Manures used were :—(1) Crude night soil, (2) F.Y.M., (3) Town sweepings, (4) Poudrette, (5) Cactus, (6) *Mohua* refuse, (7) Safflower cake, (8) *Karanj* cake, (9) Castor cake, (10) Crushed cotton seed, (11) Sulphate of ammonia, (12) Nitrate of soda, (13) Calcium nitrate, (14) Calcium cyanamide, (15) Nitre, (16) Sulphate of potash and (17) Potassium chloride.

It is the practice of Dharwar to give manure to *jowar* and it is only the residue of the manures that are utilised by the cotton. The experiments show that in bulky manures poudrette proves to be better than other manures. Night soil is better than F.Y.M. which in its turn is better than town sweepings. Cactus and *mohua* refuse show no advantage. In the experiments with increasing doses of F.Y.M. 10 tons every second year gives the best results. It is also found that there is no difference between large doses at long intervals and small doses at short intervals. The oil-cakes and crushed cotton seed when used without basic F.Y.M. show no advantage. With basic F.Y.M. they give better yields than no-treatment but there is no advantage in net

profits. When nitrogenous, potassic and phospheric artificials are used, singly or in combination, with or without basic organic manure they show no advantage.

(f) *Surat Farm.*—Manures used were :—(1) F.Y.M., (2) Poudrette, (3) Night soil, (4) Town sweepings, (5) Rotted cactus, (6) *Mohua* refuse, (7) Tank mud, (8) Castor cake, (9) Crushed *neem* seed, (10) Gypsum, (11) Sulphate of ammonia, (12) Nitrate of soda, (13) Calcium nitrate, (14) Nitre, (15) Potassium sulphate, (16) Potassium chloride and (17) Superphosphate.

At Surat manure is given to cotton in the cotton-jowar rotation. Out of the bulky manures used, rotted cactus and tank mud prove to be of no use. Poudrette seems to be the best, followed by *mohua* refuse and F.Y.M. On account of high carting charges for poudrette and *mohua* refuse F.Y.M. proves to be the most profitable. The most suitable quantity of F.Y.M. is 10 tons given every second year to cotton. In the lasting effect of 20 tons of F.Y.M. it is found that the effect lasts for 10 years. Between night soil and F.Y.M. when given in large doses at once and yields taken without further manuring for 10 years, night soil stands distinctly higher than F.Y.M. Out of the various oil-cakes tried, it is found that castor cake may give some advantage but not others. Crushed *neem* seed pulls down the yield. Trials with artificials show that nitre, sulphate of ammonia and calcium nitrate sometimes give increased yields over F.Y.M. but not always, and hence F.Y.M. seems to be the most suitable manure.

#### FRUIT TREES.

*Modibag Gardens.*—Manures used were :—(1) F.Y.M., (2) Poudrette, (3) Castor-cake, (4) Bone-meal and (5) Nitrate of soda.

The experiments were done only for one year on Bananas, figs, pomegranates and oranges. For results reference may be made to Modibag Gardens in Chapters III and IV.

#### GROUNDNUT.

*Jalgaon Farm.*—Manures used were :—(1) Castor cake, (2) Ammophos and (3) Sulphate of ammonia.

The yields do not show any significant differences due to treatments.

*Poona Agricultural College Farm.*—Manures used were :—(1) Poudrette, (2) F.Y.M., (3) Sulphate of ammonia, (4) Nitrate of soda, (5) Calcium cyanamide, (6) Niciphos, (7) Sulphate of potash and (8) Superphosphate.

A mixture of poudrette, sulphate of potash and superphosphate with and without sulphate of ammonia was tried for Spanish Peanut. The results were contradictory and no conclusions can be drawn from them. Addition of sulphate of potash to poudrette does not give any advantage. When 20 lbs. of nitrogen was given in the form of artificials along with 2·5 carts of F.Y.M. as basic manure, the artificials increased the yields

significantly, nitrate of soda being the best of them. With Big Japan groundnut also artificials along with F.Y.M. as basic manure gave significantly higher yields than no-manure or F.Y.M. alone.

#### *Jowar.*

#### *Nihua.*

*Kopergaon Farm.*—Manures used were :—(1) F.Y.M., (2) Castor cake and (3) Sulphate of ammonia.

Manures give significantly higher yields than no-manure.

*Poona Agricultural College Farm.*—Manures used were (1) F.Y.M., (2) Sulphate of ammonia, (3) Sulphate of potash, (4) Superphosphate and (5) Lime.

The manures do not show any advantage over no-manure and in some cases give lower yields.

#### *Shalu.*

*Dharwar Farm.*—Manures used were :—(1) Crude night soil, (2) F.Y.M., (3) Town sweepings, (4) Poudrette, (5) Cactus. (6) *Mohua* cake, (7) Safflower cake, (8) *Karanj* cake, (9) Castor cake, (10) Crushed cotton seed, (11) Sulphate of ammonia, (12) Nitrate of soda, (13) Calcium nitrate, (14) Calcium cyanamide, (15) Nitre, (16) Sulphate of potash and (17) Potassium chloride.

When the bulky manures are used in equal quantities poudrette proves to be the best. Night soil is better than F.Y.M. which in its turn is better than town sweepings. Cactus and *mohua* refuse do not show any advantage. In the experiments with increasing doses of F.Y.M. 10 tons every second year has given the best results. It is also found that there is no difference between large doses at long intervals and small doses at short intervals. Oil-cakes as top-dressing without basic F.Y.M. have no advantage. With basic F.Y.M. the yields are higher but no advantage is shown in net profits. In comparison between sulphate of ammonia and F.Y.M. of equal value as a top-dressing with F.Y.M. basic manure to both the treatments F.Y.M. proved to be better than sulphate of ammonia.

When artificials are used singly or in combination, without any basic organic manure, superphosphate is found to increase the yields but does not show any advantage in net profits. Nitrogenous artificials give better yields with basic F.Y.M. but do not show advantage in net profits. Without basic F.Y.M. no advantage is shown by the nitrogenous artificials even in yields.

*Dhulia Farm.*—Only F.Y.M. was tried and it was found that it shows no advantage over no-manure.

*Kopergaon Farm.*—Manures used were :—(1) F.Y.M., (2) Groundnut cake and (3) Sulphate of ammonia, (4) *San* green.

*Jowar* is grown after *san* green. Sulphate of ammonia and oil cake (used singly) give better yields than no-manure or F.Y.M. F.Y.M.

is practically equal to no-manure in yields and hence gives less net profits. In net profits cake is not better than no-manure. Sulphate of ammonia, therefore, proves to be the best.

*Manjri Dry Farm.*—Manures used were :—(1) F.Y.M., (2) Green manures, (3) Sulphate of ammonia and (4) Nitrate of soda.

In most cases manures do not show any advantage over no-manure. In one year—1930-31—F.Y.M. gave distinctly higher yields than other treatments and no-treatment.

*Nadiad Farm.*—Manures used were :—(1) Urine earth and (2) Cattle dung.

Cattle dung proved to be better than urine earth both for grain and fodder.

*Poona Agricultural College Farm.*—Manures used were :—(1) F.Y.M., (2) Sulphate of ammonia, (3) Nitrate of soda, (4) Calcium cyanamide, (5) Leunaphos, (6) Nitrophoska and (7) Niciphos.

When the artificials are used with basic F.Y.M. none shows any better yields than no-manure. With basic F.Y.M. artificials give on an average less yields than F.Y.M. alone. F.Y.M. alone seems to be the best.

*Surat Farm.*—At Surat manuring is done to cotton and *jowar* gets only the residual effects. The results are given under cotton on Surat Farm.

#### MAIZE CROP.

*Arbhavi Farm.*—Manures used were :—(1) F.Y.M., (2) Poudrette, (3) Sheepdung, (4) Urine earth, (5) Rotted cactus and (6) Green manures.

Poudrette proves to be far better than any other bulky manure. F.Y.M. stands next to poudrette. When niger, *san*, and *kulthi* are compared as green manure with fallow or with each other *san* green is found to be the best both in yields and in net profits. The other green manures do not show any advantage over fallow. With increasing doses of F.Y.M. the yields increase but for net profits 5 tons per acre is the best dose.

*Dohad Farm.*—Manures used were :—(1) F.Y.M., (2) Cattle dung, (3) Urine earth and (4) Nitrate of soda.

The results of the experiments are not conclusive.

#### RICE OR PADDY CROP.

*Alibag Farm.*—Manures used were :—(1) Poudrette, (2) Urine earth, (3) Rice husk, (4) *Mohua* refuse, (5) *Karanj* leaves, (6) Bone-meal, (7) Fish, (8) Sulphate of ammonia and (9) Superphosphate.

The bulky manures show no advantage over no-manure. *Mohua* refuse gives more yield but in net profits it is lower than no-manure. *Karanj* leaves, bone-meal and other nitrogenous manures have a distinct advantage over no-manure. Fish and bone-meal are very effective. The most economic dose is 30 lbs. of nitrogen per acre.



*Dohad Farm.*—Manures used were :—(1) F.Y.M., (2) Green manure, (3) Castor cake and (4) Sulphate of ammonia.

The green manure seems to be the best followed by F.Y.M., but on the whole results of this farm are not conclusive.

*Karjat Farm.*—Manures used were :—(1) Green leaves and (2) Sulphate of ammonia.

The green leaves give distinctly higher yields and better net profits than no-manure. Sulphate of ammonia gives higher yields and better net profits than no-manure. The most economic quantity of sulphate of ammonia is 40 lbs. of nitrogen per acre. It is also found that it is better to give the sulphate of ammonia in two doses instead of in one.

*Kumta Farm.*—Manures used were :—(1) F.Y.M., (2) Green leaves, (3) Bone-meal, (4) Sulphate of ammonia, (5) Ammophos, (6) Calcium cyanamide and (7) Rock phosphate.

The manurial experiments are on two varieties of rice :—*Halga* variety grown on low-lying lands and *Maskati* variety grown on high-lying lands. The low-lying lands are sub-divided into non-springy, springy (with springs in the rains) and some as ill-drained. The experiments show that manuring with F.Y.M. gives higher yields and net profits than no-manuring on all classes of lands.

*Terminalia paniculata* leaves are equal in effect to F.Y.M. but *nux vomica* leaves are better. Bone-meal is significantly better than F.Y.M. in most cases. F.Y.M. is better than sulphate of ammonia, while rock phosphate is slightly better than F.Y.M. Ammophos is distinctly better than F.Y.M. Calcium cyanamide also has given good yields. Bone-meal, rock phosphate, calcium cyanamide or sulphate of ammonia in combination with either F.Y.M. or green leaves gives very good results both in yields and in net profits. The effects of manures are practically of the same nature on all classes of lands except the ill-drained ones.

*Nadiad Farm.*—Manures tried were :—(1) F.Y.M., (2) Cattle dung, (3) Urine earth and (4) Nitre.

On unirrigated rice F.Y.M. with nitre gives better yields than no-manure but not so high as to pay the cost of the manure. No-manure yields are better than those of F.Y.M. and there is no loss as with F.Y.M. On irrigated rice addition of nitre along with F.Y.M. gives higher yields than F.Y.M. alone.

*Ratnagiri Farm.*—The manures used were :—(1) Urine earth, (2) Cattle folding, (3) Night soil, (4) Poudrette, (5) Green leaves, (6) Rice husk, (7) Fish, (8) Bone-meal, (9) Groundnut cake, (10) *Undi* cake, (11) Castor cake and (12) Rock phosphate.

At Ratnagiri there are the low-lying and high-lying rice lands. Manurial experiments have been performed on both of these types. The usual practice at Ratnagiri is not to manure the low-lying lands. On these lands out of the bulky manures mentioned above poudrette and night soil do not show any effect. Urine earth, cattle-folding and

rice husk show advantage over no-manures in yields and net profits. All the three are found to be of equal value. *Rui* leaves give significantly higher yields and net profits than no-manure. Oil-cakes and other manures were given at the rate of 20 lbs. of nitrogen per acre and they all gave higher yields than no-manure. Fish is distinctly better than oil-cakes both in yields and net profits. Sulphate of ammonia is less advantageous than fish. Bone-meal in equivalent quantities of nitrogen is better in yields than any other manure. When rock phosphate was tried it failed to show any advantage over no-manure. The high-lying lands called *Kuryat* are always manured with F.Y.M. *Undi* cake, bone-meal, fish and sulphate of ammonia along with F.Y.M. give higher yields than F.Y.M. alone.

#### SUGAR-CANE CROP.

*Amalsad Farm.*—Manures used were :—(1) F.Y.M., (2) Castor cake and (3) Sulphate of ammonia.

The experiments tried were intended to compare the effect of local manuring alone with the effect of local manuring along with 100 lbs. of nitrogen—50 lbs. nitrogen as castor cake and 50 lbs. nitrogen as sulphate of ammonia. The local manuring is 20 carts of F.Y.M. per acre and then *san* green. For the *manjav* variety the yields due to 100 lbs. of additional nitrogen are higher than those due to the local manuring but they are not so high as to give better profits and therefore there is no advantage for the extra treatment. For stripped Mauritius variety there is actually a loss in giving the extra 100 lbs. of nitrogen. In the case of the "*Malbari*" variety, the additional 100 lbs. of nitrogen give advantage both in yields and in net profits. With "*Malbari*" variety and "*Red sports*" variety when grown according to what is known as the *Manjri* method (wide planting with less number of sets) additional 100 lbs. of nitrogen give higher yields but not enough to get higher net profits than local manuring. In this experiment the *Manjri* method of planting was used even for local manuring.

*Arbhavi Farm.*—Manures used were :—(1) F.Y.M., (2) Sheep folding, (3) Poudrette, (4) Sugar-cane trash, (5) Fish, (6) Safflower cake, (7) Sulphate of ammonia, (8) *Ammophos*, (9) Groundnut cake, (10) Calcium cyanamide, and (11) *Gurhal* ashes.

Out of the bulky manures, poudrette proves to be the best. F.Y.M. though much below is next to it. Others do not show any advantage. Out of the nitrogenous manures used for top dressing, oil-cake proves to be better than sulphate of ammonia and the mixture of the two is between them. There is no difference in the effect between mill-pressed and country *ghani*-pressed oil-cakes. When calcium cyanamide *plus* oil-cake is compared with sulphate of ammonia *plus* oil-cake the latter proves to be significantly better than the former.

*Baramati Farm.*—Manures used were :—(1) F.Y.M., (2) *San* green, (3) Oil-cakes and (4) Sulphate of ammonia.

As basic manure *san* green proves to be the best. Addition of F.Y.M. to *san* is of no use. The local method of adding 30 to 40 carts of F.Y.M.

with 5,000 lbs. of cake as top-dressing is better than *san green plus F.Y.M.* 12 carts *plus* sulphate of ammonia (150 lbs. nitrogen). For top-dressing with sulphate of ammonia 150 lbs. of nitrogen seems to be the most suitable quantity.

*Dhulia Farm.*—Manures used were :—(1) F.Y.M., (2) Castor cake, and (3) Safflower cake.

Comparison was made between castor cake and safflower cake as top-dressing (50 lbs. nitrogen) with 20 carts F.Y.M. as basic manure, castor cake proves to be better than safflower cake both in yields and in net profits.

*Kopergaon Farm.*—Manures used were :—(1) Green manure, (2) Safflower cake, (3) Groundnut cake and (4) Castor cake.

Green manure is the basic manure in all the experiments. For top-dressing the cane, mixture of castor cake and safflower cake (150 lbs. total nitrogen) proved to be better than the mixture of sulphate of ammonia and cake or the mixture of nitrate of soda and cake. The latter mixture, however, gives better results than the former. With regard to the quantity of nitrogen for top-dressing 150 lbs. of nitrogen (when given as a mixture of sulphate of ammonia and safflower cake) seems to be the best.

*Kumta Farm.*—Manures used were :—(1) F.Y.M., (2) Fish, (3) Bone-meal, (4) *Undi* cake and (5) Sulphate of ammonia.

Two varieties of sugar-cane were experimented upon—Red Mauritius and *Daskabbu*. In all cases 15,000 lbs. of F.Y.M. per acre is used as basic manure.

With Red Mauritius variety when fish, *undi*-cake and sulphate of ammonia are compared all the top-dressings give better yields than no top-dressing. The yields due to top-dressings are equal but in net profits fish proves to be the highest and sulphate of ammonia the lowest. With the *Daskabbu* variety these top-dressings do not show any advantage over no top-dressing.

In another series of experiments mixtures of the above manures with each other were used. Bone-meal was taken as one more manure. With the Red Mauritius variety sulphate of ammonia pulls down the yields and the net profits also. With the *Daskabbu* variety sulphate of ammonia proves to be worse than no-top-dressing. *Undi*-cake and bone-meal give equal yields and net profits which are distinctly higher than those of no top-dressing. The combination of *undi*-cake and bone-meal is found to be better than either of them alone.

*Manjri Farm.*—Manures tried were :—(1) F.Y.M., (2) Green manure, (3) Stable manure, (4) Sugarcane trash, (5) Safflower cake, (6) Castor cake, (7) Cotton seed cake, (8) Groundnut cake, (9) Fish, (10) Sulphate of ammonia, (11) Nitrate of soda, (12) Potassium sulphate, (13) *Gurhal* ashes and (14) Superphosphate.

The experiments on bulky manures show that F.Y.M. may be reduced from 30,000 lbs. to 20,000 lbs. but not below that quantity. F.Y.M.,

*san* green and stable manure are all equal in their effect but cane trash is below any of these. Supplementing *san* green by F.Y.M. or oil-cakes as a basic manure does not show any advantage. Substituting F.Y.M. by oil-cakes as a basic manure has not shown any advantage.

Taking the various experiments tried in finding out the most suitable quantity of nitrogen for top-dressing, 150 lbs. of nitrogen seems to be the best. Comparing the effects of nitrogen in various forms of manure, sulphate of ammonia and fish stand higher than other manures, oil-cakes which come next are all equal. Nitrate of soda stands much below other manures. Between sulphate of ammonia and nitrate of soda given in combination with oil-cakes, the sulphate of ammonia stands much higher than nitrate of soda. Use of *gurhal* ashes along with sulphate of ammonia shows advantage but with nitrate of soda the yields are reduced. Addition of potash or phosphoric acid either singly or two together with nitrogenous top-dressings has shown no advantage at all.

#### TOBACCO CROP.

*Nadiad Farm.*—Manures used were :—(1) F.Y.M., (2) Green manure, (3) Cotton seed cake, (4) Safflower cake, (5) Groundnut cake, (6) Sulphate of ammonia, (8) Nitrate of soda, (9) Nitre, (10) Sulphate of potash, (11) Wood ashes and (12) Superphosphate.

*San* green was found to be better than F.Y.M. Addition of castor cake to F.Y.M. is advantageous but not the other cakes. Addition of nitrogenous artificials does not compare well with that of castor cake. Artificials are all equal in their effects. Addition of 50 lbs. of potash per acre shows increase in yields.

#### VEGETABLES.

Under this heading are included, (1) potatoes, (2) onions, (3) turmeric, (4) cabbage and knol khol, (5) *suran* and (6) ginger.

The manurial experiments on these are only a few and they are all on the Poona Agricultural College Farm. For results reference may be made to chapters III and IV under that farm.

#### WHEAT CROP.

*Dhulia Farm.*—Manures used were :—(1) F.Y.M., and (2) sulphate of ammonia. Sulphate of ammonia with F.Y.M. does not give higher yields than F.Y.M. alone and hence lowers the net profits.

*Poona Agricultural College Farm.*—Manures used were :—(1) F.Y.M., (2) *san* green, (3) poudrette, (4) sulphate of ammonia and (5) nitrate of soda.

With irrigated wheat F.Y.M. showed itself to be better than *san* green. Sodium nitrate in combination with poudrette gives higher yields than sulphate of ammonia with poudrette. In combination with F.Y.M. sulphate of ammonia proves to be better than nitrate of soda. No treatment yields are many times better than yields of treated plots and hence no-manure gives higher net profits.

## CHAPTER III.

**Manurial Experiments with the Conclusions drawn from them.**

In this chapter the manurial experiments are given separately farm by farm. The farms are taken in the alphabetical order. Under each there is first of all the situation of the farm with its latitude, longitude and altitude. This is followed by the range of temperatures, rainfall, period of the rainy season, etc. Then there is the general description of the soils with chemical and mechanical analyses. General object of the farm and the chief object of the manurial experiments are mentioned. Information such as years of scarcity or of abnormal rainfall, attack of diseases, if any, etc. is also given. Then each experiment is described separately. Its object, constituents, period, method and results are discussed and the conclusions drawn are stated. When all the experiments of a particular farm are described there is at the end a general summary of all the manurial experiments of that farm.

The farms for which manurial experimental data have been collected are:—(1) Alibag, (2) Amalsad, (3) Arbhavi, (4) Baramati, (5) Dharwar, (6) Dhulia, (7) Dohad, (8) Jalgaon, (9) Karjat, (10) Kopergaon, (11) Kumta, (12) Manjri, (13) Manjri Dry Farm, (14) Modibag Gardens, (15) Nadiad, (16) Poona Agricultural College Farm, (17) Ratnagiri, (18) Surat, and (19) Manjri Sewage Farm.

(N.B.—1. The various tables referred to by Roman figures are given in Chapter IV.

2. F.Y.M.=Farm Yard Manure.)

**ALIBAG FARM.**

The main station where manurial experiments were tried was at Veshvi about 3 miles from Alibag. It was started in 1911 and closed in 1919. It is situated on 18° 38' 17" north latitude and 72° 52' 26" east longitude. Its elevation is only a few feet from the sea-level. The area of the farm was 38 acres.

The rainy season extends from the first week of June to the end of September and the average rainfall is 85 inches.

The soil which is derived from trap is sticky clay containing an admixture of grit and stones.

*Chemical analysis.**Mechanical analysis.*

	Per cent.		Per cent.
Organic matter	.. 2·04	Finest silt	.. 6·90
Lime	.. 0·50	Fine silt	.. 1·52
Potash	.. 0·74	Medium silt	.. 1·91
Phosphoric acid	.. 0·07	Coarse silt	.. 7·74
Nitrogen	.. 0·06	Fine sand	.. 32·54
		Coarse sand	.. 49·39

The manurial experiments were tried on the variety of rice known as "*Bhadus*". It is a mid-late variety and takes about 140 days for its growth. Rice seedlings are grown on rabbed plots. In 3 to 4 weeks they grow to 24 to 30 inches. They are then uprooted and transplanted in puddled fields early in July.

The crop is weeded out twice and harvested in the last week of October. The average per acre is 2,000 lbs. grain and 2,000 lbs. straw.

Bulky manures and bone-meal were ploughed into the soil before puddling. Oil-cakes were given at the time of puddling while the artificials were given after transplanting.

The results of the various manurial experiments are given below.

*I—To ascertain the effect of Karanj leaves (Pongamia glabra), with and without bone-meal, as a manure for Rice.*

400 lbs. of *Karanj* leaves per acre formed one treatment, in another the same quantity of leaves was combined with 46 lbs. of bone-meal per acre. The yields of plots under these treatments are compared with those of no-manure plots since the usual local practice is to give no-manure.

Experiments were carried on for five years from 1915 to 1919 in duplicate plots. For calculations the results of 1915 and 1916 with duplicates have been taken as four replications and the results of the remaining three years as six replications. This was necessary to show the difference in net profits due to increase in cost of cultivation per acre, which rose from Rs. 36 in 1915 to Rs. 92 in 1919. Both the groups have been manipulated by Fisher's method of analysis of variance and it is seen in both the cases that treatment with *Karanj* leaves and bone-meal combined is significantly better than "no-manure" or treatment with *Karanj* leaves alone. *Karanj* leaves also show an advantage over no-manure although the advantage is not statistically significant.

Examination of the average net profits per plot as shown below confirms the same result.

*Net profits per plot in Rupees.*

	1915 and 1916 average	1917 and 1919 average
No-manure .. ..	3·68	0·63
<i>Karanj</i> leaves .. ..	3·57	0·99
<i>Karanj</i> leaves and bone-meal ..	4·14	2·28

On account of heavy cost of cultivation the net profits have gone down very much.

For detailed figures reference may be made to Table Alibag No. I.

*II—To ascertain the effect of Fish manure (at the rate of 20 lbs. Nitrogen per acre) over no manure for Rice.*

The experiments were carried out for four years from 1911 to 1914. There were duplicate plots in the last three years but in 1911 there were only single plots. All the results are taken as seven replications. The yields of "fish-manure" plot are significantly higher than no-manure plots. In net profits also fish manure shows advantage over no-manure.

For detailed figures reference may be made to table Alibag No. II.

*III—To ascertain the effect of increasing doses of Nitrogen in the form of manure on Rice Crop.*

The experiment was carried on for three years from years 1915 to 1917 with duplicate plots. The quantities of fish manure given were equivalent to 20, 30 and 40 lbs. of nitrogen per acre. 30 lbs. dose has a significant advantage over 20 lbs. dose while 40 lbs. dose has a decidedly significant advantage over 20 lbs. dose but not over 30 lbs. dose. The average net profits per plot are :—

	20 lbs. N.	30 lbs. N.	40 lbs. N.
Rupees net profit per acre ..	1.81	1.90	1.38

This shows that 30 lbs. nitrogen as fish is the best of the three treatments.

For detailed figures reference may be made to Table Alibag Farm III.

*IV—To ascertain the effect of Bone-meal equivalent to 20 lbs. of Nitrogen as compared to no-manure on Rice Crop.*

These experiments were done for six years from 1913 to 1918 in duplicate plots. The results show a decidedly positive significance of bone-meal treatment over no-manure plot. The difference is 9 times the standard error. In the net profits, however, bone-meal is not economically advantageous, the chief reason being its abnormally high cost.

*V—To ascertain the effect of "20 lbs." of Nitrogen per acre in the form of Karanj cake on the Rice Crop.*

The experiments were done for 7 years in 1911 and from 1913 to 1918. The experiments were on single plots and as such have no value statistically. The average yields of plots treated with 20 lbs. nitrogen as Karanj cake and of the "no-treatment" have a difference of 33 which is nearly 7 times the standard error and hence Karanj cake may be taken to have advantage over no-manure. The same conclusion can be drawn by comparing average net profits.

For detailed figures reference may be made to Table Alibag Farm V.

VI—To compare the effects of no-treatment with Sulphate of ammonia 112 lbs. per acre, with Superphosphate 112 lbs. per acre and with the combination of sulphate of ammonia 112 lbs. and superphosphate 112 lbs. per acre.

The experiments were conducted for three years from 1916 to 1918 on single plots and hence they are of no value statistically. If the three years are taken as replications sulphate of ammonia is significantly superior to no-manure treatment. Superphosphate and sulphate of ammonia are equal in their effects. Their combination is decidedly better than any other treatment.

The net profits, however, upset the results lowering the advantage of sulphate of ammonia. This is due to the high cost of the material ruling in 1916 to 1918. With the cheapening of sulphate of ammonia to the rates of 1930-1931, sulphate of ammonia comes up high and shows its advantage over no-manure treatment.

Detailed figures are given in Table Alibag Farm VI.

VII—To ascertain the effects of the following manures on Rice as compared with (1) No-manure (2) Mohua (*Basia latifolia* refuse 90 lbs. per acre (3) Rice husk 500 lbs. per acre (4) Urine earth 74 lbs. per acre and (5) Poudrette 222 lbs. per acre.

These experiments were done for three years from 1913 to 1915 on single plots and hence they are of no value statistically. The results do not show any advantage for any treatment except *Mohua* refuse over no-manure. Economically no-manure treatment is better than any other treatment.

Figures of details are in Table Alibag Farm VII.

Taking all the experiments mentioned above it may be stated that treatment with nitrogen whether as leaves, oil-cake, sulphate of ammonia, bone-meal or fish manure has a distinct advantage over no-manure. Comparing different quantities of nitrogen, 30 lbs. seems to be the most advantageous economically although larger doses may give greater yields.

#### AMALSAD FARM.

55 inches average rainfall.

Rainy season from June 20th to September end.

Maximum temperature about 105°F.

Minimum temperature about 43°F.

Rotation—(1) Sugar cane—November to November.

(2) Ginger—May to February.

(3) *Tur* and *Wal*—June to March.

(4) *San*—June to August.

(5) Sugar-cane—in November.

Manurial experiments of a very simple type have been tried at Amalsad.



1—To compare the effects of local manuring with and without 100 lbs. of nitrogen as a mixture of castor cake and sulphate of ammonia on sugar-cane.

50 lbs. of additional nitrogen was given in the form of castor cake and 50 lbs. in the form of sulphate of ammonia. Local manuring is 20 carts of F. Y. M. per acre and then *san green*. Yields from 1920-21 to 1928-29 for "*manjav*" are higher with 100 lbs. of additional nitrogen than without it but the cost of manuring brings the net profits equal to no additional nitrogen and therefore there is no advantage for the extra treatment. In stripped "*mauritus*" variety there is actually a loss in giving additional 100 lbs. of nitrogen.

The addition gives a distinct advantage in the case of "*malbari*" variety both in yields and net profits. With "*malbari*" variety and "*Red Sports*" variety when grown according to what is known as the "*Manjri method*" (wide planting with less number of sets) addition of 100 lbs. of nitrogen gives higher yields but not enough to get higher net profits.

Details are given in Tables in Chapter IV under Amalsad Farm.

### ARBHAVI FARM.

Arbhavi Farm is situated on the northern side and at the foot of the sandstone hills on the northern banks of the Ghataprabha river. It is near the Arbhavi village, 4 miles from Hukeri station on the M.S.M. Railway. It is on 16° 12' North latitude and 74° 54' East longitude. Its elevation from sea-level is 1920. Its area is 62.5 acres. It is commanded by the Gokak canal which runs for eight months from 15th June to 15th February. The farm was started in 1906-07.

*Temperature.*—The mean maximum temperature is 99°F. in the month of April and the mean minimum temperature is 56°F. in the month of December and January.

The farm gets anti-monsoon rains in April and May amounting to about 4 inches, the south-east rains in June, July and August giving a total of about 8 inches and it receives the north east rains from the middle of September to mid November amounting to about 12 inches. The annual average rainfall is about 23 inches. The only irregular years are 1910 (37 inches) 1910-11 (31 inches) 1914-15 (32 inches) and 1916-17 (51.5 inches) of high rainfall and 1913-14 (15 inches), 1918-19 (17 inches), 1920-21 (15.5 inches) and 1923-24 (14.9 inches) of low rainfall. The crops are affected adversely by high rainfall and not by low rainfall.

*Soils.*—The underlying rock is sand-stone intersected by trap dykes. The soils are derived mostly from the disintegration of sand-stone and trap. The farm soils mostly appear to be medium black in colour but they consist of a mixture of black silt and gritty yellowish red sand. There is a good deal of variation in the soils from sandy to stiff clay *karl* (stiff clay) and alkali patches are found here and there all over the

area. The underlying material is yellowish red *shadu* met at 1.5 to 5 feet from the surface.

## ANALYSIS.

*Chemical.*Light Black. Red alluvial. *Kurl* (stiff clay).

	per cent.	per cent.	per cent.
Loss on ignition .. .. .	9.42	12.32	13.50
Sand .. .. .	79.08	71.40	72.94
Lime, .. .. .	1.90	2.85	3.64
Potash .. .. .	0.27	0.29	0.39
Phosphoric acid .. .. .	0.09	0.07	0.04
Nitrogen .. .. .	0.06	0.08	0.04

*Mechanical.*

Finest silt .. .. .	10.80	7.12	14.70
Fine silt .. .. .	2.50	2.90	5.70
Medium silt .. .. .	3.60	4.10	4.50
Coarse silt .. .. .	11.10	18.00	18.10
Fine sand .. .. .	16.00	29.68	18.80
Coarse sand .. .. .	56.00	38.20	38.20

The manurial experiments carried on so far were many but they were not given sufficient trials or replications. In some cases they were only for one year in single plots, in other cases the basic manures *plus* top dressings were changed either in quality or in quantity and hence many experiments had to be left out of consideration. Even out of those that are taken there are some that have statistically no value but they have been included only to mention the indications given by the experiments. The chief crops on which manurial experiments have been tried are (1) sugarcane (2) maize and (3) cotton. There are manurial experiments on rice, chillies or fruits but they are not worth any consideration.

In calculating net profits on the income side are included all the money values of the main and by-products and on the expenditure side are included all charges of cultivation, irrigation, harvesting, watching, supervision, rent and interest on outlay.

Where special calculation is made it is indicated.

## SUGAR-CANE CROP.

*I—To compare the effect of sheep-folding, Poudrette and F.Y.M. on sugar-cane crop.*

The experiment was conducted in 1910-11 in duplicates on four guntha plots. There was no previous green manuring and there was no top dressing. Both in yields and net profits poudrette is significantly higher than F.Y.M. and F.Y.M. is higher than sheep folding.

Details in Table Arbhavi Farm I.

*II—To ascertain the comparative effects of (1) poudrette (2) trash and (3) F.Y.M. all 20,000 lbs. per acre as basic manure to sugar-cane.*

The experiment was done for four years from 1915-16 to 1919-20 on single plots of 5 gunthas each. The top dressing was 150 lbs. nitrogen per acre, half as oil-cake and half as sulphate of ammonia. Both in yields and net profits poudrette stands first, then F.Y.M. and last comes trash.

Details in Table Arbhavi Farm II.

*III—To compare the effects of different top dressings on sugar-cane.*

This experiment was tried for four years from 1910-11 to 1913-14 in duplicates on 4 guntha plots. The manure was 20,000 lbs. F.Y.M. per acre. The nitrogen in the top dressing was 150 lbs. The treatments were (1) no top dressing, (2) Fish, (3) Safflower cake, (4) Safflower cake 75 lbs. Nitrogen, and sulphate of ammonia 75 lbs. Nitrogen, (5) Sulphate of ammonia, (6) Sulphate of ammonia plus sulphate of potash 150 lbs. of  $K_2O$ .

Addition of sulphate of potash shows no advantage. All the other treatments give significantly higher yields than no top dressing. Oil-cake is far superior to any other treatment both in yields and net profits, fish manure comes next to oil-cake, mixture of oil-cake and sulphate of ammonia is better than sulphate of ammonia but is below oil-cake alone.

Details in Table Arbhavi Farm III.

*IV—To ascertain the effect of top dressing in the form of oil-cake and mixture of oil-cake and sulphate of ammonia to sugar-cane.*

The experiment was tried for five years from 1915-16 to 1919-20 on duplicate plots of 4 gunthas each. Top dressing has significant higher yields and net profits over no-top-dressing. Out of the two materials used the cake alone is better than the mixture of cake and sulphate of ammonia.

Details in Table Arbhavi Farm IV.

*V—To compare the effect of mill pressed and ghani pressed oil-cake when given with sulphate of ammonia as top dressing to sugar-cane.*

This experiment was tried on 4 guntha plots in duplicate for two years 1915-16 and 1916-17 and on single plots in 1917-18. Basic manure was *san green*, F. Y. M. and sheep folding. The advantage of top dressing is significant in yield and in net profits. There is no difference between mill pressed and *ghani* pressed cake.

Details in table Arbhavi Farm V.

*VI—To compare the effect of groundnut cake alone and with sulphate of ammonia as top dressing to sugar-cane.*

The experiment was tried for three years in duplicates on 4 guntha plots. Basic manure was *san green*, F.Y.M. and sheep folding.

Nitrogen in top dressing was 150 lbs. per acre. Top dressing shows its advantage as usual. Cake alone is better than its mixture with sulphate of ammonia both in yields and net profits.

Details in Table Arbhavi Farm VI.

*VII—To compare ammophos and groundnut cake as top dressing to sugar-cane.*

Only one plot experiment was tried in 1924–25 and it was found that ammophos gave a better yield. This can not be taken as conclusive.

*VIII—To compare the effects of groundnut cake, ammophos and sulphate of ammonia alone or in mixture as top dressing to sugar-cane.*

The experiment was tried only in 1926–27 on single plots and hence not conclusive. The quantity of nitrogen for top dressing was 150 lbs. The basic manure was *san green* and 20,000 lbs. of poudrette.

Singly ammophos is better than cake and cake better than sulphate of ammonia. But the mixture of ammophos and cake or sulphate of ammonia and cake is better than any of the materials singly. The two mixtures are equal.

Details in Table Arbhavi Farm VII.

*IX—To compare the effects of the following treatments as top dressing for sugar-cane :—*

(1) *Gurhal* ashes 20,000 lbs. plus groundnut cake 75 lbs. nitrogen plus sulphate of ammonia, 75 lbs. nitrogen, (2) Groundnut cake 75 lbs. nitrogen plus sulphate of ammonia 75 lbs. nitrogen, (3) Ammophos No. 2 150 lbs. nitrogen, (4) Ammophos No. 1 150 lbs. nitrogen.

The basic manure was *san green* and 20,000 lbs. of F.Y.M. The experiment was tried on single plots only in 1927–28 and therefore the results are not conclusive. The mixture of groundnut cake and sulphate of ammonia seems to be the best top dressing.

*X—To compare calcium cyanamide plus groundnut cake with sulphate of ammonia plus groundnut cake as top dressing to sugar-cane.*

The basic manure was *san green* and 20,000 lbs. of F.Y.M. Top dressing contained 150 lbs. of nitrogen. The experiment was tried for two years 1929–30 and 1930–31 in 5 replications on one guntha plots. Sulphate of ammonia is significantly better than calcium cyanamide.

Details in Table Arbhavi Farm X.

## MAIZE CROP.

*XI—To compare various bulky manures for maize crop.*

The manures were, (1) Sheep-dung, (2) F.Y.M., (3) Poudrette, (4) Rotted cactus, (5) No manure.

Each of the manures was given at the rate of 5 tons per acre. The experiments were tried for two years in 1910-11 and 1911-12 in duplicate plots. The best results in yields and net profits are given by Poudrette. In yields F.Y.M. and sheep folding are equal but in net profits F. Y. M. is better.

Details are in Table Arbhavi Farm XI.

*XII—To compare the effects of the bulky manures.*

(1) No manure ; (2) F.Y.M. ; (3) Urine earth ; and (4) Poudrette.

Each of the manures was given at the rate of 7.5 tons per acre. The experiments were tried on 4 guntha plots in duplicates for three years from 1913-14 to 1916-17. Poudrette stands out far above others in yields and net profits. Out of the other treatments F. Y. M. is better than urine earth both of which are better than no-manure.

Details in Table Arbhavi Farm XII.

*XIII—To ascertain the effects of the following green manures in the kharif season compared with fallow before rabi maize.*

The crops for green manuring were : (1) niger, (2) *san*, (3) fallow—no crop and (4) *kulthi*.

The experiments were tried on 4 guntha plots in duplicates for four years from 1910-11 to 1914-15. *San* green only stands out, others do not show much advantage over fallow.

Details in Table Arbhavi Farm XIII.

*XIV—To ascertain the effects of increasing doses of F.Y.M. on maize crop.*

Quantities of F.Y.M. given were 5 tons, 7.5 tons and 10 tons per acre. The experiments were conducted on single plots of 2 gunthas each for three years from 1928-29 to 1930-31. Increasing doses give increasing yields but are not so high as to compensate the cost of manure and hence 5 tons dose proves to be the best.

Details in Table Arbhavi Farm XIV.

*XV—To compare the effects of (1) 7.5 tons F.Y.M. and (2) 5 tons F.Y.M. plus groundnut cake 40 lbs. nitrogen per acre on maize.*

The experiments were done on 4 guntha plots in duplicate in 1919-20 and in singles for three years from 1920-21 to 1922-23. The substitution of groundnut cake 40 lbs. nitrogen for 2.5 tons F.Y.M. gives higher yields but less net profits.

Details in Table Arbhavi Farm XV.

*XVI—To ascertain the effect of Calcium cyanamide as top dressing (on cotton crop).*

The experiment was tried only for one year in 1927-28 and hence not conclusive. The top-dressing did not give a better yield ; and both the plots gave losses.

## COTTON CROP.

XVII—To compare the effects of 28 lbs. of nitrogen in various forms of artificials along with basic 2.5 F.Y.M. per acre for cotton.

The treatments were (1) no artificial (2) nitrate of soda (3) calcium cyanamide, (4) ammophos.

The experiment was tried on one guntha plots in five replications for two years 1929-30 and 1930-31.

The treatments are all equal in their effects and do not show any advantage over no artificial.

Details in Table Arbhavi Farm XVII.

XVIII—To compare the effects of 28 lbs. of nitrogen in the form of various artificials without any basic manure for cotton.

The treatments were (1) no artificial, (2) nitrate of soda, (3) calcium cyanamide, (4) ammophos.

The experiments were tried on one guntha plots in five replications for two years 1929-30 and 1930-31. Artificials do not show any difference amongst themselves. In outturns and net profits no-treatment is better than any artificial.

Details in table Arbhavi Farm XVIII.

## CHILLIES.

XIX—To ascertain the effects of F.Y.M. 7 tons with F. Y. M. 5 tons plus 40 lbs. nitrogen as cake, as top dressing.

The experiment was tried for three years from 1920-21 to 1923-24. The second treatment shows higher yields than the first but in both cases there is loss which is greater in the second case. The results are inconclusive.

The bulky manures for sugar-cane at Arbhavi Farm included, poudrette, Farm Yard Manure, sheep folding, sugar-cane trash etc. Out of all these poudrette proved to be the best. F.Y.M. though much below was next to it. Others did not show any advantage. Out of the nitrogenous substances used for top dressing oil-cakes proved to be better than sulphate of ammonia and the mixture of the two was between them. Mill pressed cakes and country *ghani* pressed oil-cakes did not show any difference when used as a top dressing manure for sugar-cane.

When calcium cyanamide plus oil-cake was compared with sulphate of ammonia plus oil-cake the latter proved to be significantly better than the former.

In the case of maize also, poudrette proved to be far better than any other bulky manure like F.Y.M., sheep folding, urine earth, rotted cactus: F.Y.M. stands next to poudrette. When niger, *san* and *kulthi* were compared with fallow and with each other as green manuring crop, *san* was found to be the best both for yields and net profits, the other

green manures did not show any advantage over fallow. With increasing doses of F.Y.M. for maize the outturns increased but for net profits 5 tons per acre was the best.

In manuring cotton various nitrogenous artificials were used with basic F.Y.M., the artificials were found to be equal with each other and also with the plot which had only F.Y.M. When the artificials were used without F.Y.M. net profits were less than those of no-manure plots.

### BARAMATI FARM.

Baramati farm is situated two and half miles on the west of Baramati town. It is 18°8' north latitude and 74°37' east longitude. This farm was started in 1920. Its area is 21 acres and 7 gunthas. Object of the farm was to demonstrate improved methods of growing sugar-cane. Some manurial experiments were also conducted.

*Temperature.*—The average minimum temperature is 45°F in December and the maximum is 109 in May.

The rainy season begins by the Middle of June and extends to the end of November. The largest quantity of rain is received in September. The total annual rainfall is 18 inches.

The farm is under Nira left bank canal irrigation.

*Soil.*—The soil is all derived from trap and is medium black, depth varying from 4 to 9 feet.

### SUGAR-CANE.

*I*—To compare the effects of different quantities of F.Y.M. added to san green manuring to make up 20,000, 30,000 and 40,000 lbs. of dry matter per acre on sugar-cane.

The variety was *Pundya*. The experiment was tried for three years from 1921–22 to 1923–24. *San* green alone gives the highest yields and therefore naturally the highest net profits.

Details in Table Baramati Farm I.

*II*—To compare effects of the following treatments on sugar-cane (*Pundya*).

The treatments were: (1) *san* green plus 150 lbs. nitrogen for top-dressing (2) *san* green plus 12 carts F.Y.M. plus 150 lbs. nitrogen for top-dressing and (3) 40 carts F.Y.M. plus 5,000 lbs. of oil-cakes.

The third is the local method of manuring. The experiment was tried on 10 guntha plots for three years in singles. The treatments one and three are equal and are better than two. This confirms the results in experiment I, where addition of F.Y.M. to *san* green has given lower yields.

III—To ascertain the effects of the following treatments per acre on "D 109" variety and also on "Pundya" variety.

The treatments were :—

(1) *San green plus* F.Y.M. 12 carts *plus* 150 lbs. nitrogen (half as cake and half as sulphate of ammonia).

(2) F.Y.M. 30 carts *plus* 5,000 lbs. of cake.

The experiment was conducted on 10 guntha plots in duplicates on "D 109" for three years from 1926-27 to 1928-29 and on "Pundya" for two years 1929-30 and 1930-31. The results on 'D 109' are not consistent and require further trials. On *Pundya* the second treatment is better than the first.

Details in Table Baramati Farm III.

IV—To ascertain the effect of increasing doses of nitrogen for top-dressing for sugar-cane.

The treatments were as follows :—

(1) Basic *san green* alone *plus* 150 lbs. nitrogen.

(2) Basic *san green plus* 12 carts F.Y.M. *plus* 150 lbs. nitrogen.

(3) Basic *san plus* 12 carts F.Y.M. *plus* 200 lbs. nitrogen.

(4) Basic *san plus* 12 carts F.Y.M. *plus* 250 lbs. nitrogen.

(5) Basic *san plus* 12 carts F.Y.M. *plus* 300 lbs. nitrogen.

The experiments were tried on 10 guntha plots for 6 years from 1921-22 to 1926-27. The nitrogen for top dressing consisted of one third as sulphate of ammonia, one third as cake and one third as fish manure.

Considering the yields and also the net profits the second treatment having *san green* and 12 carts F.Y.M. with 150 lbs. nitrogen proves to be the best. Additional nitrogen for top dressing has no advantage.

Details in Table Baramati Farm IV.

V—To ascertain the effect of increasing doses of nitrogen for top-dressing per acre with 30 carts F.Y.M. per acre for sugar-cane.

This experiment was tried for two years in 1929-30 and 1930-31. The quantities of nitrogen for top-dressing were (1) 75 lbs. (2) 100 lbs. (3) 125 lbs. and (4) 150 lbs., half of it was as sulphate of ammonia and half as cake. The best yields and net returns are given by 150 lbs. Taking experiments IV and V it may be said that for top-dressing 150 lbs. nitrogen is the most suitable quantity.

As basic manure *san green* proves to be the best. Addition of F. Y. M. to *san green* is of no use. The local method of adding 30 to 40 carts of F.Y.M. with 5,000 lbs. cake as top-dressing is itself better than *san green plus* F.Y.M. 12 carts *plus* sulphate of ammonia. For top-dressing 150 lbs. of nitrogen per acre is the most suitable quantity.

#### DHARWAR FARM.

Dharwar Farm is situated near Dharwar town about 2 miles to the east. It is on 15°27' north latitude and 75°6' longitude. Its elevation is 2,580 feet from the sea level. It was started in 1904 and is the most



important experimental station in the southern Division of the Bombay Presidency. Its area is about 146 acres.

*Temperature.*—The mean maximum temperature is 100°F. in March and the mean minimum temperature is 62°F. in December.

The rainy season extends from June to November. This place receives anti-monsoon rains in March and April to the extent of about 4 inches. The monsoon rains consist of south west showers from June to September and of north east showers in October and November. The average annual rainfall is 27 inches.

*Soils.*—The soils of the farm are mostly medium black and the plots for manurial experiments are all on these soils. They are derived from diorites, schists and hæmatitic Quartzites of the well known Dharwar or Transition system of rocks.

## ANALYSIS.

*Chemical.**Mechanical.*

Loss on ignition	..	16·88	Finest silt and clay	..	4·97
Sand	..	77·10	Fine silt	..	1·52
Lime	..	0·32	Medium silt	..	2·11
Potash	..	0·48	Coarse silt	..	6·27
Phosphoric acid	..	0·07	Fine sand	..	78·80
Nitrogen	..	0·08	Coarse sand	..	6·33

The most important crops of the farm are *Jowar* and Cotton grown in rotation. The usual practice of the tract is to manure the land for *Jowar* with 2·5 tons of F.Y.M. and take cotton after *jowar*. No direct manure is given to cotton. The manure is harrowed into the land in the month of May.

The cost of cultivation calculated includes tillage, harvesting and threshing, winnowing but does not include land rent or assessment, interest on out-lay, marketing and supervision charges.

The net profits are calculated per rotation of two years consisting of manured *jowar* and cotton of the succeeding year. In some manurial experiments manures are applied to cotton and the net profits are calculated for cotton and *jowar* of the succeeding year. This method is adopted to spread the cost of manure over crops for which it is intended.

The years 1912–13, 1914–15 and 1919–20 had more than usual rainfall and the (*Kharif*) *jowar* crop suffered in its young stage on account of extra rains in July and August. The crop yields for *jowar* are therefore low in these years. In 1914–15 and 1919–20 the ripening period of the cotton crop was prolonged and this exposed the cotton to the anti-monsoons of April of the next year and thus reduced the yields. The years 1911–12, 1920–21 and 1926–27 were of low rainfall. The yields of both *jowar* and cotton went low. There was also the attack of "strigalutia" on *jowar* which further reduced the yields of *jowar*.

In 1916-17 although the total rainfall was normal yet the distribution was unfavourable. There were extra rains in November at the time of fertilisation of flowers. This reduced the yields of *jowar*.

The cotton varieties were changed as follows:—

1907-08 to 1916-17 ..	..	Kumta ordinary (K.O).
1917-1918 to 1920-21 ..	..	Dharwar No. 1 (D.1).
1921-22 ..	..	Gadag No. 1 (only for F.Y.M. series experiment).
1922-23 to 1926-27 ..	..	Dharwar No. 2 (D.2).
1927-28 ..	..	Dharwar No. 1 (D.1).
1928-29 onwards ..	..	Jaywant (D.1 × D.2).

Kumta ordinary was replaced by D.1 as the latter was a selected superior strain. It, however, began to suffer from wilt going down in yields per acre year after year. This was, therefore, displaced by a resistant cotton Dharwar No. 2 which in its turn was replaced by D.1 × D.2 which was found satisfactory in yields, quality and resistance to wilt.

#### JOWAR AND COTTON ROTATION.

*I—To compare the lasting effects of heavy manuring once for all with (1) crude nightsoil, (2) F.Y.M. and (3) also to compare them with the local method of manuring to jowar and cotton rotation.*

The experiments were conducted from 1914-15 to 1925-26. Size of each plot without the ring was 8 gunthas. There were two sets of three plots. One set was sown with *jowar* and the other with cotton. Next year the crops were interchanged so that there was the *jowar*-cotton rotation. Manuring treatments were:—(1) ordinary local practice of 2.5 tons F.Y.M. per acre given to *jowar* in the two year rotation, (2) 20 tons F.Y.M. per acre given once for all in 1914, (3) 20 tons night soil per acre given once for all in 1914.

Since the heavy manures were put in 1914 one set of plots received it for *jowar* and the other for cotton. In each case for the first two rotations the yields of plots manured with 20 tons with night soil or F.Y.M. gave higher yields of both *jowar* and cotton than the plots manured with 2.5 tons every second year, night soil being better of the two heavy doses. But for the total effect we must take a sufficiently long period. There is no plot without manure to get a definite residual effect year after year and hence the average results are compared for a period from 1914-15 to 1925-26.

The treatment with 20 tons F.Y.M. has given over a long period lower yields and lower net profits than the local practice both for *jowar* and cotton. The treatment with night soil has given consistently better yields and net profits than no manure and hence that treatment may be taken as effective.

Details in table Dharwar Farm I.

II—To ascertain the effect of increasing doses of F.Y.M. for jowar-cotton rotation.

This is one of the most important experiments tried at Dharwar. This was started in 1908 and is still being continued. The size of each plot without the ring is 4 gunthas. The treatments per acre are as follows :—

No-manure.

2·5 tons F.Y.M. every second year.

2·5 tons F.Y.M. every year.

5 tons F.Y.M. every second year.

10 tons every second year.

{ 10 tons every fourth year. }  
 or  
 { 15 tons every second year. }

The treatment 10 tons every fourth year was tried up to 1919-20 after which it was replaced by 15 tons every second year. The manure is given to the *jowar* crop in all treatments except the one where manure is added every year. In this case it is given to both *jowar* and cotton. There are two blocks of 12 plots each. One block is sown with *jowar* and the other with cotton. Next year the order is reversed, i.e. cotton is sown in the block in which *jowar* was sown in the first year and vice versa. Thus there are two sets of results for the two blocks and these again are further divided into *jowar* and cotton plots. When the yields are compared statistically it is found that variance due to treatment is greater than that due to error and therefore the results are significant. Comparing the means of treatments for *jowar* it is found that yields due to larger quantities of manure are significantly higher than those given by small quantities of manure and no-manure. In the case of cotton the manured plots give significantly higher yields than no-manure. Amongst the treated ones, the higher quantities of manure show better yields than smaller quantities though not significant in some cases. The best outturn is given by 15 tons F.Y.M. followed by 10 tons F.Y.M. and so on. The *jowar* which receives manure is benefitted much more than the cotton which gets the residual effect in the second year. The net profits per rotation per plot are as given below :—

Treatment.	Average net profits for 4 gunthas per rotation of 2 years.
	Rs.
15 tons every second year .. ..	11·8
10 tons every second year .. ..	12·1
5 tons every second year .. ..	11·1
2·5 tons every year .. ..	10·1
2·5 tons every second year .. ..	9·7
No-manure .. ..	7·3

The best results are therefore yielded by the 10 ton treatment every second year.

With regard to the point whether the manure should be given in relatively larger doses at long intervals or in relatively small doses at short intervals, the following figures from 1908 to 1919 will be useful :—

Treatment.	Average yield per plot of 4 gunthas.		
		Jowar	Cotton
		Lbs.	Lbs.
2.5 tons every year .. ..	109.8	42.0	
5 tons every second year .. ..	106.7	41.6	
10 tons every fourth year .. ..	109.8	44.0	

This shows that there is no difference between large doses at long intervals and small doses at short intervals.

Details in Table Dharwar Farm II.

*III—To ascertain the effects of various bulky manures on jowar-cotton rotation.*

The various treatments were :—(1) No-manure, (2) Five tons F. Y. M., (3) Five tons Cactus, (3a) 2.5 tons. F.Y.M., (4) Five tons Poudrette, and (5) Five tons town sweepings.

Manure was in all cases given to *jowar*. There were two sets of plots. One set was manured in 1908-09 and the other in 1909-10. The experiments went on till 1921-22. From 1916-17 the cactus treatment was replaced by 2.5 tons of F.Y.M. which is the usual local practice. The results may therefore be considered separately for the two periods from 1908-09 to 1915-16 and from 1916-17 to 1921-22. Size of each plot was 4 gunthas. Taking the first period for *jowar* yields it is found that excepting cactus all treatments give significantly higher yields than no manure. Amongst the treatments themselves poudrette is the best. Next to this is 5 tons F.Y.M. followed by 5 tons of town sweepings.

The yields of cotton, however, do not show much advantage of the residual effects of the treatments although we might say that poudrette and F.Y.M. stand higher than other treatments followed by town sweepings. Treatment with cactus has no advantage over no-manuring. The results of the second period agree with those of the first. The 2.5 ton F.Y.M. treatment used in this period is slightly better than no manure. The average net profits calculated per rotation per plot are as follows :—

Treatment.	Average net profits per 4 guntha plot per rotation.	
	1908 to 1916	1917 to 1922.
	Rs.	Rs.
No-manure .. ..	6.1	9.4
5 tons town sweepings .. ..	7.0	13.2
5 tons poudrette .. ..	7.6	14.5
5 tons cactus (1908-16) .. ..	5.5	9.4
2 5 tons F.Y.M. (1917-22) .. ..		
5 tons F.Y.M. .. ..	7.0	12.4

The net profits also show that 5 tons pouquette is the best, followed by 5 tons F.Y.M. or town sweepings.

Details in Table Dharwar Farm III.

*IV—To compare the effect of mohua-refuse with no manure for jowar cotton rotation.*

In this experiment the *mohua* refuse was given every year, i.e. both *jowar* and cotton got the manure. For the first two years 1911-12 and 1912-13 there were duplicate plots and from 1913-14 and 1914-15 there were only single plots. In the first period the manure showed advantage over no-manure for *jowar* but not for cotton. In the second period no advantage was shown either for *jowar* or cotton. Net profits for both the periods and in all cases were less for the manure than for no-manure.

Details in Table Dharwar Farm IV.

*V-A & B—V-A.—To ascertain the effect of 20 lbs. of nitrogen per acre in the form of various oil cakes as top dressing over no top-dressing to jowar-cotton rotation.*

The treatments were:—(1) no manure, (2) 20 lbs. of nitrogen as safflower cake, (3) 20 lbs. of nitrogen as *karanj* cake, (4) 20 lbs. of nitrogen as castor cake, (5) 20 lbs. of nitrogen as crushed cotton seed.

Local basic F.Y.M. was not given.

The experiment was conducted from 1908-09 to 1912-13 in two sets of plots (each plot of 4 gunthas). Manure was given to *jowar* in both the sets. The yields due to treatments do not show any significant effect over no top-dressing. The treatments with safflower, *karanj* and castor cakes give slightly better yields than no-manure for *jowar*. When net profits are considered the above treatments show no advantage over no-manure.

*V-B.—To ascertain the effect of 20 lbs. of nitrogen per acre in the form of oil-cakes as in "V-A." with 2 tons of F.Y.M. as basic manure to jowar cotton rotation.*

The experiment was tried from 1912-13 to 1915-16. This experiment is a development of V-A. The treatments show some advantage in yields over no-manure but when net profits are considered they have very little advantage over no treatment.

These oil-cakes either with basic F.Y.M. or without it show no advantage for the *jowar*-cotton rotation.

Details in Table Dharwar Farm V-A and V-B.

*VI—To compare the effect of 10 lbs of nitrogen as sulphate of ammonia with F.Y.M. of the same money value given every year to jowar-cotton rotation.*

This experiment was tried from 1908-09 to 1914-15 in two sets of plots. Each plot was 4 gunthas. Basic manure of 2.5 tons was given

to *jowar* according to local practice and the two manures were given every year, i.e. both *jowar* and cotton received these manures. The total result is that F.Y.M. top dressing is better in yields and profits than sulphate of ammonia.

Details in Table Dharwar Farm VI.

*VII—To ascertain the effect of superphosphate, sulphate of potash and sulphate of ammonia and their combinations given to cotton rotated with jowar.*

The experiments were tried from 1908-09 to 1917-18. No basic organic manure was given either to *jowar* or to cotton. Artificial fertilizers were given to cotton. Size of plot was 4 gunthas. There were two sets of plots. In the treatments mentioned below N = sulphate of ammonia 100 lbs., K = sulphate of potash 100 lbs. and P = superphosphate 100 lbs. The treatments were:—(1) P, (2) K, (3) N, (4) nil, (5) P + K, (6) P + N, (7) K + N and (8) P + K + N.

There are no replications.

The average yields per plot from both sets are as below:—

			Seed-cotton lbs.	<i>Jowar</i> grain lbs.
			Lbs.	Lbs.
1.	P	..	48	73
2.	K	..	45	66
3.	N	..	45	69
4.	Nil	..	45	62
5.	P + K	..	45	70
6.	P + N	..	49	76
7.	K + N	..	43	67
8.	P + K + N	..	46	74

These figures indicate that none of the treatments has any effect on the cotton yields. The *jowar* yields are favourably affected in all cases by superphosphate but not by other artificials. Net profits show that it will not pay to use superphosphate. During the time of the experiments superphosphate was got at 8 lbs. per rupee while it can be had at 12 lbs. to 14 lbs. per rupee now. Even with this lowering of prices for superphosphate it will not pay to use it.

Details in Table Dharwar Farm VII.

*VIII—To compare the effects of 10 lbs. of nitrogen in various forms in combination along with the basic F.Y.M. with the effect of basic F.Y.M. alone on jowar-cotton rotation.*

The experiment was conducted from 1908-09 to 1917-18. The size of each plot was four gunthas. There were four sets of plots. The treatments were:—(1) Nitre, (2) Calcium Cyanamide, (3) Sulphate of Ammonia, (4) F.Y.M. 10 lbs. N, (5) No-manure, (6) Calcium Nitrate, (7) Nitrate of Soda.

The basic F.Y.M. was given to *jowar* every second year while the additional artificials and also additional F.Y.M. were given every year, i.e. for both *jowar* and cotton. The additional nitrogen has given increased yields for *jowar* over basic manure.

The nitre treatment is the highest followed by nitrate of soda and sulphate of ammonia which are equal. The calcium nitrate, calcium cyanamide and F.Y.M. come next and are all equal.

In cotton there is only very slight increase in yield due to treatments and all treatments prove to be equal. When we come to net profits we find that calcium nitrate, nitrate of soda and sulphate of ammonia give lower net profits than basic manure alone while nitre, calcium cyanamide and F.Y.M. give highest net profits. The F.Y.M. treatment stands the highest being distinctly higher than any other treatment.

Details in Table Dharwar Farm VIII.

*IX—To ascertain the comparative effect of (1) ammophos, (2) sulphate of ammonia, (3) safflower cake, each equal to 20 lbs. nitrogen per acre as top dressing to jowar-cotton rotation.*

This experiment was tried from 1924-25 to 1927-28. Basic manure was 2.5 tons applied to *jowar* but the additional manures were given to cotton. Size of each plot was 4 gunthas. Two sets of plots were taken with the usual *jowar*-cotton rotation. Nil or no-manure plot had only basic F.Y.M. In *jowar* the treated plots give a sufficiently higher yield than no-manure and all the treatments are equal. In cotton safflower cake gives a higher yield than no-manure but sulphate of ammonia is equal to no-manure.

Details in Table Dharwar Farm IX.

*X—To compare the effects of the following three manurial treatments on jowar-cotton rotation:—*

- (1) F.Y.M. 3 tons per acre.
- (2) F.Y.M. 1.5 tons + superphosphate 224 lbs. + Potassium chloride 80 lbs. + sulphate of ammonia 60 lbs.
- (3) Treatment (2) without potassium chloride.

This experiment was tried from 1912-13 to 1914-15. This was in duplicate plots. The size of each plot was 4 gunthas. In all cases both for *jowar* and cotton the highest yields and net profits are given by F.Y.M.

Detailed Figures in Table Dharwar Farm X.

*XI—To compare the effects of the following treatments on jowar-cotton rotation:—*

- (1) F.Y.M. 5 tons per acre.
- (2) F.Y.M. 5 tons + superphosphate 201 lbs. + sulphate of ammonia 67 lbs.

- (3) Cotton waste 5 tons.
- (4) Cotton waste 5 tons + superphosphate 201 lbs. + sulphate of ammonia 67 lbs.
- (5) No manure.

The experiments were tried from 1911-12 to 1915-16. There were two sets of plots. Cotton is manured and not *jowar*. For *jowar* as also for cotton higher yields are given by treated than non-treated plots. The treated plots with the exception of those of F.Y.M. give less net profits than no manure and hence F.Y.M. is the only treatment that has any advantage over no-manure both in yields and net profits.

Details in Table Dharyar Farm XI.

*XII—To compare the effects of the following as top dressing per acre to cotton :—*

- (1) Ammophos 28 lbs. N.
- (2) Safflower cake 28 lbs. N.
- (3) Calcium cyanamide 28 lbs. N.
- (4) Nitrate of soda 28 lbs. N.
- (5) Sulphate of ammonia 28 lbs. N.
- (6) Nitrate of soda 28 lbs. N + F.Y.M. 14 lbs. N.
- (7) No manure.

The experiment was carried out in 1928-29 in duplicate. The size of the plot was 4 gunthas. Basic manure for all was 2·5 tons F.Y.M. sodium nitrate and sodium nitrate plus F.Y.M. give slightly higher yields than no-manure, but others give less yield and when we come to net profits it is found that no-manure stands far above the treated plots.

Details in Table Dharwar Farm XII.

*XIII-A.—To compare the effects of the following manurial treatments to jowar :—*

- (1) Nil.
- (2) Nitrate of soda 14 lbs. N + 2·5 tons F.Y.M.
- (3) Nitrate of soda 14 lbs. N.
- (4) Sulphate of ammonia 14 lbs. N.
- (5) Calcium cyanamide 14 lbs. N.
- (6) Safflower cake 14 lbs. N.

The basic manure of 2·5 tons F.Y.M. was given to all plots. Size of each plot was 4 gunthas. The experiment was tried on duplicate plots for two years. The treated plots give significantly higher yields than non-treated plots. In the second year treatments 2 and 5 are distinctly better than treatments 3, 4 and 6 which are equal.



**XIII-B—To compare the effects of the manures in XIII-A on cotton and on complete rotation of jowar and cotton.**

This experiment was continued on plots where experiments in XIII-A were done. Additional manures were given to cotton with the change that they were equal to 28 lbs. of nitrogen instead of 14 lbs. per acre. Treatment 5 which gives the highest yields for *jowar* does not show the same effect on cotton. Treatments 2, 3 and 4 give high yields for cotton. Taking net profits into consideration for the whole rotation treatment 4 proves to be the best.

Details in Table Dharwar Farm XIII-A and XIII-B.

To summarise the results of all the experiments for *jowar*-cotton rotation at Dharwar we might classify the manures into three groups such as the bulky manures, oil-cakes and the mineral substances or the artificials. The various bulky manures tried include F.Y.M., night-soil, poudrette, town sweeping, cactus and *mohua* refuse. Manures were given to *jowar*. When used in equal quantities poudrette proves to be better than other manures. Night-soil is better than F.Y.M. Next to F.Y.M. are town sweepings. Night-soil has not been compared with poudrette and hence nothing can be said as to which of these is better. Cactus and *mohua* refuse did not show advantage. In the experiments with increasing doses of F.Y.M. 10 tons every second year has given the best results. It is also found that there is no difference between large doses at long intervals and small doses at short intervals. Various oil-cakes and crushed cotton seed were tried as top-dressings to *jowar* with and without the basic F.Y.M. Without the basic F.Y.M. they do not show any advantage either in yields or net profits. Along with the basic F.Y.M. oil-cakes show some advantage in yields but in net profits no advantage is shown over no-treatment. In a comparison between sulphate of ammonia and F.Y.M. of equal money value F.Y.M. as a top dressing proved to be better than sulphate of ammonia where basic F.Y.M. was common to both.

When nitrogenous, potassic and phosphatic artificials are used either singly or in combination, without any basic organic manure, super-phosphate increases the yields of *jowar* but not of cotton and even those of *jowar* are not so high as to give advantage in net profits. When the artificials equal to 10 lbs. of nitrogen per acre are given every year along with the basic F.Y.M. every second year, only nitre, nitrate of soda and sulphate of ammonia give higher yields for *jowar* but not for cotton. None of the artificials shows any advantage in net profits. The various nitrogenous artificials when used without the basic F.Y.M. do not show any advantage. When they are used with basic F.Y.M. they give higher yields for *jowar* but they are not high enough to give advantage in net profits. F.Y.M. given in addition to basic F.Y.M. is effective and is better than the artificials.

#### DHULIA FARM.

Dhulia is the headquarters of West Khandesh and is situated on 21° 10' North latitude 75° 20' east longitude and has 844 feet altitude.

The farm is about a mile and a half from the town and was started in 1905.

The chief object of the farm was to improve the local cotton. Manurial experiments were tried along with other experiments on cotton, wheat, *jowar*, chillies and sugarcane.

From 1913-14 the farm was turned into a demonstration farm and all the manurial experiments were discontinued, since then. In 1923 an Agricultural School was started on the area. The cultivated area of the farm is about 22 acres.

The average minimum temperature is 56° F. in January and the average maximum temperature is 110° in May.

The rainy season extends from 20th of June to the middle of October. Average rainfall is 22 inches.

The soil of the farm is medium black. Its depth on the farm varies from 2 to 5 feet. Under the soil is *shadu*.

The Chemical and Mechanical analysis of the soil is as follows :—

*Chemical Analysis.*

*Mechanical Analysis.*

	Per cent.		Per cent.
Loss on ignition	.. 9.16	Clay and finest silt	.. 45.46
Silica and insoluble silicates	64.00	Fine silt	.. 4.56
Lime as CaO	.. 1.63	Medium silt	.. 6.15
Magnesia	.. 0.50	Coarse silt	.. 12.84
Potash	.. 0.17	Fine sand	.. 26.52
Phosphoric acid	.. 0.08	Coarse sand	.. 4.47
Nitrogen	.. 0.11		

The variety of cotton on which manurial experiments have been tried is N.R. (*Neglectum rosea*). It is sown after the first rains in the 3rd week of June and the first picking begins in the 1st week of October and all the pickings are over by the middle of November. The usual yield is about 450 lbs. per acre.

The usual rotation is cotton and groundnut or cotton and *jowar* or *bajri*. Wheat is grown as an irrigated crop. It is sown at the beginning of December and harvested by the end of February. The usual yield is 600 lbs. per acre.

Usual cultivation begins after the harvest of the crop. The land is ploughed once and harrowed three times :—

COTTON.

*I—To compare the effects of the following treatments on cotton.*

In 1906-07 the treatments were :—(1) no manure, (2) F.Y.M. 7.5 tons per acre and (3) sulphate of ammonia 112 lbs. This was a single plot experiment. F.Y.M. gave the highest yield and was higher in net profit

than no-manure. Sulphate of ammonia lowered the yields and lowered the profits very much. In 1907-08 F.Y.M. 10 tons was compared with no-manure. F.Y.M. gave higher yields but went below no-manure in net profits.

Details in Table Dhulia Farm I.

*II—To compare the effect of 10 lbs. and 20 lbs. nitrogen as sulphate of ammonia with no-manure for cotton.*

The experiment was tried on 4 guntha plots in 1912-13. The results show that no-manure is the best both in yields and in net profits. The larger the quantity of sulphate of ammonia the worse is the result.

Details in Table Dhulia Farm II.

#### JOWAR.

*III—To compare the effect of 10 tons of F.Y.M. with no-manure on jowar.*

This experiment, tried only once in 1907-08, shows that F.Y.M. 10 tons brings less yield and gives loss.

Details in Table Dhulia Farm III.

#### SUGAR-CANE.

*IV—To compare the effect of the following treatments on sugar-cane :—*

- (1) 20 tons F.Y.M.
- (2) 20 tons F.Y.M. plus 50 lbs. nitrogen as castor cake.
- (3) 20 tons F.Y.M. plus 50 lbs. nitrogen as safflower cake.

The experiment was tried on 10 guntha plots in 1908-09 and 1910-11. 20 tons F.Y.M. plus 50 lbs. nitrogen per acre as castor cake gives the highest yields and net profits. Other treatments cause losses.

Details in Table Dhulia Farm IV.

#### CHILLIES.

*V—To compare the effects of various manures on chillies when given in quantities equal to 20 lbs of potash per acre.*

The manures used were :—(1) castor cake, (2) safflower cake, (3) sulphate of potash, (4) potassium nitrate, (5) F.Y.M. and (6) no manure.

The cakes give less yields than no-manure. The potash salts show some advantage over no-manure. Potassium nitrate is slightly better than F.Y.M. but F.Y.M. is better than sulphate of potash. On the whole F.Y.M. is the best. The experiment was tried only in single plots in 1910-11.

Details in Table Dhulia Farm V.

VI—To compare the effects of the following treatments per acre on Chillies.

The treatments were :—(1) 2 tons F.Y.M., (2) 2 tons F.Y.M. plus 100 lbs. of superphosphate plus 200 lbs. of nitre.

This experiment was done in duplicates for three years from 1911-12 to 1913-14. Although the yields of the second treatment are significantly higher than those of the first yet it gives greater losses.

Details in Table Dhulia Farm VI.

### WHEAT.

VII—To ascertain the effects of 10 lbs. and 20 lbs. of nitrogen in the form of sulphate of ammonia in addition to 3 tons of F.Y.M. for wheat.

The experiment was tried on 4 guntha plots in 1911-12 and 1912-13.

The addition of sulphate of ammonia does not give increase in yields and hence lowers the profits.

Details in Table Dhulia Farm VII.

The experimental work at Dhulia is of a poor character but as a general outcome of the experiments that have been tried it seems that F.Y.M. is the most suitable manure for all crops and for sugar-cane addition of castor cake as top-dressing is very valuable. Sulphate of ammonia has proved to be bad for cotton.

### DOHAD FARM.

This farm was started in 1906. It is situated 2 miles east of Dohad town and 3 miles south of Dohad Railway station. It is on 19° north latitude and 51° east longitude, and it is 1,000 feet above sea level. Its mean maximum temperature is 106°F. in May and mean minimum temperature 50°F. in December. Average rainfall is 28 inches and the rainy season generally begins by the 20th June and extends to October end. There are occasional rainfalls in November.

The area of the farm is 67 acres ; out of which 45 acres are under Double cropping. The usual *kharif* crops are maize and paddy, groundnut, *tur* and cotton and the *rabi* crops are gram, wheat and peas.

This area is commanded by the Muvalia Left Bank Canal.

*Kharif* Paddy gets irrigation from this canal. Wheat is regularly irrigated and gram only if occasion demands.

This farm is chiefly meant for demonstration of good agricultural practices and distribution of good seed. There are very few manurial experiments and those that have been tried are valueless since they are without any basis ; but those results that could be extracted are given for what they are worth.

## RICE.

*I—To compare the effect of 10 carts F.Y.M. per acre with that of san green manure for irrigated paddy or rice.*

This experiment was tried in single plots for two years 1929-30 and 1930-31 and the results show that *san green* gives better yields and higher net profits. The variety of rice was *Jiresal*. The data, however, needs confirmation by further trials.

Details in Table Dohad Farm I.

*II—To compare the effects of 30 carts F.Y.M. and 600 lbs. of castor cake per acre for irrigated paddy.*

The experiments were tried on 1918-19 and 1919-20 on *Kamod* variety and then on *Sutarsal* for one year and on *Jiresal* for one year. On the whole yields for both are equal with some advantage for F.Y.M. but in net profits castor-cake is better than F.Y.M.

Details in Table Dohad Farm II.

*III—To compare the effects of 15 lbs. of nitrogen per acre in the form of (1) castor-cake, (2) sulphate of ammonia and (3) san green for irrigated rice.*

The variety of rice was *Jiresal*. The experiment was tried for two years 1929-30 and 1930-31 on 10 guntha plots in singles. On the whole the treatments seem to be equal both in yields and net profits.

Details in Table Dohad Farm III.

*IV—To compare the effects of the following treatments per acre on irrigated paddy:—*

- (1) 20 carts F.Y.M.
- (2) 20 carts F.Y.M. plus sulphate of ammonia.
- (3) *san green*.
- (4) *san green* plus castor cake 400 lbs.

The experiment was tried in 1929-30 and 1930-31 on 13 guntha plots in singles. *San green* alone gives the highest yields and the best net profits. F.Y.M. alone comes next. The other two treatments are equal with each other and are below F.Y.M.

Details in Table Dohad Farm IV.

## MAIZE.

*V—To compare 30 carts F.Y.M. and 20 carts F.Y.M. per acre with no-manure for kharif maize.*

*Kharif* maize is rotated with *rabi* wheat the same year, if possible without irrigation. The experiment was tried for four years from

1918-19 to 1921-22 on the same variety of maize. F.Y.M. is effective, but 30 carts has no advantage over 20 carts. A further experiment from 1922-23 to 1927-28 shows that F.Y.M. in quantities lower than 20 carts is not of any use and that 30 carts may prove to be the best. This experiment requires further confirmation.

Details in Table Dohad Farm V.

*VI—To compare effects of urine earth and cattle dung on kharif maize.*

The variety of maize was "Sameri". Urine collected from 10 bullocks for 3 months was absorbed in earth and used as manure and this was compared with cattle dung collected from 10 bullocks for 3 months used as manure per acre. The experiment was tried from 1912-13 to 1919-20. Both the treatments seem to be equal.

Details in Table Dohad Farm VI.

*VII—To compare the effects of 150 lbs. and 300 lbs. per acre of nitrate of soda for kharif maize.*

The experiment was tried on 18.75 guntha plots in singles from 1917-18 to 1921-22. The treatments increase yields but on account of bad years there were losses.

Details in Table Dohad Farm VII.

On Dohad Farm manurial experiments were of a secondary nature and hence the results are not of much value. Manures were tried on irrigated paddy and *kharif* maize. They are very few and need not be summarised.

## JALGAON FARM.

Jalgaon is on the G.I.P. Railway line and is the headquarters of East Khandesh District. It is situated on 21° north latitude and 75° 35' east longitude and its altitude is 700 feet. The farm is about 2 miles from Jalgaon town. It was started in 1913.

The temperature in the cold season varies from 46° F. to 97° F. and in the hot season from 66° F. to 114° F.

The rainy season extends over about three and half months from the 15th of June to the end of September. Rains after the 10th of October spoil the cotton crop. The average rainfall is 28 inches.

The farm area is in the Tapti valley and its soil is deep black varying in depth from 7 to 9 feet. Below this is yellowish black earth which is very sticky. The rock is at a depth of 40 to 50 feet.

The chemical and mechanical analysis of the soil is as follows :—

Chemical.		Per cent.	Mechanical.		Per cent.
Loss on ignition	..	9.20	Clay and finest silt	..	49.15
Sand and Insoluble silicates.		60.14	Fine silt	..	3.99
Lime	..	2.69	Medium silt	..	6.34
Magnesia	..	0.20	Coarse silt	..	10.76
Potash	..	0.20	Fine sand	..	25.62
Phosphoric acid	..	0.09	Coarse sand	..	4.15
Nitrogen	..	0.11			

This farm is chiefly meant for *kharif* cotton, but they also grow *kharif jowar*, groundnut and *rabi* wheat. The total area of the farm is 204 acres.

The variety of cotton grown is N.R. (*Neglectum rosia*). Recently Banila has been introduced but all the manurial experiments tried so far are on the N.R. cotton. This cotton is sown soon after the first rains in June (about the 15th of June) and the picking begins by the 20th of October and all the three pickings are over by the end of November. The rotation followed on the farm is as follows :—

- (1) 1st year cotton.
  - (2) 2nd year cotton.
  - (3) 3rd year *kharif jowar* plus *udid* or groundnut.
- or
- (4) 3rd year wheat or gram or coriander.

The average yield in normal years for the farm is 550 to 650 lbs. or even 700 lbs. of *kapas*.

The practice of rotation in this district depends on the prices of cotton. If cotton prices are high cotton is taken without rotation for years together but with low prices cotton is rotated with *jowar*, groundnut and wheat.

Most of the manurial experiments are on cotton but in recent years a few experiments have been tried on groundnut, *jowar* and wheat. It was only two years ago that the new system of experiments with one guntha plots and with randomisation was introduced. The experiments previous to that were in duplicates on 10 guntha plots for calculations two to three years are put together. Some of the experiments were on very large plots like 3 acres each. Experiments tried for one year only with duplicate plots and also those with unknown mixtures have been left out.

The following years were abnormal and have therefore been dropped out—

1917-18—Yields of cotton were very low on account of irregular distribution of rain.

1925-26—There was no rain from 3rd September onwards and therefore the yields of cotton were very low.

1927-28—Heavy late rains soiled cotton.

Cost of cultivation includes the following items:—

1. Preparatory tillage such as ploughing, harrowing and cleaning.
2. Manure and manuring.
3. Seed and sowing.
4. After tillage and care such as interculturing, weeding and watching.
5. Harvesting and preparing for market.
6. Marketing charges.
7. Supervision charges of *mukadam*.
8. Interest on the outlay.
9. Rent of land at Rs. 18 per acre. (This includes assessment).
10. Hire charges for implements.

The chief object of carrying on manurial experiments in the original was to find out a substitute for F.Y.M. which is ordinarily used at the rate of 15 carts per acre and subsequently also as a substitute of castor cake. The F.Y.M. was rising in price from Re. 1 to 5 per cart. The castor cake also went on rising in price from 40 to 100 rupees per ton. There is one plot of one acre which was not manured at all up to 1928.

If timely and proper tillage is done it is said to improve soils to such an extent as to give 25 to 30 per cent. more yields in the deep black soils of Khandesh. Under these circumstances manuring may not show any appreciable advantage over no-manure.

Timely tillage means—

Ploughing from November to end of January, stalks to be removed immediately after the third picking, i.e. in December or January. Two to three harrowings immediately after removing stalks.

Interculturing 4 to 5 times at least and weeding 2 to 3 times during the growing period of cotton.

#### COTTON CROP.

1.—To ascertain the effect of the following treatments per acre on cotton:—

- (1) Crude nightsoil 30 carts.
- (2) Sheep folding (2,000 sheep for one night).
- (3) Castor cake 400 lbs.
- (4) F.Y.M. 15 carts.
- (5) No manure.



The experiments were tried from 1919-20 to 1922-23 on single plots. Treated plots varied from 20 to 60 acres each while the non-treated plots varied from 1 to 5 acres. Nightsoil and F.Y.M. treatments give a much higher yield than non-treated plot but the cost of manure takes away a large share of the profit and hence non-manured plot is the most profitable. The prices of the above manures were nearly the same as at present while the prices of cotton have gone down much.

Details in Table Jalgaon Farm I.

*II(a)—To compare the effect of (1) 15 carts of F.Y.M. with (2) 7.5 carts plus 360 lbs. of castor cake (equal in value to 7.5 carts F.Y.M.).*

*(b)—To compare the effect of (1) 15 carts of F.Y.M. with (2) groundnut husk equal in weight to 15 carts F.Y.M.*

The experiments were tried in duplicates on 10 guntha plots. Replacing half of F.Y.M. by castor cake or the whole of it by groundnut husk gives slightly higher yields, but treatment with manures shows loss and hence none can be favourably considered.

Details in Table Jalgaon Farm II.

*III—To compare the effects of increasing doses of castor cake to cotton.*

The experiment was tried for two years in duplicate plots of 8 gunthas each in 1920-21 and 1921-22. The quantities used were 400, 500, 600, and 700 lbs. of castor cake per acre. Beyond 500 lbs. the yields do not show any significant increase. From the point of net profits 400 lbs. seems to be best.

Details in Table Jalgaon Farm III.

*IV—To ascertain the effect of 400 lbs. and 800 lbs. of Mohua cake on cotton.*

The experiment was tried in duplicate plots of 16 gunthas in 1920-21, and of 10 gunthas in 1921-22. The larger quantity of the cake does not give higher yields but brings less net profits.

Details in Table Jalgaon Farm IV.

*V—To compare equal doses of castor cake and Mohua cake for cotton.*

This experiment was tried in 1923-24 in duplicate with 2 to 3 acre plots. 400 lbs. of each cake per acre was the dose. The mohua cake gave higher yield and definitely higher profits although castor cake was slightly cheaper than mohua cake.

Details in Table Jalgaon Farm V.

*VI—To ascertain the effects of the following treatments per acre to cotton:—*

(1) 7.5 carts F.Y.M. plus groundnut cake 250 lbs. plus 44 lbs. nitrates of soda.

(2) 7.5 carts F.Y.M. plus groundnut cake 250 lbs. plus 40 lbs. sulphate of ammonia.

(3) 15 carts F.Y.M.

The experiment was tried in duplicate plots of 10 gunthas each for two years 1927-28 and 1928-29. The first treatment gives higher yields than the other two which are equal but all the treatments show losses.

Details in Table Jalgaon Farm VI.

VII—To compare ammophos 80 lbs. per acre with castor cake 400 lbs. per acre on equal basis of nitrogen for cotton.

The experiments were tried in duplicate plots of 10 gunthas each for two years 1924-25 and 1926-27. Yields of both the treatments are equal but ammophos gives higher net profits.

Details in Table Jalgaon Farm VII.

VIII—To compare the effects of the following treatments per acre on cotton :—

(1) 15 carts F.Y.M. plus nitrate of soda 100 lbs.

(2) 15 carts F.Y.M. plus nitrate of soda 150 lbs.

(3) 15 carts F.Y.M. alone.

The experiments were tried on 10 guntha plots in duplicates in 1924-25 and 1925-26 and in singles in 1926-27. Taking all the results, treatment two gives higher yields than the other treatments but with regard to profits all of them show losses.

Details in Table Jalgaon Farm VIII.

IX—To ascertain the effects of the following treatments per acre on cotton :—

(1) Groundnut cake 200 lbs. plus 40 lbs. of sulphate of ammonia.

(2) Groundnut cake 200 lbs. plus 50 lbs. nitrate of soda.

(3) Castor cake 400 lbs.

The experiment was tried on 10 guntha plots for two years 1927-28 and 1928-29. All the treatments are practically equal in yields and all of them show losses.

Details in Table Jalgaon Farm IX.

X(a) and (b)—To ascertain the effects of ammophos and sulphate of ammonia with and without castor cake on cotton.

(a) (1) 100 lbs. castor cake plus 60 lbs. ammophos.

(2) 100 lbs. castor cake plus 30 lbs. sulphate of ammonia.

(3) castor cake alone.

The nitrogen in ammophos and sulphate of ammonia was equal in proportion. Plots were 1 guntha each; and there were 4 replications. The experiment was tried for two years 1929-30 and 1930-31. The yields of all the treatments were practically the same.

- (b) (1) Ammophos 100 lbs.  
 (2) Sulphate of ammonia 50 lbs.  
 (3) No manure.

The experiment was tried for two years 1929-30 and 1930-31 in four replications on one guntha plots. Only in one year ammophos yields showed significance over no-manure yields but the results cannot be taken to be conclusive.

Details in Table Jalgaon Farm Xa and Xb.

*XI(a) and (b)—To ascertain the effects of calcium cyanamide and sulphate of ammonia with and without castor cake.*

- (a) (1) 100 lbs. castor cake plus 112 lbs. calcium cyanamide.  
 (2) 100 lbs. castor cake plus 100 lbs. sulphate of ammonia.  
 (3) 100 lbs. castor cake alone.

The experiment was tried for two years in 1929-30 and 1930-31 on one guntha plots in four replications. The results do not show any significant differences in yields. There is therefore no advantage in adding artificials to castor cake.

- (b) (1) 112 lbs. calcium cyanamide.  
 (2) 100 lbs. sulphate of ammonia.  
 (3) No manure.

The experiment was tried for two years in 1929-30 and 1930-31 on one guntha plots with four replications. In the first year treatments did not get significant yields over no-manure. In the second year there was significance but it cannot be taken as conclusive.

Details in Table Jalgaon Farm XIa and XIb.

#### GROUNDNUT CROP.

*XII(a) and (b)—To ascertain the effect of ammophos and sulphate of ammonia with or without castor cake on groundnut crop.*

- (a) (1) Castor cake 100 lbs. plus ammophos 60 lbs.  
 (2) Castor cake 100 lbs. plus sulphate of ammonia 30 lbs.  
 (3) Castor cake alone.

This experiment was tried on one guntha plots with four replications for two years 1929-30 and 1930-31. The yields did not show any significant differences:—

- (b) (1) Ammophos 100 lbs.  
 (2) Sulphate of ammonia 50 lbs.  
 (3) No manure.

The experiment was tried on one guntha plots with four replications for two years 1929-30 and 1930-31. In the first year sulphate of ammonia and no-manure are better than ammophos but in the second year no significant difference is shown by any of the three.

Details in Table Jalgaon Farm XIIa and XIIb.

To summarise the results of manurial experiments on cotton at Jalgaon, we can say that out of the various bulky manures tried nightsoil and F.Y.M. are able to increase yields and castor cake also has a good effect. Between castor cake and *mohua* cake the latter proved to be better than the former. Oil-cakes in quantities higher than 400 or 500 lbs. do not give any higher yields than those given by 400 lbs. or 500 lbs.

Between ammophos and castor cake ammophos gives higher yields. Ammophos, sulphate of ammonia and calcium cyanamide give sometimes better yields than no-manure. When they are given along with castor cake they do not show any advantage over castor cake alone. On the whole it seems that manuring to cotton does not pay, adding of artificials causes losses.

### KARJAT FARM.

Karjat is situated at the foot of the Western Ghats on the G. I. P. Railway line in Kolaba District. It is on 18° 81' north latitude and 73° 60' east longitude and its altitude is 169 feet. The farm was started in 1919 as a Rice Research Station.

Temperature varies from 50° F. in January-February to 110° F. in April-May. During the rainy season the temperature is between 74° and 90° F.

The rainy season extends from the first week of June to middle of October. The average rainfall is 120 inches.

The farm is situated between hills and the fields receive washings from the hills. The soil is sandy loam to loam. Its depth varies from 6 to 18 inches. It overlies *murum* which is a disintegrated material from the trap rock below :—

#### *Chemical Analysis.*

Per cent.

#### *Mechanical Analysis.*

Per cent.

Loss on ignition	..	13.46	Finest silt	..	6.75
Sand	..	62.32	Fine silt	..	9.57
Lime	..	0.80	Medium silt	..	11.26
Potash	..	0.14	Coarse silt	..	19.90
Phosphoric acid	..	0.13	Fine sand	..	43.69
Nitrogen	..	0.10	Coarse sand	..	8.83

All the manurial experiments given are tried on the late variety of rice known as "Kolamba". It takes 145 days for its growth. Rice seedlings are grown on *rabbed* plots. In three to four weeks they grow to 24 to 30 inches. They are then uprooted and transplanted in puddled fields in bunches early in July. In the manurial experiments each bunch had 4 seedlings. The crop is weeded twice and is harvested in November. Sometimes a winter crop of pulse is taken but on the experimental plots this was not taken. No cultivation is given in hot weather. The average yield is 2,000 lbs. of grain and 2,000 lbs. of straw per acre. The total cultivation and harvesting charges are about Rs. 50 per acre.

The cultivators never manure the crop and the chief object of the experiments was to ascertain what manure and in what quantity would give increased yields.

The results of the various manurial experiments are given below:—

*I—To ascertain the effect of increasing doses of Nitrogen in the form of sulphate of ammonia.*

The experiments extended from 1922 to 1928. In the year 1922 there were only two doses—40 lbs. and 60 lbs. of nitrogen and there was only one plot for each treatment. In 1924 this experiment was dropped and in 1925 the experiment was put on bad plots yielding irregular results. All these have, therefore, been left out of consideration. Taking the results of 1923, 1926, 1927 and 1928 it is seen that the treated plots give significantly higher yields than no-treatment plots but quantities of nitrogen greater than 40 lbs. do not give significant increase over 40 lbs., 60 lbs. and 100 lbs. of nitrogen give practically the same yields and therefore diminishing net profits. Under Karjat conditions 40 lbs. of nitrogen in the form of sulphate of ammonia is the most suitable of the quantities tried. This holds true for individual years and for all the years taken together. For detailed figures refer to table Karjat Farm I.

*II—To ascertain the best distribution of sulphate of ammonia (60 lbs. N.)*

Manure was given (1) all at once soon after transplanting (2) in two doses of 30 lbs. each, one soon after transplanting and the other at pre-flowering time; (3) in three doses of 30 lbs., 15 lbs. and 15 lbs., the first dose was given soon after transplanting the second at pre-flowering and the third at flowering time and (4) in three doses of 20 lbs. each at timings indicated under No. 3.

Experiments were done in duplicates for four years from 1925 to 1928 and in quadruplicates in 1929. Manured plot yields are significantly higher than no-treatment plot yields. Manure given in two doses gives invariably a higher—though not significantly higher—yield than when given all at once. The net profits also are higher. Three doses do not show any advantage over two doses. For detailed figures refer to table Karjat Farm II.

*III—To ascertain the effect of increasing doses of sulphate of ammonia on varying number of seedling (culms) per bunch.*

The experiments were tried in duplicates in 1928, in triplicates in 1929 and in six replications in 1930. The quantities of manure used were equivalent to 30, 40, and 60 lbs. of nitrogen.

Taking the results of 1930 it is seen that higher the quantity of manure the higher is the outturn. The best combination is 4 culms with 60 lbs. nitrogen, next to this is 8 culms with 60 lbs. nitrogen followed by 4 culms with 40 lbs. nitrogen and then 8 culms with 40 lbs. nitrogen. The experiments of 1929 give very similar results. 60 lbs nitrogen does not show much advantage over 40 lbs. nitrogen. Practically with every treatment 4 and 8 culms are better than 12 culms both in yields and profits. For detailed figures refer to table Karjat Farm III.

*IV—To ascertain the effect of green manuring 60 lbs. of Nitrogen ploughed into the land before transplanting.*

The experiments were tried in duplicates for three years 1925, 1927 and 1928. Two types of green leaves were used *Rui* (*calotropia gigantea*) and *Ipomia carnia*. In all the three years the green manures have given significantly higher yields than no-treatment. Net profits also are higher. In 1925 *Rui* leaves and *Ipomia* leaves are equal in their effects but in 1927 and 1928 *Rui* leaves are distinctly more effective both in yields and net profits. For detailed figures refer to table Karjat Farm IV.

Taking all the four experiments into consideration it may be stated that manuring with sulphate of ammonia always gives a significant advantage over no-manure. The greater the quantity of manure the higher is the outturn but out of the various doses tried (40, 60, 80 and 100 lbs. of nitrogen per acre), 40 lbs. is the most economic. (Experiments with 30 lbs. nitrogen were not tried.)

It is also shown that to give the manure in two doses instead of giving it all at once is distinctly advantageous.

Green manuring also has a significant effect. Out of the two manures tried—*Rui* and *Ipomia carnia*—the first is more advantageous than the second.

### KOPERGAON FARM.

Kopergaon farm is situated at a distance of 7.5 miles from Kopergaon Railway Station and 4.5 miles from Kopergaon town in Ahmednagar district. It is on 19° 50' north latitude and 74° 30' east longitude. Its elevation is 1,790 feet from the sea level. Area of the farm is 110 acres out of which 30 acres are under cultivation.

It was started in the year 1915 for growing fodder and it continued to be so till the year 1925. After this sugarcane and its rotation crops were introduced. Manurial experiments were first done on *shalu jowar* and *nilva jowar* and later on sugarcane. On the whole the manurial experiments are very few.

*Temperature.*—The average maximum temperature is 104° F in April and the average minimum temperature is 51° F in January.

The rainy season begins in the middle of June and extends up to November. Many times some showers are received in May. The period between 15th of July to 15th of September is generally dry.

The crops are grown on irrigation from Godavari Right bank canal.

The soils are all derived from the trap and are medium brown coloured. Their depth varies from a few inches to 2.5 feet. The substratum is soft grey *murum*.

There is a five-year rotation for sugarcane as follows:—(1) *san*, (2) plant cane, (3) ratoon, (4) *bajri* and gram, and (5) groundnut.

The rotation for *jowar* is of two years—(1) *san* and *jowar (shalu)* and (2) *nilva jowar* and gram.

The basic manure for sugarcane in the manurial experiments is *san* green. The top dressing for cane is given in three doses—(1) at 3 to 4 weeks after planting, (2) at 8 to 10 weeks after planting and (3) at earthing up which comes at 5 to 6 months after planting.

#### *Nilva (JOWAR).*

*I—To ascertain the comparative effects of the following treatments on Nilva:—*

- (1) Sulphate of ammonia 100 lbs. per acre.
- (2) Castor cake 480 lbs.
- (3) F.Y.M. 12,000 lbs.
- (4) No-manure.

The experiment was done for two years in 1919–20 and 1921–22 on one-acre plots in duplicate. In 1921–22 castor cake was replaced by 286 lbs. of safflower cake. The yields of fodder are more important than grain in the case of *nilva* and hence these are calculated statistically. All the manures give significantly higher yields than no-manure. When we consider the net profits we find that in 1919–20 all manures are equal and give good profits. While in 1921–22 the profits are low and only sulphate of ammonia is of use. F.Y.M. actually gives losses.

Details in Table Kopergaon Farm I.

#### *Jowar (SHALU).*

*II—To compare the effects of the following treatments on jowar crop:—*

- (1) Sulphate of ammonia 100 lbs. per acre.
- (2) Groundnut cake 300 lbs.
- (3) F.Y.M. 12,000 lbs.
- (4) No-manure.

The rotation is (1) *san* and *jowar* one year and (2) *nilva jowar* and gram second year. The experiment was tried in duplicate for two years 1918-19 and 1919-20. In 1919-20 the groundnut cake was replaced by 480 lbs. of castor cake. Sulphate of ammonia and cake give higher results than F.Y.M. and no-manure in both the years. F.Y.M. is practically equal to no-manure in yields and therefore gives profits. In net profit cake also is not better than no-manure. Sulphate of ammonia therefore proves to be the best.

Details in Table Kopergaon Farm II.

### SUGARCANE (*Pundya*).

III—To compare the effects of the following top-dressing for sugarcane planted and ratoon :—

- (1) Sulphate of ammonia and safflower cake equal to 75 lbs. of nitrogen each per acre.
- (2) Nitrate of soda and safflower cake equal to 75 lbs. of nitrogen each per acre.
- (3) Sulphate of ammonia and groundnut cake equal to 75 lbs. of nitrogen each per acre.
- (4) Castor cake and safflower cake equal to 75 lbs. nitrogen each.

The experiments were conducted on 10-guntha plots in 1920-21 and 1922-23 on planted cane and in 1921-22 and 1923-24 on ratoon cane. The ratoon of 1921-22 was very poor and has been dropped from calculations. Both in yields and net profits the mixture of two cakes, castor and safflower proves to be the best for planted and ratoon cane. Next to this is the mixture of sodium nitrate and safflower cake.

Details in Table Kopergaon Farm III.

IV—To ascertain the effects of increasing doses of nitrogenous top-dressings in the form of sulphate of ammonia and safflower cake each equal to half the nitrogen for sugarcane.

The basic manure was *san* green. The experiments for plant cane were tried from 1926-27 to 1930-31 on duplicate plots of 5 gunthas each. For ratoon the experiments were for three years only from 1926-27 to 1928-29. The outcome of all the trials is that 150 lbs. of nitrogen is the most suitable quantity of top-dressing for planted as well as ratoon cane.

Details in Table Kopergaon Farm IV.

For *nilva* the results of manurial trials are not conclusive but it seems that sulphate of ammonia may prove to be a very good manure, for *shalu jowar* also sulphate of ammonia is the best. F.Y.M. does not show any advantage. For sugarcane the mixture of castor and safflower cakes has proved to be more advantageous than the mixture of sulphate



of ammonia and cake or sodium nitrate and cake. The latter mixture, however, has given better results than the former. With regard to the quantity of nitrogenous manures for top-dressing of cane 150 lbs. of nitrogen is the most suitable for planted as well as ratoon cane.

### KUMTA FARM.

Kumta Farm is situated near Kumta in North Kanara District. It is on 14.5° N Latitude and 74.5° E Longitude. It is only a few feet above the sea-level. The farm was started in 1916 to commemorate the name of King Edward VII. The objects of the farm include experimental work to produce higher yields of rice and sugarcane by manuring.

*Temperature.*—The temperature is fairly even throughout the year, the average minimum being 74° F in December and the average maximum 98° F in April. The average rainfall is 142 inches. The rainy season begins in the 1st week of June and ends at the end of October.

*Soils.*—The soils are all derived from laterite. The low-lying laterite of Kumta is more gravely than the laterite at Ratnagiri. The soils are ordinarily divided into two classes, high-lying and low-lying. Some of the low-lying soils have springs throwing out water (pH 6.0 to 6.8). The soils are all well drained except some parts of the low-lying soils. The soils of this place give the pH values as follows:—

		Ph.
High-lying	..	.. 6.8 to 7.8
Low-lying, non-springy	..	.. 6.8 to 7.3
Low-lying, springy	..	.. 5.9 to 7.3

The acidic tendency of the soils shows its effects on the manurial treatments. For manurial experiments the soils are classified as (1) high-lying, (2) low-lying springy and (3) low-lying non-springy.

### *The Chemical Analysis.*

	High-lying.	Low-lying non-springy.	Low-lying springy.
	Per cent.	Per cent.	Per cent.
Loss on ignition	.. 8.88	9.11	8.43
Sand	.. 64.70	68.20	71.27
Lime	.. 0.28	0.17	0.11
Potash	.. 0.58	0.57	0.57
Phosphoric acid	.. 0.20	0.15	0.10
Nitrogen	.. 0.11	0.18	0.12

*Mechanical Analysis.*

	High-lying.	Low-lying non-springy.
	Per cent.	Per cent.
Finest and fine silt .. ..	26.04	34.06
Medium silt .. ..	8.53	8.00
Coarse silt .. ..	11.92	8.72
Fine silt .. ..	38.00	37.21
Coarse sand .. ..	15.46	11.06

The varieties of rice grown are "*Maskati*" for high-lying and "*Halga*" for low-lying soils. Both the varieties are grown by transplanting. The average yield of the "*Maskati*", or early variety is 1,200 to 1,500 lbs. of grain and 1,300 to 1,500 of straw, while that of the "*Halga*" or late variety is 1,600 to 2,000 lbs. of grain and 1,800 to 2,500 lbs. of straw.

The transplanting is done at the end of June. After the harvest of rice, no other crop is taken except in a few very low-lying lands. The land is ploughed two times after harvest. Big clods are crushed by wooden hammers. The land is manured with F.Y.M. 5 carts per acre before the 1st puddling. The land is puddled twice. There is one hand weeding. Manuring with F.Y.M. is the local practice.

The varieties of sugarcane grown are "*Daskabbu*" and "Red mauritious". These are grown both on the high-lying and the low-lying lands. Planting time is from the beginning of January to the middle of March. The crop is a 12-month crop. The outturn of "*Daskabbu*" is 4,000 to 5,000 lbs. of liquid *gul* and for "mauritious" from 5,000 to 7,000 lbs. of liquid *gul*.

## RICE.

*I—To ascertain the effects of bone-meal with and without F.Y.M. as a manure for rice on low-lying non-springy lands.*

The F.Y.M. was given at the rate of 5 carts per acre and the bone-meal at the rate of 224 lbs. The experiments were conducted in 1924 and 1925 on guntha plots in duplicates and in 1929 and 1930 on half guntha plots in four replications. In all the years bone-meal and F.Y.M. together have given the highest yields. Bone-meal yields are significantly better than F.Y.M. yields and the combined effect of bone-meal and F.Y.M. is significant over bone-meal alone in three years out of four. From the point of net profits bone-meal alone is nearly as good as bone-meal plus F.Y.M.

Detailed figures are given in Table Kumta Farm I.

*II—To compare the effects of the following for rice grown on low-lying non-spring lands: (1) F.Y.M., (2) Bone-meal plus green leaves of Terminalia paniculata, (3) Bone-meal plus green leaves of Strychnos nux-vomica, (4) Green leaves of Terminalia paniculata, and (5) Green leaves of Strychnos nux-vomica.*

The quantities of F.Y.M. were 5 carts per acre, bone-meal 224 lbs., Terminalia leaves 8,000 lbs. and Strychnos nux-vomica leaves 7,270 lbs. per acre. The experiments were done for two years—1929 and 1930 in four replications on half guntha plots. Terminalia paniculata leaves do not show any advantage over F.Y.M. Nux-vomica leaves are better than F.Y.M. but not always significant. Addition of bone-meal with leaves has a significant advantage. The combination of bone-meal and nux-vomica leaves gives the highest yields which are significantly higher than yields of any other treatment. In net profits also this combination is the best.

Detailed figures are given in Table Kumta Farm II.

*III—To ascertain the effect of F.Y.M., Sulphate of ammonia and the combination of these two for rice on low-lying non-spring land.*

The F.Y.M. was added at the rate of 5 carts per acre and the sulphate of ammonia at the rate of 40 lbs. nitrogen per acre. The experiments were tried in quadruplicates in 1924 but in 1925 and 1926 they were in duplicates only. Each of the plots was one guntha. The F.Y.M. and sulphate of ammonia are equal but their combination is significantly better than either of them. In net profits the combination is the best in two out of three years and F.Y.M. is always better than sulphate of ammonia.

Detailed figures are given in Table Kumta Farm III.

*IV—To ascertain the effect of F.Y.M., Rock phosphate and their combination for rice on low-lying, non-springy lands.*

F.Y.M. was given at the rate of 5 carts per acre and the rock phosphate 112 lbs. The experiments were tried only in 1923 and 1924 in single plots and are not of much use, but taking them as they are the three treatments are equal. Rock phosphate alone is slightly better than other treatments in net profits.

Detailed figures are given in Table Kumta Farm IV.

*V—To compare the effects of rock phosphate with and without leaves, with F.Y.M. for rice on low-lying non-springy lands.*

F.Y.M. was given at the rate of 5 carts per acre, rock phosphate 112 lbs. and leaves green and dry equivalent to 20 lbs. of nitrogen. The object was to see how far rock phosphate alone or in combination either with green or dry leaves increased the yields of rice crops. The experiments were tried for three years—1918 to 1920—on single plots and hence the results are not of much use. They however, show that rock-phosphate is better than F.Y.M. The same conclusion was derived from experiment IV.

The combination of rock-phosphate with leaves is better than rock-phosphate alone. Combination with green leaves gives higher yields than with dry leaves. In net profits rock-phosphate with green leaves is the best, rock-phosphate and its combination with dry leaves are equal in net profits.

Detailed figures are given in Table Kumta Farm V.

*VI—To ascertain the effect of ammonium phosphate with and without F.Y.M. and of F.Y.M. alone for rice on low-lying non-springy land.*

F.Y.M. was given at the rate of 5 carts per acre and ammonium phosphate at 224 lbs. The experiment was tried only for one year in 1929 in four replications. Ammonium phosphate or its combination with F.Y.M. gives significantly higher yields than F.Y.M. Combination of ammonium phosphate with F.Y.M. is better than ammonium phosphate alone.

Detailed figures are given in Table Kumta Farm VI.

*VII—To ascertain the effect of the following manurial treatment for rice on low-lying non-springy land: (1) Ammonium phosphate, (2) Ammonium phosphate plus F.Y.M., (3) Calcium cyanamide, (4) Calcium cyanamide plus F.Y.M., (5) Bone-meal, (6) Bone-meal plus F.Y.M., (7) F.Y.M. alone.*

F.Y.M. was given at the rate of 5 carts while the other manures were given at the rate of 224 lbs. per acre. The experiment was done in 1930 by the Latin square method in seven replications. Leaving out bone-meal we find every treatment is significantly better than F.Y.M. The artificial manure with F.Y.M. is significantly better than the artificial alone. Calcium cyanamide and ammonium phosphate are equal. It is surprising to find bone-meal even below the F.Y.M. treatment, in this experiment only.

Full details are given in Table Kumta Farm VII.

*VIII—To ascertain the effect of bone-meal with and without F.Y.M. for rice on low-lying, non-springy, ill-drained land.*

This is the only experiment tried on ill-drained soil. It was done for two years in 1925 and 1926 in duplicates. Bone-meal alone or its combination with F.Y.M. is significantly inferior to F.Y.M.

Detailed figures are in Table Kumta Farm VIII.

*IX—To compare the effect of bone-meal with or without F.Y.M. with that of F.Y.M. on low-lying springy land.*

The quantity of F.Y.M. was 5 carts and that of bone-meal 224 lbs. per acre. The experiments were tried for 5 years. For the first three years they were in duplicates but in 1927 and 1928 they were in single plots and therefore of very little use. Taking the first three years bone-meal alone or with F.Y.M. is significantly better than F.Y.M. alone. In the third year the superiority is not significant. If the net profits for all the five years are taken bone-meal alone stands first followed by its combination with F.Y.M.

Detailed figures are given in Table Kumta Farm IX.

*X—To compare the effect of the following manures for rice on low-lying springy lands : (1) F.Y.M., (2) Bone-meal, and (3) Bone-meal plus green leaves.*

F.Y.M. was given at the rate of 5 carts, bone-meal 224 lbs. and green leaves 3,750 lbs. per acre. Single plot experiments were tried for three years—1918 to 1920. Bone-meal or bone-meal with green leaves is distinctly superior to F.Y.M. both in yields and net profits. There is no difference between bone-meal alone and its combination with green leaves.

Detailed figures are given in Table Kumta Farm X.

*XI—To ascertain the effect of F.Y.M., sulphate of ammonia and their combination for rice on low-lying springy land.*

F.Y.M. was given at the rate of 5 carts and sulphate of ammonia at the rate of 40 lbs. of nitrogen per acre. The experiment was done for three years in single plots and is therefore not of much use but the results show that F.Y.M. alone is better than sulphate of ammonia alone and their combination is better than either of them alone. In net profits F.Y.M. alone is more than twice as good as the combination.

Detailed figures are given in Table Kumta Farm XI.

*XII—To ascertain the effect of F.Y.M., sulphate of ammonia and their combination for rice on high-lying land.*

F.Y.M. was given at the rate of 5 carts and sulphate of ammonia equivalent to 40 lbs. of nitrogen. The experiment was tried for three years from 1925 to 1927 in duplicates. The results are not consistent. The combination is significantly better than either of the manures alone for two years. It is better also in net profits. Between F.Y.M. and sulphate of ammonia, F.Y.M. is lower in yields but is better in net profits than sulphate of ammonia.

Detailed figures are given in Table Kumta Farm XII.

*XIII—To compare the effect of manuring by the local methods, 5 carts of F.Y.M. with no-manure for rice on all types of land.*

The experiments are from 1924 to 1927 and again in 1929. In almost all cases the F.Y.M. has given significantly higher yields than no-manure.

Detailed figures are given in Table Kumta Farm XIII.

#### SUGARCANE.

*XIV—To ascertain the effects of various manures on Red Mauritius and Daskabbu varieties of sugarcane.*

The quantities of manures given per acre were (1) F.Y.M. 15,000 lbs., (2) Fish 1,250 lbs., (3) Undicake 2,500 lbs., (4) Sulphate of ammonia 375 lbs. In all cases F.Y.M. 15,000 lbs. was the basic manure. The experiments were tried for four years from 1919 to 1922 in single plots. In the case of Red Mauritius the addition of top-dressings give higher yields and higher net profits. The top-dressings amongst themselves do not show any difference in yields but in net profits fish is the highest

and sulphate of ammonia the lowest. With Daskabbu variety, the top-dressings do not show any advantage over no-top-dressing either in yields or net profits.

Detailed figures are given in Table Kumta Farm XIV.

XV—To ascertain the effect of various manures with basic F.Y.M. 15,000 lbs. per acre for Red Mauritius and Daskabbu varieties of sugarcane.

The experiments were tried on single 2-guntha plots for three years from 1927 to 1929. The treatments were (1) no-top-dressing, (2) *undicake* 2,500 lbs. plus bone-meal 200 lbs., (3) Bone-meal 200 lbs., (4) *undicake* 2,500 lbs., (5) Sulphate of ammonia 375 lbs., and (6) Bone-meal 200 lbs. plus sulphate of ammonia 375 lbs. The addition of sulphate of ammonia pulls down the yields and the net profits and in the case of *Daskabbu* they go below no-top-dressing. *Undicake* and Bone-meal are equal both in yields and net profits which are distinctly higher than no-top-dressing. The combination of *undicake* and bone-meal is better than either of these alone.

Detailed figures are given in Table Kumta Farm XV.

A large number of experiments have been carried out in manuring of rice and a few in manuring of sugarcane. The rice experiments are on *Halga* variety grown on low-lying lands and on *Maskati* variety grown on high-lying lands. The low-lying lands have been further classified into non-springy, springy (with springs in the rainy season) and some as ill-drained. The experiments show that manuring with F.Y.M. gives higher yields and profits than no-manuring on all classes of lands. *Terminalia paniculata* leaves are equal in effect to F.Y.M. but *nux-vomica* leaves are better. Bone-meal is significantly better than F.Y.M. in most cases. F.Y.M. is better than sulphate of ammonia while rock phosphate is slightly better than F.Y.M. Ammonium phosphate is distinctly better than F.Y.M. Calcium cyanamide also has given good yields. Bone-meal, rock phosphate, calcium cyanamide or sulphate of ammonia in combination with either F.Y.M. or green leaves give very good results both in yields and net profits. The effects of manures are practically of the same nature on all lands except the ill-drained. Manurial experiments on sugarcane were tried on two varieties—Red Mauritius and *Daskabbu*. Out of the various top-dressings that were tried, fish, *undicake* and bone-meal show distinct advantage while sulphate of ammonia pulls down the yields and hence net profits also.

### MANJRI FARM.

The Manjri Farm is situated in the area of Manjri village about seven and half miles from Poona. It is on 18° 32' north latitude and 74° 2' east longitude. Its elevation is about 1,835 feet from the sea level. Its area is 62 acres. It was started in 1,894 for conducting experiments in irrigating and manuring sugarcane.

*Temperature.*—The average minimum temperature is 45° F in January and the average maximum temperature is 106° F in April.

The rainy season extends from last week of June to middle of October. There are some irregular showers in the beginning of June. The average rainfall is 20 inches.

*Soils.*—The soil is formed from decomposed trap. It varies in character from light and shallow on the eastern side of the farm to a heavy deep soil on the western side. The substratum is from nine inches to three or more feet. The manurial experiments have been carried out on the medium black soil from one to three feet in depth.

#### ANALYSIS OF MEDIUM BLACK SOIL.

<i>Chemical.</i>			<i>Mechanical.</i>		
		Per cent.			Per cent.
Loss on ignition	..	9.93	Clay	..	26.95
Sand	..	59.14	Fine silt	..	36.85
Lime	..	1.93	Silt	..	13.75
Potash	..	0.26	Fine sand	..	9.82
Phosphoric acid	..	0.07	Coarse sand	..	1.65
Nitrogen	..	0.08			

The area of the farm is commanded by irrigation water of the Mutha Right Bank Canal.

The chief crop of the farm is sugarcane. Other crops are grown mostly in rotation.

There is a power crusher at the farm and hence the crushing is fairly uniform. Ordinarily yields are in lbs. of *gul*, but when crushing was noted as unsatisfactory yields of canes were taken for comparison. The nitrogen reduction series have been conducted on an area near the farm. This has a better and more fertile soil and therefore the yields obtained there are higher than those of the farm area.

The years 1918-19 and 1919-20 had very poor rains and the experiments had to be closed down during those years.

The years 1915-16 to 1917-18 have given high yields all over the farm. The results for these years have been, therefore, compared amongst themselves only.

In calculating the cost of cultivation charges for harvesting, *gul*-making and marketing as also for rent, interest and supervision have been included. To these actual cost of basic and top dressing manure is added to obtain net profits.

In the cultivation of sugarcane there is the basic bulky manure given before planting and the top dressing given after the seedlings come up. The manurial experiments have been tried both as regards the basic bulky manures and the manures for top dressing.

## BASIC BULKY MANURES.

*I—To study the possibilities of reducing the basic dose of F.Y.M. (30,000 lbs. per acre) for sugarcane.*

The three quantities used were 30,000 lbs., 20,000 lbs. and 10,000 lbs. of F.Y.M. The experiments were done in four replications for two years 1929-30 and 1930-31. In none of the two years there is a significant difference between treatments, but 20,000 lbs. treatment is the best both in yields and net profits. This means that there is no necessity of larger quantities and it also means that the quantities cannot be reduced below 20,000 lbs. with any advantage.

Detailed figures are in Table Manjri Farm I.

*II—To compare effects of F.Y.M., san green, sugarcane-trash and stable manure as basic manure for sugarcane.*

Each manure given was equal to 10,000 lbs. dry matter. The experiments were tried for four years from 1914-15 to 1917-18 on single plots. The trash gives lower yields and lower net profits than other treatments in all the years. The other treatments give nearly equal yields but amongst them *san green* stands the highest both in yields and net profits.

Detailed figures are in Table Manjri Farm II.

*III—To ascertain the effect of supplementing basic san green manure by F.Y.M. or oil-cake to make up 200 lbs. of nitrogen per acre for sugarcane.*

The experiments were tried for four years from 1924-25 to 1927-28 on single plots. The results indicate that the additional material gives neither higher yields nor higher net profits than *san green* alone.

*IV—To ascertain the most economic and efficient substitute for F.Y.M. as basic manure, for sugarcane.*

The experiments were carried on for three years from 1923-24 to 1925-26 on single plots. The results are contradictory and unsatisfactory. No conclusions can be drawn from them.

Detailed figures are in Table Manjri Farm IV.

*V—To compare the effect of 30,000 lbs. of F.Y.M. with and without san green on sugarcane.*

The experiments were tried for three years from 1908-09 to 1910-11 on single plots and no conclusions can be drawn. It is surprising to find the addition of *san green* slightly lowering the yields.

Detailed figures are in Table Manjri Farm V.



## MANURES FOR TOP DRESSING.

*VI—To ascertain the effect of varying quantities of nitrogen used for top dressing for sugarcane.*

The experiment was tried for three years from 1920-21 to 1922-23 on single plots. The basic manure was *san green* to all. The quantities of nitrogen were 75 lbs., 100 lbs., 125 lbs. and 150 lbs. half in the form of cake and the other half as sulphate of ammonia. The higher quantities do not show any higher yields than that of 75 lbs. nitrogen and in net profit 75 lbs. nitrogen is the best. The results cannot be taken as conclusive.

Detailed figures are in Table Manjri Farm VI.

*VII—To ascertain the effect of varying quantities of nitrogen as top dressing for sugarcane.*

These experiments are a modified form of those in VI. The basic manure was 30,000 lbs. F.Y.M. instead of *san green* and the top dressing doses were 75 lbs., 125 lbs. and 150 lbs. of nitrogen, half as oil-cakes and the other half as sulphate of ammonia. The experiments were tried for three years from 1928-29 to 1930-31 with four replications. The yields of larger doses are not significantly higher than those of smaller doses but in two years out of three the 150 lbs. dose has given greater net profits than the other doses.

Detailed figures are in Table Manjri Farm VII.

*VIII—To ascertain the effect of increasing doses of nitrogen as top dressing for sugarcane.*

Taking 150 lbs. of nitrogen as normal dose per acre for top dressing, experiments V and VI were made to see the effect of reducing the quantities while experiment VIII was conducted to see if any advantage could be gained by increasing the doses beyond 150 lbs. of nitrogen. The basic manure was *san green*. The experiments were tried for six years from 1923-24 to 1928-29. In 1928-29 they were in duplicates but in other years they were in single plots. The doses were 75 lbs., 150 lbs., 225 lbs. and 300 lbs. of nitrogen per acre, half as cake and the other half as sulphate of ammonia. In all the years the yields of 75 lbs. nitrogen are low. The treatments 225 lbs. and 300 lbs. do not show significantly higher yields than treatment 150 lbs. The results cannot be taken as conclusive. The treatment 150 lbs. of nitrogen, however, seems to be the best.

Detailed figures are in Table Manjri Farm VIII.

*IX—To compare the effect of nitrogen in various forms for top dressing for sugarcane.*

The basic manure was *san green*. The nitrogen was given in the form of castor, safflower, groundnut and cotton seed oil-cake and as fish manure, sulphate of ammonia and nitrate of soda. The experiments were tried for five years from 1917-18 to 1922-23 in duplicate plots in 1917-18 and in single plots in other years. Nitrate of soda was not tried

in 1917-18. Taking the figures available the oil-cakes give practically equal yields. Fish manure and sulphate of ammonia are slightly better than oil-cakes. The nitrate of soda is far below the oil-cakes.

Detailed figures are in Table Manjri Farm IX.

*X—To compare effects of sulphate of ammonia and nitrate of soda as top dressing for sugarcane.*

Basic manure was F.Y.M. 10,000 lbs. of dry matter. Only 75 lbs. of nitrogen was supplied as sulphate of ammonia or nitrate of soda. The remaining nitrogen was in the form of safflower cake. The experiments were tried for three years from 1915-16 to 1917-18 in single plots. Sulphate of ammonia has given higher yields and higher net profits in all the three years confirming the conclusions of experiment IX.

Detailed figures are in Table Manjri Farm X.

*XI—To ascertain the number of doses and time of their application for nitrogen top dressing to get the best results for sugarcane.*

The basic manure was *san* green and top dressing of total 150 lbs. of nitrogen per acre. half as oil-cake and half as sulphate of ammonia. The treatments were as follows:—(1) Three equal doses, at planting, at 3 weeks and 8 weeks from planting. (2) Three equal doses at planting, at 3 weeks from planting and at earthing up. (3) Three equal doses at planting, at 8 weeks from planting and at earthing up. (4) Three equal doses, at 3 and 8 weeks after planting and at earthing up. (5) Four equal doses at planting, at 3 weeks and at 8 weeks from planting and at earthing up. (6) One-third at 3 weeks after planting and two-thirds at earthing up. (7) One-third at 3 weeks and two-thirds at 8 weeks after planting.

The experiments were tried for three years from 1923-24 to 1925-26 in single plots. The results cannot be taken as conclusive; still the indication is that treatment No. 7 is the best, followed by Nos. 3 and 5. The other treatments are much below these.

Detailed figures are in Table Manjri Farm XI.

*XII—To ascertain the best combination of water-cum-top dressing for sugarcane.*

Basic manure was *san* green. Quantities of water were 70 acre-inches and 100 acre-inches of irrigation in addition to rains. Nitrogen was given half as oil-cake and half as sulphate of ammonia. With each quantity of water top dressing nitrogen was 75 lbs., 150 lbs. and 300 lbs. per acre. The experiments were tried for two years, 1929-30 and 1930-31, in duplicates. Taking 70 acre-inches of water 300 lbs. nitrogen is the best both in yields and net profits. These, however, are not significantly higher than treatment with 150 lbs. nitrogen. The same statement may be made about 100 acre-inches watering. In comparing 75 acre-inches and 100 acre-inches results of 1929-30 are contradicted by those of 1930-31 and hence are not conclusive.

Detailed figures are in Table Manjri Farm XII.

**XIII—To ascertain the effect of gurhal ashes containing 100 lbs. of potash and 40 lbs. of phosphoric acid.**

(a) Basic manure was F.Y.M. equal to 10,000 lbs. dry matter per acre. Nitrogen in top dressing was 75 lbs. as oil-cake and 75 lbs. as nitrate of soda. The *gurhal* ashes are those found in the pit of the juice boiling furnace. The experiments were conducted on single plots for three years from 1915-16 to 1917-18. The addition of *gurhal* ashes gave lower yields and lower net profits.

(b) These experiments were repeated in a modified form for two years, in 1920-21 and 1921-22. The F.Y.M. was substituted by *san* green and nitrate of soda by sulphate of ammonia. In the experiments in both the years the addition of *gurhal* ashes gave higher yields and higher net profits.

Detailed figures are in Table Manjri Farm XIII a & b.

**XIV—To ascertain the effect of additions of  $K_2O$  and  $P_2O_5$  in the top dressing of sugarcane.**

The basic manure was F.Y.M. equal to 10,000 lbs. dry matter. 150 lbs. of nitrogen as top dressing was half as oil-cake and half as nitrate of soda. The experiments were conducted for four years from 1917-18 to 1922-23 in single plots. The quantities of  $K_2O$  and  $P_2O_5$  were as follows:—(1) Nil. (2) 100 lbs.  $K_2O$  as sulphate of potash, (3) 100 lbs.  $P_2O_5$  as super-phosphate and (4) 100 lbs.  $K_2O$  as sulphate of potash plus 100 lbs. of  $P_2O_5$  as superphosphate.

The addition of  $K_2O$  or of  $P_2O_5$  does not show any advantage.

Detailed figures are in Table Manjri Farm XIV.

The experiments on bulky manures show that the F.Y.M. may be reduced from 30,000 lbs. to 20,000 lbs. but not below that quantity. F.Y.M., *san* green and stable manure are equal in their effect but trash is below any of these. Supplementing *san* green by F.Y.M. or oil-cake as a basic manure does not show any advantage. Substituting F.Y.M. by oil-cakes as a basic manure has not shown any advantage.

Taking the various experiments tried in finding out the most suitable quantity of nitrogen 150 lbs. of nitrogen seems to be the best. Comparing the effects of nitrogen in various forms of manures, sulphate of ammonia and fish manure stand higher than other manures, oil-cakes which come next are all equal. Nitrate of soda stands much below other manures. Between sulphate of ammonia and nitrate of soda given in combination with oil-cakes, the sulphate of ammonia stands much higher than nitrate of soda. Use of *gurhal* ashes along with sulphate of ammonia shows advantage but with nitrate of soda the yields are reduced. Addition of potash or phosphoric acid either singly or two together with nitrogenous top dressings has shown no advantage at all.

**MANJRI DRY FARM.**

There is a laboratory and a small plot at Manjri (near Poona) to conduct experiments on dry farming. A few trials of manures on *Rabi jowar*

have been done along with other work. It will be seen from the yields for three years from 1926-27 to 1929-30 that manurial treatment such as F.Y.M., green manure, sulphate of ammonia and sodium nitrate do not show any advantage over no-manure treatment. The size of the plots was 590 square feet each. In 1930-31 the yields show that F.Y.M. has a distinct advantage over green manuring, sulphate of ammonia, sodium nitrate and no-manure. It is therefore only F.Y.M. that has any advantage over no-manure on *rabi jowar*.

Details are given in the accompanying table.

### MODIBAG GARDENS.

Modibag gardens are on the area of the Poona Agricultural College. These are used for growing fruits of various kinds. Recently manurial experiments have been started on such fruit plants as the bananas, figs, pomegranates, and *santras* (oranges). The experiments have not been long enough to take the results as conclusive but they are given to show the general tendency of the effects of some of the manures. For bananas and figs the yields are expressed in lbs. per plant but for pomegranates and oranges the number of fruits is given.

*I—To ascertain the comparative effect of the following treatments on Banana plants. The treatments are per plant :—*

- (1) F.Y.M.
- (2) Poudrette 125 lbs.
- (3) Castor-cake 11 lbs.
- (4) Bone meal 10 lbs.

The quantities of manure were given to make half a pound of nitrogen per plant. There were plants under each treatment. The manures were added in March 1925. All the treatments prove to be equal.

Details in Table Modibag Gardens I.

*II—To ascertain the effects of the following treatments on fig plants. The quantities of manure are per plant :—*

- (1) F.Y.M. 80 lbs.
- (2) Bone meal 3 lbs. *plus* nitrate of soda 1.5 lbs. *plus* F.Y.M. 20 lbs.
- (3) F.Y.M. 20 lbs. *plus* nitrate of soda 2 lbs.
- (4) F.Y.M. 20 lbs. *plus* bone meal 10 lbs.

In each treatment quantity of nitrogen was half a pound. There were 18 plants under each treatment. In yields and net profits the 4th treatment containing bone meal is the best and next to it is 80 lbs. F.Y.M.

Treatments containing nitrate of soda are below the other two. The experiment was tried in 1928-29.

Details in Table Modibag Gardens II.

*III—To ascertain the effects of the following treatments on pomegranates plant, manures given are per plant :—*

- (1) F.Y.M. 80 lbs.
- (2) Bone meal 3 lbs. *plus* nitrate of soda 1·5 lbs. *plus* F.Y.M. 20 lbs.
- (3) F.Y.M. 20 lbs. *plus* nitrate of soda 2 lbs.
- (4) F.Y.M. 20 lbs. *plus* bone meal 10 lbs.

The nitrogen per plant for each treatment was half a pound. The experiment was tried in 1928–29, in two sets. The results of the two sets are not consistent and therefore no conclusions can be drawn.

Details in Table Modibag Gardens III.

*IV—To ascertain the effects of the following treatments on orange plants. The manures given are per plant.*

- (1) F.Y.M. 80 lbs.
- (2) Bone meal 3 lbs. *plus* nitrate of soda 1·5 lbs. *plus* F.Y.M. 20 lbs.
- (3) F.Y.M. 20 lbs. *plus* nitrate of soda 2 lbs.
- (4) F.Y.M. 20 lbs. *plus* 10 lbs. bone meal.

The quantity of manure per plant in all the treatments was equal to half a pound of nitrogen.

40 plants in blocks were treated.

The results of the two blocks are not quite consistent but on the whole F.Y.M. 80 lbs. as also F.Y.M. 20 lbs. *plus* nitrate of soda 2 lbs. seem to be better than the other two treatments. These require further trials.

Details in Table Modibag Gardens IV.

### NADIAD FARM.

Nadiad Farm was started in 1903. It had an area of 44 acres. Nadiad is situated on the B. B. & C. I. Railway line in North Gujerat. It is on 22° 44' North latitude and 73° East longitude. Its elevation is practically sea level. The average rainfall is about 34 inches. The maximum temperature is about 114° F in May and minimum about 42° F in January. The most important experiments in manures on this farm were on tobacco.

### TOBACCO CROP.

*I—To compare san green manure with F.Y.M. 15 tons per acre for irrigated tobacco.*

The experiment was tried for two years 1906–07 and 1907–08. The rotation was tobacco and *Kodra*. Both in yields and net profits *san green* is better than F.Y.M. The experiment was done on two tillage conditions side by side. It is found that tillage gives higher yields and net profits.

Details in Table Nadiad Farm I.

*II—To compare the effects of the following treatments on irrigated tobacco :—*

- (1) F.Y.M. 20,000 lbs. per acre as basic manure.
- (2) Basic F.Y.M. *plus* castor cake 1,000 lbs. as top dressing.
- (3) Basic F.Y.M. *plus* cotton seed cake 1,000 lbs.
- (4) Basic F.Y.M. *plus* safflower cake 1,000 lbs.
- (5) Basic F.Y.M. *plus* groundnut cake.

The experiments were conducted in unreplicated conditions from 1909–10 to 1914–15. Plots were one-eighth of an acre each. Safflower cake was tried for the first two years and then it was substituted by groundnut cake. Addition of castor cake gives the highest yields and net profits. Next is safflower. Other oil-cakes give higher yields but they do not show any advantage over basic manure alone in net profits.

Details in Table Nadiad Farm II.

*III—To compare the effects of the following treatments on irrigated tobacco under shallow and deep tillage :—*

- (1) F.Y.M. 15 tons per acre.
- (2) Castor cake 2,000 lbs.
- (3) F.Y.M. 10 tons *plus* castor cake 600 lbs.
- (4) F.Y.M. 10 tons *plus* nitre 112 lbs.
- (5) F.Y.M. 10 tons *plus* nitrate of soda 112 lbs.
- (6) F.Y.M. 10 tons *plus* sulphate of ammonia 112 lbs.
- (7) *San* ploughed in as green manure.

The experiment was tried on unreplicated plots for four years without rotation. One series of plots received local shallow tillage while the other received deep tillage. F.Y.M. *plus* castor cake is the only treatment which with shallow or deep tillage gives distinctly high yields and profits. Other treatments which are less effective are practically equal.

Details in Table Nadiad Farm III.

*IV—To ascertain the comparative effects of the following treatments to irrigated tobacco :—*

1. Superphosphate 300 lbs. +
  - (a) 100 lbs.  $K_2O$  as potassium sulphate.
  - (b) 100 lbs.  $K_2O$  as wood ashes.
  - (c) 50 lbs.  $K_2O$  as potassium sulphate.
  - (d) 50 lbs.  $K_2O$  as wood ashes.
  - (e) no potash.
2. Superphosphate 300 lbs. and + nitrate of soda 200 lbs.
  - (a) 100 lbs.  $K_2O$  as potassium sulphate.
  - (b) 10 lbs.  $K_2O$  as wood ashes.

2. Superphosphate+300 lbs. and (c) 50 lbs.  $K_2O$  as potassium sulphate.  
Nitrate of soda 200 lbs.  
(d) 50 lbs.  $K_2O$  as wood ashes.  
(e) No potash.
3. Nil .. (a) 100 lbs.  $K_2O$  as potassium sulphate.  
(b) 100 lbs.  $K_2O$  as wood ashes.  
(c) 50 lbs.  $K_2O$  as potassium sulphate.  
(d) 50 lbs.  $K_2O$  as wood ashes.  
(e) No potash.

The experiments were tried from 1911-12 to 1914-15. The results are not satisfactory for definite statements yet it can be said that the combination of superphosphate and nitrate of soda gives better yields than the other two treatments and that 50 lbs. potash is more advantageous than 100 lbs.

Details in Table Nadiad Farm IV.

#### RICE.

V—To compare the effects of 7.5 tons F.Y.M. per acre alone and with nitre against no-manure for rice (non-irrigated).

The experiment was tried on single 9-guntha plots from 1906-07 to 1910-11 F.Y.M. with nitre gives better yields than no-manure but not so high as to pay the cost of manure. No-manure yields are better than F.Y.M. and there is no loss as in F.Y.M.

Details in Table Nadiad Farm V.

VI—To compare the effects of F.Y.M. 7.5 tons plus nitre 80 lbs. per acre with F.Y.M. 7.5 tons alone on irrigated rice.

The experiments were conducted on 6-guntha unreplicated plots from 1906-07 to 1910-11. Addition of nitre gives high yields and some profits while Farm Yard Manure alone gives low yields and net losses.

Details in Table Nadiad Farm VI.

#### SUNDHIA JOWAR.

VII—To compare the effects of the following treatments on Sundhia Jowar :—

- (1) Urine earth 15,000 lbs. per acre.
- (2) Cattle dung 15,000 lbs. per acre.

The experiments were done on unreplicated plots of 10 gunthas each from 1911-12 to 1914-15. In the last year the plots were in duplicates. Cattle dung is better than urine earth both in grain and in fodder.

Details in Table Nadiad Farm VII.

At Nadiad the manurial experiments were tried on tobacco, rice and *sundhia jowar*. With tobacco it was found that *san green* was better than F.Y.M. Addition of castor cake to F.Y.M. is advantageous but other cakes show no advantage. The addition of nitrogenous artificials does not compare well with castor cake. The artificials are all equal in their effects. Addition of 50 lbs. of potash per acre shows increase in yields.

With unirrigated rice no-treatment is better than any of the treatments tried while with irrigated rice F.Y.M. *plus* nitre shows advantage over F.Y.M. alone. For *sundhia jowar* cattle dung gave better yields than urine earth.

### POONA AGRICULTURAL COLLEGE FARM.

The Poona Agricultural College Farm is situated on the north-western side of Poona city on the Ganeshkhind Road. It is on 18° 30' north latitude and 73° 50' east longitude. Its elevation is 1,850 feet above sea level.

*Temperature.*—The mean maximum temperature in April is 108° F. and the mean minimum temperature in January is 42° F.

The rainy season begins at the end of the first week of June and ends by the middle of October. The average rainfall is 24 inches.

*Soils.*—The soils of the farm are derived from the Deccan trap. They vary very much from light *murmud* to medium black. The depth varies from a foot to over six feet.

The chemical and mechanical analysis of the soil is as follows:—

#### *Chemical Analysis.*

#### *Mechanical Analysis.*

	Per cent.		Per cent.
Loss on ignition .. ..	10·17	Clay and finest silt.. ..	25·73
Sand .. ..	66·07	Fine silt .. ..	8·11
Lime .. ..	5·74	Medium silt .. ..	7·90
Potash .. ..	0·14	Coarse silt .. ..	25·39
Phosphoric acid .. ..	0·18	Fine sand .. ..	25·91
Nitrogen .. ..	0·07	Coarse sand .. ..	6·96

The farm is chiefly meant for teaching, yet some experiments on manuring of crops have been carried out. The manurial experiments were first started in 1908–09 and were practically discontinued in 1916. They were recently revived on a systematic basis. A variety of crops both irrigated and unirrigated have been experimented upon. The cultivation of these crops is of the usual type and hence is not given here.

The results of the experiments are as given below.

#### CROP—JOWAR NILWA (KHARIF).

*I—To compare the effects of various combinations of F.Y.M. and artificial fertilisers with no-manure treatment.*

The treatments were as follows per acre:—(1) 5 carts Farm Yard Manure *plus* sulphate of potash 200 lbs., (2) 5 carts Farm Yard Manure, (3) No-manure, (4) 5 carts F.Y.M. *plus* 200 lbs. sulphate of



potash + 640 lbs. superphosphate and 160 lbs. sulphate of ammonia, (5) 10 carts F.Y.M., (6) 5 carts F.Y.M. + 200 lbs. sulphate of potash + 640 lbs. superphosphate + 160 lbs. sulphate of ammonia and 672 lbs. lime, and (7) 5 carts F.Y.M. + 200 lbs. sulphate of potash and 640 lbs. of superphosphate. The experiments were tried for two years in 1912-13 and 1914-15 in duplicate plots.

In 1914-15 the last two treatments gave significantly low yields, but the other treatments including no-manure in that year and all the treatments in 1912-13 gave yields with differences less than the significance. No-manure treatment which is without the cost of manuring is naturally therefore the most profitable.

Detailed figures are in Table Poona College Farm I.

#### CROP—SHALU JOWAR (RABI).

*II—To compare basic 5 carts F.Y.M. with additions of 10 lbs. of nitrogen per acre in various forms.*

The nitrogen was supplied as sulphate of ammonia, nitrate of soda, calcium cyanamide, leunaphos and nitrophoska. The experiment was tried in 1929-30 in four replications. The variance due to treatments is less than that due to error. There is no significance between means of treatments. The Highest average is that of F.Y.M. alone. For yields and net profits F.Y.M. alone is the best.

Detailed figures are in Table Poona College Farm II.

*III—To compare basic 5 carts F.Y.M. with additions of nitrogen in various forms.*

This experiment is a repetition of experiment II with some materials changed. The materials were:—niciphos, complete fertiliser, calcium cyanamide, nitrate of soda and sulphate of ammonia. This was done in 1930-31 with four replications and it confirms the results of experiment II. Variance due to treatment is less than that due to error. There is no significance between means of any two treatments. F.Y.M. alone is the best and the most profitable treatment.

Detailed figures are given in Table Poona College Farm III.

#### JOWAR (SHALU).

*IV—To ascertain the comparative effects of chemical fertilisers on jowar.*

- |                          |                       |
|--------------------------|-----------------------|
| (1) Sulphate of ammonia. | (5) Ammophos.         |
| (2) Nitrate of soda.     | (6) Nitrophoska.      |
| (3) Calcium cyanamide.   | (7) Farm Yard Manure. |
| (4) Leunaphos.           |                       |

There was no basic manure given as the land was heavily manured. Each plot was 15' × 15' with ring and without ring 10' × 10'. Each of the top-dressing manures was added in quantities equal 10 lbs. of nitrogen. Each treated plot had a check without any artificial. The experiment was tried in 1928-29. When the results are statistically calculated it is found that the effect due to treatment over no-treatment is not significant and the different treatments are all equal.

Details in Table Poona College Farm IV.

#### CROP—BAJRI (AKOLA VARIETY).

V—*To compare the effect of basic 5 carts F.Y.M. with additions of 10 lbs. of nitrogen per acre in various forms.*

The nitrogen was supplied as sulphate of ammonia, nitrate of soda, calcium cyanamide, leunaphos and nitrophoska. The experiment was done in 1929-30 in four replications. Difference in yields due to treatments is less than that due to error. Comparing the means of treatments calcium cyanamide addition is significantly higher than no treatment and nitrate of soda addition is significantly lower than no treatment.

Details in Table Poona College Farm V.

VI—*To compare the effect of 5 carts of F.Y.M. with additions of 10 lbs. of nitrogen in various forms.*

This experiment is only a modified form of experiment V. The following materials were used:—Sulphate of ammonia, nitrate of soda, calcium cyanamide, niciphos and complete manure containing 12.9 lbs. nitrogen, 13.3 lbs. phosphoric acid and 11.3 lbs. potash. This experiment was done in 1930-31 with eight replications. Except sodium nitrate addition none of the artificials gives a significantly higher yield than those of F.Y.M. alone. This contradicts the results of experiment V.

Details in Table Poona College Farm VI.

#### CROP—BAKSHI WHEAT (IRRIGATED).

VII—(a) *To compare san green with 10 carts poudrette per acre.*

The experiments were done in 1912-13 and 1913-14 in duplicates. Poudrette gave significantly better results than san green.

(b) *To compare san green with 10 carts F.Y.M. per acre.*

The experiment was done in duplicate in 1914-15. Farm Yard Manure proved to be better than san green.

(c) *To compare 20 lbs. of nitrogen as sulphate of ammonia with 20 lbs. nitrogen as nitrate of soda both given in addition to 5 carts poudrette per acre.*

The experiment was done in duplicate in 1912-13. The nitrate of soda gave better yields than sulphate of ammonia in the above combinations.

(d) *To compare 20 lbs. of nitrogen as sulphate of ammonia with 20 lbs. of nitrogen as nitrate of soda, both in addition to 5 carts F.Y.M. per acre.*

This combination of sulphate of ammonia gives better yields than nitrate of soda. This experiment was done in 1914-15 in duplicates.

Details are given in Table Poona College Farm VI.

#### CROP—"PUSA 4" WHEAT (ROTATED WITH COTTON).

VIII—*To compare the effects of the following treatments:—*

(1) No manure, (2) 2·5 carts F.Y.M., (3) 2·5 carts F.Y.M. plus 10 lbs. nitrogen as sulphate of ammonia, (4) 10 lbs. nitrogen as sulphate of ammonia.

The experiment was done in 1930-31 with eleven replications. No manure treatment yields are as good as those of any other treatment and naturally gives higher profits than other treatments. This is distinctly shown.

Details in Table Poona College Farm VIII.

#### CROP—COTTON.

IX—*To compare the effect of the following treatments on cotton:—*

(1) 5 carts F.Y.M. plus 320 lbs. sulphate of potash, (2) 5 carts F.Y.M., (3) no manure, (4) 5 carts F.Y.M., 320 lbs. sulphate of potash, 640 lbs. superphosphate and 128 lbs. sulphate of ammonia, (5) 10 carts F.Y.M., (6) 5 carts F.Y.M., 320 lbs. sulphate of potash, 640 lbs. superphosphate, 128 lbs. sulphate of ammonia and 672 lbs. of lime, and (7) 5 carts F.Y.M. 320 lbs. sulphate of potash and 640 lbs. superphosphate.

The experiments were conducted on "Varadi" variety for three years from 1912-13 to 1914-15 in duplicates. In the first year treatments 1, 5 and 6 are better than others. In the second year treatments 1, 2, 6 stand better than 4, 5 and 7 which are better than no treatment. In the third year treatment 2 stands out high and treatment 7 very low. Taking all experiments it may be said that treatments 1, 2 and 5 are promising. No. 6 which is good will go down in net profits.

Details in Table Poona College Farm IX.

X—*To compare the effects of 8 carts F.Y.M. with, with additional 30·5 ammophos, 25 lbs. superphosphate and 5·25 lbs. sulphate of potash.*

The experiment was tried on N. R. variety in 1916-17 in four replications. The additional fertilisers do not show advantage over F.Y.M. alone.

Details in Table Poona College Farm X.

XI—*To compare the effects of F.Y.M., sulphate of ammonia and their combination with that of no manure.*

The experiment was tried on N. R. variety in 1929-30 with four replications. Quantity of F.Y.M. or sulphate of ammonia was

equal to 10 lbs. nitrogen per acre. In the combination treatment the nitrogen was 20 lbs. Variance due to treatment is less than the variance due to error. The differences in the means of treatments are not significant.

Details in Table Poona College Farm XI.

#### CROP—GROUNDNUT.

*XII—(a) To ascertain the effect of the addition of sulphate of ammonia to a mixture of poudrette with sulphate of potash and superphosphate on groundnut (Spanish peanut variety).*

The experiments were done for three years 1912-13 to 1914-15 in duplicates. The portions of manures were not the same in all the three years. No conclusion can be drawn from these as the results are contradictory and the error is very high.

*(b) To ascertain the effect of the addition of sulphate of potash to poudrettes on groundnut (Spanish peanut variety).*

The experiments were done for three years from 1912-13 to 1914-15 in duplicates. The yields do not show any significant difference.

Details in Table Poona College Farm XII.

*XIII—To compare the effects of the following combinations on groundnut (Big Japan variety with no manure):—*

- (1) 2.5 carts F.Y.M. and 320 lbs. sulphate of potash.
- (2) 2.5 carts F.Y.M.
- (3) No manure.
- (4) 2.5 carts F.Y.M., 320 lbs. sulphate of potash, 640 lbs. superphosphate, 128 lbs. sulphate of ammonia.
- (5) 10 carts F.Y.M.
- (6) As in 4 plus 1,000 lbs. lime.
- (7) 2.5 carts F.Y.M., 320 lbs. sulphate of potash and 640 lbs. superphosphate.

Treated plots give significantly higher yields than those of non-treated plots in all the three years 1912-13 to 1914-15. The experiments were in duplicates. The order of merit for the various treatments varies from year to year. Treatments 6, 5, 4, and 1 are the best.

Details in Table Poona College Farm XII.

*XIV—To compare the effects of F.Y.M. 2.5 carts with addition of 20 lbs. nitrogen in various forms on groundnut (Spanish peanut variety).*

The manures used were sulphate of ammonia, nitrate of soda, calcium cyanamide and niciphos. The complete fertiliser treatment consisted of 12.9 lbs. nitrogen, 13.3 lbs. phosphoric acid and 11.3 lbs. potash. The experiment was done in 1930-31 in 8 replications. There is significance in the yields of different treatments. Addition of sodium nitrate is the best followed by that of niciphos. Others are all equal.

Details in Table Poona College Farm XIV.

## CROP—CHILLIES.

XV—To compare the following treatments :—

- (1) Poudrette 12 carts, nitrate of soda 160 lbs. thomas slag 200 lbs.
- (2) The above plus sulphate of ammonia 224 lbs.

The experiment was tried in 1914-15 in duplicate. The addition of sulphate of ammonia significantly diminishes the yields.

Details in Table Poona College Farm XV.

XVI—To ascertain the effect of 20 lbs. of nitrogen in various forms in addition to 20 lbs. of nitrogen as F.Y.M. for chillies.

The manures used were sulphate of ammonia, nitrate of soda, calcium cyanamide, leunaphos and nitrophoska. It is only the nitrophoska that gives a significantly higher yield than that of F.Y.M. alone. The experiment was tried in 1929-30 in four replications.

Details in table Poona College Farm XVI.

XVII—To ascertain the effects of 20 lbs. of nitrogen in various forms in addition to 20 lbs. of nitrogen as F.Y.M. on chillies.

This is practically experiment XV in a modified form. The materials used were :—sulphate of ammonia, nitrate of soda, calcium cyanamide, niciphos and complete fertiliser (consisting of 12·9 lbs. of nitrogen, 13·3 lbs. of phosphoric acid and 11·9 lbs. of potash). Difference due to treatments is greater than that due to error and hence additional nitrogen treatments are significantly better than F.Y.M. alone treatment. Amongst the additions that of sulphate of ammonia stands the lowest. All others are equal.

Details in Table Poona College Farm XVII.

## CROP—POTATO (RABI IRRIGATED).

XVIII—Comparisons of various treatments.

During the three years from 1912-13 to 1914-15 five sets of treatments were tried in duplicates as given below :—

- A.—1. Poudrette plus sulphate of potash plus superphosphate.
  2. Poudrette plus sulphate of potash plus sulphate of ammonia.
- No. 2 nearly significantly higher than No. 1.

- B.—1. Poudrette.
2. Poudrette plus sulphate of potash.

Difference in yields is not significant.

- C.—1. Green manuring with niger.
2. Green manuring plus sulphate of potash.

No difference in yields.

- D.—1. Poudrette plus sulphate of potash plus superphosphate.
2. Poudrette plus sulphate of potash plus superphosphate plus safflower cake.

Addition of safflower cake gives a significantly higher yield.

- E.—1. Poudrette plus superphosphate.
  2. Poudrette plus superphosphate plus sulphate of potash.
- The difference in yields is not significant.

Details in Table Poona College Farm XVIII.

## CROP—ONIONS.

*XIX—To compare certain treatments on onions.*

Experiments were done in 1912-13, 1913-14 and 1914-15 in duplicates as follows :—

- A.—1. Poudrette 10 carts *plus* sulphate of ammonia 300 lbs.  
2. Poudrette 10 carts *plus* nitrate of soda 400 lbs.

There is no significant difference between two treatments.

- B.—1. Poudrette 24 carts *plus* sulphate of ammonia =75 lbs. nitrogen.  
2. Poudrette 24 carts *plus* nitrate of soda =75 lbs. nitrogen.

Sulphate of ammonia has given nearly significantly higher yields than nitrate of soda.

- C.—1. F.Y.M. 24 carts *plus* sulphate of ammonia 500 lbs.  
2. F.Y.M. 24 carts *plus* nitrate of soda 660 lbs.

Yields of nitrate of soda are significantly higher than those of sulphate of ammonia. All the above experiments are inconclusive. More experiments are necessary to draw definite conclusions.

Details in Table Poona College Farm XIX.

*XX—To compare the effects of addition of 20 lbs. of nitrogen in various forms of artificials to the basic 20 lbs. of nitrogen as F.Y.M. per acre on onions.*

The experiment was done in 1929-30 in four replications. The manures used were :—sulphate of ammonia, nitrate of soda, calcium cyanamide, leunaphos and nitrophoska. Variance due to treatments is less than that due to error hence there is no significant difference due to treatments. Even between treatments there is no difference.

Details in Table Poona College Farm XX.

*XXI—To ascertain the comparative effects of chemical fertilizers on irrigated onions.*

- (1) Sulphate of ammonia.
- (2) Nitrate of soda.
- (3) Calcium cyanamide.
- (4) Leunaphos.
- (5) Ammophos.
- (6) Nitrophoska.
- (7) F.Y.M.

The previous crop was "French beans" which was manured at the rate of 10 carts of F.Y.M. per acre. The artificials given were equivalent to 10 lbs. of nitrogen per acre. Size of each plot without the ring was 10' × 10'. The experiment was done in 1928-29.

There is a significant effect due to treatments. Out of the various treatments used sulphate of ammonia is the best. Next is ammophos followed by leunaphos. These are significantly higher than the other treatments. Nitrate of soda, calcium cyanamide and F.Y.M. are equal with the check while nitrophoska is significantly lower than the check.

Details in Table Poona College Farm XXI.

## CROP—TURMERIC (IRRIGATED).

XXII—*To compare various combinations.*

Experiments were tried in duplicates in 1912-13 and in 1914-15.

- A.—1. Poudrette 15 carts *plus* safflower cake 1,184 lbs. *plus* sulphate of ammonia, 124 lbs.  
 2. Poudrette 15 carts *plus* safflower cake 592 lbs. *plus* sulphate of ammonia 124 lbs.

There is no significant difference in yields.

- B.—1. Poudrette 15 carts *plus* safflower cake 1,528 lbs.  
 2. Poudrette 15 carts *plus* safflower cake 764 lbs. *plus* sulphate of ammonia 178 lbs.

The second treatment gave a significantly higher yield than the first.

- C.—1. Poudrette 30 carts.  
 2. Poudrette 15 carts *plus* safflower cake 1,800 lbs.

The substituting poudrette by safflower lowered the yields nearly significantly.

- D.—1. Poudrette 30 carts.  
 2. Poudrette 15 carts *plus* safflower cake 1,528 lbs.

There is no significance in yields of the two treatments.

Details in Table Poona College Farm XXII.

## CROP—CABBAGE AND KNOL-KHOL.

XXIII—*To compare certain treatments.*

- A.—1. F.Y.M. 48 carts.  
 2. F.Y.M. 24 carts *plus* nitrate of soda 330 lbs.

The experiment was done in 1913-14 in triplicates. There is no difference in yields due to treatments.

- B.—1. Poudrette 48 carts.  
 2. Poudrette 24 carts *plus* nitrate of soda 660 lbs.

This experiment was done in 1914-15 in duplicates. Substituting 24 carts of poudrette by 660 lbs. of nitrate of soda has given significantly higher yields.

Details in Table Poona College Farm XXIII.

## CROP—SURAN (IRRIGATED).

XXIV—*To compare the effects of (1) 800 lbs. groundnut cake, (2) complete manure 115 lbs. nitrogen as sulphate of ammonia, 170 lbs. of  $K_2O$  as sulphate of potash and 84 lbs. of superphosphate per acre and (3) 115 lbs. of nitrogen as sulphate of ammonia.*

The experiment was tried in 1930-31 with six replications. There is no significant difference due to treatment. The treatment of sulphate of ammonia alone has given sufficiently higher yields and the net profits are higher than the complete manure treatment.

Details in Table Poona College Farm XXIV.

## CROP—GINGER (IRRIGATED).

*XXV—To compare the effects of (1) 20 carts F.Y.M. plus 800 lbs. of groundnut cake, (2) complete manure consisting of 45 lbs. of nitrogen as sulphate of ammonia, 52 lbs. of potash as sulphate of potash and 22 lbs. of phosphoric acid as superphosphate and (3) 45 lbs. as sulphate of ammonia.*

The quantities of constituents given in treatment 2 are those found in 10,000 lbs. of green ginger.

This experiment was done in 1930-31 with six replications. There is no significant difference due to treatment. Individual treatments also do not differ significantly from each other.

Details in Table Poona College Farm XXV.

## CROP—LINSEED (RABI-DRY).

*XXVI—To compare the following two treatments :—*

- |   |             |
|---|-------------|
| (1) F.Y.M. 10 carts, nitrate<br>of soda 133 lbs., sulphate<br>of potash 64 lbs., lime<br>600 lbs. | } per acre. |
| (2) As in (1) plus superphosphate 320 lbs.  |             |

The experiment was done in 1914-15 in duplicate. It did not give any significant difference between the two treatments. Addition of superphosphate gave less yield.

Details in Table Poona College Farm XXVI.

## CROP—LUCERNE.

*XXVII—To ascertain the effect of the addition of 300 lbs. superphosphate to be applied in December to 60 carts of F.Y.M. applied every year in three doses to lucerne.*

The crop was started in 1927-28 and the results obtained up to 1930-31 show that there is no significant difference due to treatment except in 1929-30. Addition of superphosphate does not show any advantage. In net profits it will be a disadvantage.

Details in Table Poona College Farm XXVII.

On the Poona Agricultural College Farm manurial experiments have been tried on various crops and they must be summarised separately for each crop.

On *kharif jowar (Nilwa)* only one experiment has been tried. In this 5 carts of F.Y.M. per acre was given alone and with various artificials singly and in combinations. The yields of these were compared with each other and with no-manure plot. No advantage was shown by any treatment. On *shalu jowar* nitrogenous artificials in various forms were tried along with 5 carts of F.Y.M. per acre and it was found that F.Y.M. alone proved to be the best.



The results with *Bajri* are practically the same as with *shalu jowar*. F.Y.M. alone being the best.

With irrigated wheat, F.Y.M. showed itself to be better than san green, sodium nitrate in combination with poudrrette gave higher yields than sulphate of ammonia with poudrrette. In combination with F.Y.M. sulphate of ammonia proved to be better than nitrate of soda. "No-manure-treatment"-yields are often times better than yields of treated plots and hence no-manure plots give higher net profits.

With cotton except in rare cases artificials do not show any advantage over no-manure, or, F.Y.M. treatment.

The spanish peanut variety of groundnut did not show any increase due to artificial manures except nitrate of soda and niciphos. The Big Japan variety gave higher yields than no-manure when treated with F.Y.M. along with sulphate of potash and other artificials.

The experiments on chillies show that sulphate of ammonia does not show any advantage. Other nitrogenous artificials along with F.Y.M. give higher yields than F.Y.M. alone.

In the case of potatoes (irrigated) sulphate of potash with green manuring and with poudrrette were tried. Only two have shown significantly high yields—one is poudrrette with safflower cake and the other is poudrrette plus sulphate of potash plus superphosphate and sulphate of ammonia.

For irrigated onions various nitrogenous artificials were tried along with basic F.Y.M. but they did not show any advantage. In another case the crop previous to onions was a leguminous one which was manured with F.Y.M. and therefore no basic manure was used. The artificials showed significant effect. Sulphate of ammonia seemed to be the best followed by ammophos. These experiments want confirmation.

The experiments with other crops need not be summarised as their results are mentioned in short under each crop.

### RATNAGIRI (SHIRGAON) FARM.

Ratnagiri Farm in Shirgaon area is two miles north of Ratnagiri on north latitude  $16^{\circ}59'$ ; east longitude  $73^{\circ}18'$ . The elevation is a few feet above the sea-level.

*Temperature.*—The mean maximum temperature is  $95^{\circ}\text{F}$  in May and the mean minimum is  $67^{\circ}\text{F}$  in February.

The average rainfall is 100 inches. The rainy season extends from the beginning of June to the middle of October.

*Soils.*—The soils are all derived from the laterite. They are classified into two types. The low lying, locally called "*Malá*" lands are found in valleys, more or less flat. They receive washings from higher levels and are sufficiently retentive of moisture to allow a *rabi* crop after the *Kharif* rice. The other type of soils are situated at a higher level and are locally called "*Kuryat*". They are formed out of the slopes by terracing and embanking. They are gravely and hungry. They cannot grow dry *rabi* crop. With irrigation they grow garden crops.

## CHEMICAL ANALYSIS.

	Low-lying "Mala". High-lying "Kuryat".	
	Per cent.	Per cent.
Loss on ignition	9.09	4.80
Sand	30.93	35.23
Lime	traces	0.19
Potash	0.41	0.37
Phosphoric acid	0.16	0.10
Nitrogen	0.16	0.16

The object of the farm is to improve the staple crop of rice. The manurial experiments were tried from 1913 to 1922 after which rice breeding work displaced manurial experiments.

There are two chief varieties of rice: the *Vaksal* grown by transplantation on *Mala* land and *Patni* by broadcasting sprouted seed (called *Rahu*) on *Kuryat* land. *Vaksal* seed is sown at the first monsoon showers in June. Transplanting is done in the first week of July. The crop is ready for harvesting by the middle of October. The average yield is about 1,500 lbs. grain and 2,000 lbs. of straw per acre. The *Patni* seed in sprouted condition is broadcasted in the third week of June. The crop is harvested at the end of September. The average yield is 1,000 lbs. of grain and 1,250 lbs. of straw.

The cultivation consists of puddling only and there is one weeding by hand as interculture.

Cost of cultivation of paddy per acre at Ratnagiri is Rs. 76 for low-lying and about Rs. 52 for high-lying land. The local practice is to manure the high-lying or *Kuryat* lands with F.Y.M.—about 10 carts per acre, but the low-lying lands are not manured at all.

Most of the manurial experiments tried were to find out if manuring the low-lying lands would increase the yield and only a few to ascertain whether the present manuring of high-lying lands could be improved. The results are given below.

*I—To ascertain the effect of various bulky manures for rice crop on low-lying i.e., "Mala" lands.*

Urine earth, cattle-folding, rice husk and nightsoil each equivalent to 20 lbs. of nitrogen per acre were tried and the effect compared with no manure. The experiments extended over four years from 1915 to 1919. For the first three years there were duplicate plots but during the last two years there were only single plots. Plots treated with urine earth, cattle-folding and rice husk gave higher yields than no treatment plots. It is however difficult to say which treatment is the best. The results of different years contradict each other. The average net profits are—

	No treat- ment.	Urine earth.	Cattle folding.	Rice husk.	Night- soil.
Average per plot.	Rs. 2.2	Rs. 2.6	Rs. 2.6	Rs. 2.5	Rs. 2.4

These figures show that nightsoil has very little advantage and the other treatments which show some advantage are all equal.

For detailed figures reference may be made to Table Ratnagiri I.

*II—To test the effect of nightsoil and poudrette with each other and with no-manure on low-lying lands for rice.*

The experiments were carried out for two years 1919 and 1920 with duplicate plots. The quantities of manure were equivalent to 20 lbs. of nitrogen per acre. If they indicate anything at all they show that addition of poudrette or nightsoil has no advantage.

Detailed figures are given in Table Ratnagiri II.

*III—To test the effect of rui (Calotropis gigontia) leaves on low-lying lands for rice.*

Rui leaves were ploughed in at the rate of 8,000 lbs. per acre. The experiments were carried out for three years from 1917 to 1919 with duplicate plots. Every year treated plots have given significantly higher results than no-manure plots. Net profits also confirm the same result.

Detailed figures are given in Table Ratnagiri III.

*IV—To test the effect of bone-meal and groundnut cake with each other and with no-manure for rice on low-lying lands.*

The experiments were done for two years 1916 and 1917 with duplicate plots. The manures were given in quantities equivalent to 20 lbs. nitrogen per acre. The treated plots are distinctly better than no-treatment plot and the bone-meal has given higher results than the groundnut cake. When we come to net profits we find that the manures show no advantage and bone-meal distinctly lowers the net profits. This is due to the high cost of bone-meal.

Detailed figures are given in Table Ratnagiri IV.

*V—To compare the effects of the following manures with each other and with no manure for rice on low-lying lands: Sulphate of ammonia, fish manure and Undi-cake.*

The experiments were carried on for two years 1916 and 1917 in duplicates. The manures were given in quantities equivalent to 20 lbs. nitrogen per acre.

Plots treated with fish manure and sulphate of ammonia have given significantly higher results than no-manure plots. Undi-cake also has given higher results than no treatment but they are not significantly higher. Sulphate of ammonia has no advantage in net profits. Fish manure seems to be the best both in yields and net profits.

Detailed figures are given in Table Ratnagiri V.

*VI—To compare the effects of the following manures with each other and with no-manure for rice on low-lying lands.*

Groundnut cake, fish manure, sulphate of ammonia and Undi-cake.

These experiments were nearly combinations of experiments IV and V excluding the bone-meal.

They were carried out for two years 1920 and 1921 in duplicates. The quantities of manures given were equivalent to 20 lbs. nitrogen per acre. The Undi-cake comes higher up in these experiments, in other respects they confirm the results of experiments IV and V. All the treated plots give higher yields than no-manure plots, but except fish manure, the treatments are not of economic advantage. Fish manure stands sufficiently high both in yields and net profits.

Detailed figures are given in Table Ratnagiri VI.

*VII—To compare the effects of some oil cakes with each other and with no-manure on rice in low-lying lands.*

The experiments were tried for three years from 1913 to 1915. The oil-cakes used were castor, Undi and groundnut. Treated plots give higher yields than no-manure plots. Undi-cake and groundnut cakes give more net profits than no-manure. Between these two it is difficult to choose. Castor cake gives practically no profits.

Detailed figures are given in Table Ratnagiri VII.

*VIII—To compare the effects of fish manure and bone-meal with each other and with no-manure on rice crop in low-lying lands.*

The experiments were done for three years from 1913 to 1915. In 1913 there were single plots while in 1914 and 1915 the plots were in duplicates. The manures given were equivalent to 20 lbs. of Nitrogen per acre. The first two years show a significant advantage for bone-meal over no-treatment and also over fish manure. In the third year, however, fish manure is equally good as bone-meal. The net profits, however, take away all the advantage of bone-meal. On account of its higher cost it lowers the net profits below the no-treatment.

*IX—To ascertain the effect of bone-meal equal to 10 lbs. nitrogen per acre on rice in low-lying lands.*

These experiments were done in duplicates in 1918 and in singles for three years from 1919 to 1920. It was shown in experiments on bone-meal equivalent to 20 lbs. of nitrogen per acre that the yields were significantly higher but the net profits were low on account of the high cost of bone-meal. In order to reduce the cost the quantity of bone-meal was reduced to half in these experiments and it is seen from the results that even with half the quantity, the bone-meal shows a distinct advantage over no-manure and in these the net profits for bone-meal are higher than no-manure. Except in 1920 the bone-meal has always shown a distinct advantage.

*X—To ascertain the effect of rock-phosphate on rice in low-lying lands.*

Experiments were tried for three years from 1919 to 1921 in duplicates. The quantity of rock-phosphate used was equivalent to 112 lbs. of  $P_2O_5$ . The addition of this manure gave higher yields in 5 plots out of 6 but they were not significant.

XI—To compare the relative effects of various manures on rice crop in high-lying or *kuryat* lands in addition to the basic F.Y.M. 10 carts.

The experiments were conducted for five years from 1913 to 1917 in duplicates. The results of 1914-15 were unsatisfactory and hence they have been left out. The manures used were Undi-cake, fish-manure, bone-meal, castor cake and sulphate of ammonia. Out of these castor cake was tried only in one year and failed to show any advantage over no-manure. Undi-cake stands out to be the best both in yields and net profits. Next is sulphate of ammonia followed by fish-manure and bone-meal stands last. Here again it may be noted that in yields bone-meal stands next to Undi-cake but on account of its high cost it falls below all treatments.

Detailed figures are given in Table Ratnagiri Farm XI.

At Ratnagiri manūrial experiments were tried on low-lying rice-lands where manuring is not in practice. The trials consisted of bulky manures like urine-earth, cattle-folding, rice-husk, nightsoil and poudrette and also *rui*-leaves. The concentrated manures were groundnut, castor and Undi oil cakes and fish, bone-meal and sulphate of ammonia. Out of these bulky manures poudrette and nightsoil did not show any advantage. Urine earth, cattle-folding and rice-husk showed advantage over no-treatment and also gave higher net profits. All the three were found to be of equal value. *Rui* leaves gave significantly higher figures both in yields and profits.

The oil-cakes and other manures were given at the rate of 20 lbs. of nitrogen per acre and they all gave higher yields than no-manure plots. Fish-manure showed a distinct advantage over oil-cakes both in yields and profits. Sulphate of ammonia was less advantageous than fish. It may be nearly as good as oil-cakes. Bone-meal in equivalent quantities of nitrogen was better in yields than any other manure but its cost was prohibitive. If this goes low it will beat any other manure. In one of the series of experiments rock-phosphate was tried but it failed to show any advantage over no-manure.

The high-lying lands called *kuryat* are always manured and hence experiments were done to see whether by addition of other manures crop yields could be increased. The Undi-cake, bone-meal, fish-manure and sulphate of ammonia with F.Y.M. give higher yields than F.Y.M. alone. Bone-meal, however, does not give profits on account of its high cost.

#### SURAT FARM.

Some part of the land was bought in 1893, but operations were regularly started in 1896. The area was later on increased and now the total area is 315 acres, out of which 165 acres are arable. The farm is situated about two miles from Surat town. It is on 21° north latitude and 72° east longitude. It is nearly at the sea level.

The average maximum temperature is about 102° F in April and the average minimum about 58° F in January.

The rainy season usually begins about the middle of June and extends up to the middle of October. The total rainfall is about 40 inches.

Soils of the Surat farm on which manurial experiments are conducted are black cotton soils. These are four to five feet deep. At deeper depths yellowish alluvial material is found. The analysis of a typical soil is given below :—

<i>Chemical</i>			<i>Mechanical</i>		
		Per cent.			Per cent.
Loss on ignition	..	3·90	Clay and finest silt	..	32·29
Sand	..	60·20	Fine silt	..	6·36
Lime	..	0·75	Medium silt	..	7·39
Potash	..	0·29	Coarse silt	..	27·42
Phosphoric acid	..	0·07	Fine sand	..	26·34
Nitrogen	..	0·04	Coarse sand	..	0·20

The manurial experiments done at Surat are on cotton *jowar* rotation. The usual practice is to give manure to cotton. The *jowar* gets the residual portion.

*I—To ascertain the comparative effects of various bulky manures applied at the rate of 5 tons per acre every second year to cotton for cotton-jowar rotation.*

The experiments were tried on 4-guntha plots in duplicates from 1908–09 to 1914–15. The manures used were (1) rotted cactus ; (2) *mohua* refuse ; (3) poudrette ; (4) tank mud ; (5) F.Y.M. ; (6) town sweepings and (7) check without any manure.

Poudrette proves to be the best and stands out significantly above other treatments for *jowar*. *Mohua* refuse is closely next to poudrette. F.Y.M. and town sweepings are better than no-manure, but rotted cactus and tank mud have no advantage over no-manure. For cotton which is directly manured poudrette is again the best. *Mohua* refuse, F.Y.M. and town sweepings are very close to each other but *mohua* is better than the other two. Rotted cactus and tank mud have practically no effect.

Details in Table Surat Farm I.

*II—To ascertain the effects of increasing doses of F.Y.M. when manure is applied to cotton in the cotton-jowar rotation.*

The quantities of manure varied from *nil* to 25 tons per acre given to cotton. They were :—(1) *Nil* ; (2) 5 tons ; (3) 7·5 tons ; (4) 10 tons ; (5) 12·5 tons ; (6) 15 tons, (7) 17·5 tons, (8) 20 tons ; (9) 22·5 tons and (10) 25 tons.

The experiments were conducted in single plots from 1919–20 to 1921–22. The yields for cotton go on increasing up to 7·5 tons after which the yields go down, increasing again with 22·5 to 25 tons. With *jowar* the yields go on increasing up to 10 tons and then become steady. The best quantity on the whole is about 10 tons of F.Y.M. per acre.

Details in Table Surat Farm II.

*III—To ascertain the comparative effects of the following F.Y.M. treatments compared with no-manure on cotton-jowar rotation :—*

(1) 10 tons F.Y.M. in trenches, (2) 7.5 tons F.Y.M. in trenches and 2.5 tons on ridges before sowing, (3) 7.5 tons F.Y.M. in trenches and 2.5 tons at sowing on ridges, and (4) no-manure.

The experiments were conducted in two series : in one the *jowar* was manured and in the other the cotton was manured. There were two sets of plots in each series rotating with each other. The experiments were conducted on 4-guntha plots in duplicates from 1922-23 to 1929-30. For *jowar* all the treatments are significantly better than no-manure. The best treatment is 10 tons given all at once in trenches. The remaining treatments are equal. The same conclusions hold good for cotton also.

Details in Table Surat Farm III.

*IV—To compare the Dharwar and Surat systems of manuring with 2.5 tons manure every year in cotton-jowar rotation.*

In the Dharwar system 5 tons of F.Y.M. is given to *jowar* in the *jowar-cotton* rotation while in the Surat system it is the cotton that gets the manure in the rotation. The experiments were conducted in single plots from 1908-09 to 1916-17. The three different treatments do not show any significant difference and therefore may be all taken to be equal. But generally in the Surat system cotton gets some advantage while in the Dharwar system *jowar* gets the advantage.

Details in Table Surat Farm IV.

*V—To ascertain the comparative effects of the following on the cotton-jowar rotation :—*

- (1) Nightsoil 84.5 carts applied in beds in 1904-05 and no manure after that.
- (2) 20 carts F.Y.M. in 1905-06 and no-manure afterwards.
- (3) 40 carts F.Y.M. in 1904-05 and no-manure afterwards.
- (4) Nightsoil 84.5 carts applied in trenches in 1904-05 and no manure afterwards.

The experiments started in 1904-05 were under observation up to 1915-16. The rotation was cotton and *jowar*. There were two series of plots which alternated with each other in rotation. Taking the order of treatment according to yields, nightsoil has given very high yields both for cotton and *jowar*. Nightsoil in beds is a bit better than nightsoil in trenches. Out of the two F.Y.M. treatments 40 carts is better than 20 carts. In net profits also the treatments stand in the same order as in yields.

Details in Table Surat Farm V.

*V (a)—To ascertain the comparative effects of the following treatments, on cotton-jowar rotation :—*

(1) Poudrette 5 tons every second year, (2) nightsoil put in one dose equivalent to poudrette for a period of 10 years (25 tons), (3) no-manure.

This experiment is a modified form of experiment V. It was continued from 1912-13 to 1921-22. Two sets of plots were taken. In one set manure was given to cotton every alternate year. The treatments have consistently given higher yields than no-manure treatment. Night-soil seems to be slightly better than poudrette.

Details in Table Surat Farm V (a).

*VI—To compare on cotton-jowar rotation the effects of—*

(1) Gypsum 2,000 lbs. per acre as indirect manure, (2) F.Y.M. 5 tons per acre, (3) no-manure.

The experiments were conducted in single plots from 1905-06 to 1908-09. The results show that the treatments are better than no manure and F.Y.M. is better than gypsum for both cotton and jowar.

Details in Tables Surat Farm VI.

*VII—To judge the residual effect of F.Y.M. on cotton-jowar rotation in black-cotton soil.*

Twenty carts of F.Y.M. per acre were given to cotton in 1915-16 and no-manure since then. The yields of cotton and jowar from this plot were compared with the average yield of the Surat Farm. Distinct effect of the manure for cotton is seen till 1925-26 and for jowar till 1924-25.

Details in Table Surat Farm VII.

*VIII—To study the comparative effects of various oil-cakes applied to cotton in cotton-jowar rotation equivalent to 20 lbs. of nitrogen per acre.*

The experiments were conducted in two series with duplicate plots from 1908-09 to 1910-11. The plots were of 4 guntha size. The crushed *nimb* seed lowers the yields while castor cake shows some advantage but even this requires further confirmation.

Details in Table Surat Farm VIII.

*IX—To compare the effects of the following artificials on the cotton-jowar rotation.*

The manures used were :—(1) Superphosphate 400 lbs. plus 100 lbs. nitre, (2) 160 lbs. nitre alone, (3) no manure, (4) nitrate of soda 100 lbs., (5) castor cake 600 lbs., and (6) F.Y.M. 5 tons per acre.

The size of plots was one-sixth of an acre each. The experiments were on single plots and were conducted from 1906-07 to 1909-10. The manures were given every year. There were two sets of plots.



The cotton variety was changed from year to year and hence the yields for that crop could not be taken. Three varieties of *jowar* were tried. The treatments gave slightly different effects with different varieties. In general it may be said that superphosphate *plus* nitre as also the treatment with F.Y.M. gave the best yields and significant advantage over no-manure. The other treatments gave better yields than no-manure but not quite significant.

Details in Table Surat Farm IX.

*X—To ascertain the comparative effects of the following manures on cotton-jowar rotation.*

The treatments were :—

- (1) Nitre.
- (2) Calcium nitrate.
- (3) Sulphate of ammonia.
- (4) F.Y.M.
- (5) No-manure.
- (6) Calcium cyanamide.

The quantity of the manure was given at the rate of 10 lbs. of N per acre every year both to *jowar* and cotton.

The experiments were conducted from 1908–109 to 1914–15.

For cotton nitre, calcium nitrate and sulphate of ammonia are equal. They are better than F.Y.M. and calcium cyanamide and no-manure. F.Y.M. and calcium cyanamide are in no way better than no-manure treatment. For *jowar* only nitre and calcium nitrate show advantage over no-manure.

Details in Table Surat Farm X.

*XI—To ascertain the comparative effects of the following treatments on cotton-jowar rotation :—*

(1) No top-dressing, (2) calcium nitrate—10 lbs. N, (3) sulphate of ammonia—10 lbs. N per acre.

The basic manure was 5 tons of F.Y.M. given only to cotton, while the top-dressing was given every year to both cotton and *jowar*. There were duplicate plots from 1916–17 to 1921–22. For *jowar* the top-dressing show advantage over no-top-dressing for four years out of five. For cotton no advantage is shown by the top-dressings.

Details in Table Surat Farm XI.

*XII—To ascertain the effects of the following treatments on cotton-jowar rotation :—*

(1) No manure, (2) 20 lbs. nitrogen as sulphate of ammonia, 15 lbs. and 5 lbs. as castor cake ; (3) 20 lbs. N as sulphate of ammonia ; (4) 15 lbs. of N as sulphate of ammonia ; and (5) 15 lbs. of N as 11.75 N of sulphate of ammonia and 3.5 lbs. as castor cake.

The basic manure was 5 tons F.Y.M. per acre to cotton. This experiment was conducted in 1928–29 with five replications on 2.5 guntha plots. There were two sets of 25 plots ; one with flat plots

and the other with plots having ridges. Figures were available for cotton only. No significance was shown by any of the treatments either on flat or ridged plots.

Details in Table Surat Farm XII.

*XIII—To ascertain the effects of the following treatments on cotton-jowar rotation :—*

(1) No top-dressing, (2) 20 lbs. nitrogen per acre as sulphate of ammonia, (3) 15 lbs. nitrogen per acre as sulphate of ammonia, (4) 20 lbs. nitrogen as mixture of sulphate of ammonia and castor cake, (5) 15 lbs. of nitrogen as a mixture of sulphate of ammonia and castor cake.

The experiment was tried in 1929-30 and 1930-31 in five replications both as (1) randomised arrangement and (2) Latin square.

There were 100 plots in four square blocks of 25 plots each. In 1929-30 cotton was sown on ridges of 5' × 2' in the first block in randomised arrangement. In the next block cotton was shown in flat plots with the same arrangement. In 1930-31 jowar was sown in both the blocks with the same arrangement for treatments.

In the remaining two blocks (50 plots) jowar was sown in 1929-30 in two Latin squares and in 1930-31 cotton was sown on ridges in one block and in flat plots in another. Yields of jowar for 1929-30 could not be obtained. In all the above cases there is no significant effect due to treatment except in one case of Latin square for cotton on ridges. Here 20 lbs. nitrogen treatment is better than 15 lbs. nitrogen which in its turn is better than no-treatment.

Details in Table Surat Farm XIII.

*XIV—To ascertain the effects on cotton-jowar rotation, of the following treatments.*

The treatments were :—(1) calcium nitrate 80 lbs. plus superphosphate 160 lbs., (2) calcium nitrate 80 lbs. plus superphosphate 160 lbs. plus 2.5 tons F.Y.M., (3) 8 tons F.Y.M. per acre.

The cost of manure in each case was Rs. 20. The experiment was tried in duplicates for two years 1913-14 and 1914-15. The treatments do not show any appreciable differences.

Details in Table Surat Farm XIV.

*XV—To ascertain the comparative effects of the following on the cotton-jowar rotation :—*

(1) Sulphate of ammonia 60 lbs. plus superphosphate 224 lbs. plus F.Y.M. 1.5 tons, (2) the mixture as in (1) plus potassium chloride 80 lbs., (3) 3 tons F.Y.M. per acre.

The manures were given once in two years i.e. to cotton. There were two sets of plots and the experiment was in duplicates. It was conducted for six years from 1912-13 to 1919-20. The F.Y.M. treatment is better than any of the other two.

Details in Table Surat Farm XV.

*XVI—To ascertain the comparative effects of supplying plant food constituents singly every two years to cotton.*

The manures used were—(1) potassium sulphate 100 lbs., (2) superphosphate 300 lbs., and (3) sulphate of ammonia 100 lbs. per acre.

The experiment was conducted from 1909–10 to 1914–15 in duplicates. There were two sets of plots in rotation. The results cannot be taken to be conclusive.

Details in Table Surat Farm XVI.

Out of the various bulky manures experimented with at Surat for cotton-*jowar* rotation, rotted cactus and tank mud are found to be of no advantage. Poudrette is excellent, *mohua* refuse and F.Y.M. are next to poudrette. Carting charges for poudrette and *mohua* refuse are high and therefore F.Y.M. is advantageous. The most suitable quantity of F.Y.M. is 10 tons given every second year. It is found that instead of giving this in doses it is best to give it all at once. In comparing Dharwar and Surat systems of manuring, although there are no significant advantages yet it is found that in the Surat system where cotton is manured that crop gets some advantage while in the Dharwar system where *jowar* is manured in the rotation, it is *jowar* that gets the advantage. In the lasting effect of 20 tons F.Y.M. per acre it is found that it lasts for ten years. Between F.Y.M. and nightsoil when given in large doses at once and yields taken without further manuring for 10 years, nightsoil stands distinctly higher than F.Y.M. In another experiment it was seen that nightsoil, and also poudrette though to a slight extent only, is better than F.Y.M.

Out of the various oil-cakes tried it is found that castor cake may give some advantage but not others. Crushed *nimb*-seed pulls down the yield. Trials with artificials show that nitre, sulphate of ammonia and calcium nitrate give increased yields sometimes over F.Y.M. but not always, and hence F.Y.M. shows to be the most suitable of all.

EXTRACTS FROM "REPORT ON SEWAGE EXPERIMENTS  
NEAR POONA".

*By Professor J. B. Knight.*

"22. The effluent was compared with farm yard manure and poudrette at the rate of 20 and 25 tons per acre. Various crops were experimented with including sugarcane, forage crops, and several vegetables during the years of 1899–1900 to 1901–02. The sugarcane showed a net profit of Rs. 383 per acre as compared with Rs. 234 and Rs. 254 from farm yard manure and poudrette respectively, while the Guinea grass showed a profit of Rs. 254 and lucerne of Rs. 337, which exceeds that of the farm yard manure plots by Rs. 220 each. The other fodder experiments were affected by the season, but show an increase in profits of about Rs. 200 per acre over that of the farm yard manure or poudrette plots. From these experiments Mr. Mollison deduces that Rs. 200 per acre may be taken as the manurial value of the effluent."

(Tables of figures in Chapter IV.)

“ 23. During 1900-01 the effluent experiments at Poona were mainly to study its effect upon various vegetables, namely onion, knolkhol, potatoes, sweet-potatoes, *alu*, turmeric and yams. The effluent plots were compared with those treated with farm yard manure, poudrette and fresh nightsoil. The last named gave the lowest yields in all the crops except turmeric ; the effluent produced crops equal to those from the farm yard manure and the poudrette.

With a mixed crop of turmeric and yams the profits of the effluent were only Rs. 199, while farm yard manure gave Rs. 225 and poudrette Rs. 293.”

“ 24. In 1901-02 experiments were continued with *Suran*, turmeric and yams, groundnuts and castors and lucerne. In nearly all cases the effluent results were superior to those from other manures.”

(Table of figures in Chapter IV.)

## CHAPTER IV.

### Detailed Data with Statistical Notes on the Experiments.

The manurial experiments with the conclusions drawn are already discussed in chapter III. This chapter contains all the details of the experiments such as the lay-out, replications, size of plots, figures for outturns, net profits, significance for each of the experiments with statistical notes. The tables for prices of farm products and manures used as also those for rainfall are attached at the end of the details of the experiments for each farm.

The procedure that was adopted in analysing the data of each experiment was as follows: The first point noted in each experiment was whether all the necessary details such as size of plots, number of replications, details of treatments, etc., have been included correctly. If they were not, an attempt was made to ascertain them as far as possible. Next the plot yields were tabulated and examined to see whether there were any obvious inconsistencies or abnormalities in them. If there were, an explanation was sought from those who were in the know of those things and was noted. If the method of statistical analysis to ascertain the error significance necessitated it, such vitiated data were omitted. Then the remaining data were tabulated and the average plot yield for each treatment was determined. Next, one of the four methods given in the appendix was resorted to, to ascertain the significance in the difference due to treatments. In all cases the figure called "significance" has been taken to be the difference between two treatment means that can denote a definite superiority of one over the other. In short, if two means differ by an amount greater than this figure then there is a difference between the two treatments and if not, the two treatments were considered equal. The various treatments were compared in the light of this figure and conclusions are put down at the end of each experiment. Whenever the figures for net profits were available they have been included and a further examination as to the economic utility of the treatments has been made and the results of such investigations are noted. The lay-out of the plots is indicated for each experiment. The plans of the lay-out are also given for important experiments.

For single plot experiments of secondary nature, where they have been conducted for a few years, say for two or three, the average yields for treatments are found out and those have been compared from the commonsense point of view and the conclusions, which are of course not so reliable as those drawn from replicated experiments, have been noted. Whenever results were not consistent, it has been pointed out that no definite conclusions can be drawn and that the problem needs further investigations.

In the details of the experiments the particular statistical method used for calculation of significance, etc., of each experiment is indicated

by a number, while the explanation and details of each of the methods are given in the appendix.

F. Y. M. = Farm Yard Manure.

p/p = per plot.

#### ALIBAG FARM I.

To ascertain the effects of *Karanj* leaves, with and without bone-meal, as manure for rice.

Plots—4 gunthas each.

Lay-out—Duplicated.

Method—IV.

Treatments—(1) No manure.

(2) 400 pounds *Karanj* leaves per acre.

(3) 400 pounds *Karanj* leaves plus 46 lbs. bone-meal per acre.

#### Grain yields in lbs. per plot.

Treatments.	1915		1916		Average.
	A	B	A	B	
1 .. .. .	220	221	215	230	221.50
2 .. .. .	250	246	248	225	242.25
3 .. .. .	342	334	281	269	306.50
Average ..	271	267	248	241	257 = G.M.

#### Analysis of variance.

Kind of variation.	D	Sum of squares.	Mean square or variance.
Between treatments .. .. .	2	15,711.50	7,855.8
Between blocks .. .. .	3	1,838.70	613.0
Random Variation .. .. .	6	2,756.00	459.0

Standard Error of experiment is  $\sqrt{459} = 21.43$  and S. D.  $\frac{\sqrt{2}}{\sqrt{4}}$

= 15.15.

Value of "t" when P = 0.05, degrees of freedom = 6. is 2.447 and hence  $2.447 \times 15 = 36.6$ .

Hence a difference of 36.6 and above in the averages of treatments is significant. Judging on this we see that the 3rd treatment is significantly better over the first two, which must be regarded as more or less equal.

*Grain yields in lbs. per plot.*

Treatments.	1917		1918		1919		Average.
1 ..	186	162	179	139	261	165	182
2 ..	217	197	240	165	232	199	206
3 ..	286	299	236	164	311	308	267 method IV
Average ..	230	219	218	156	268	224	219 = G. Mean.

Kind of variance.	Degrees of freedom.	Sum of squares.	Variance.
Between treatments ..	2	22,764	11,382
Within treatments ..	15	29,108	1,941
Between blocks ..	5	19,656	3,931
Random variance ..	10	9,452	945

$$\text{Standard Error of the Experiments} = \sqrt{\frac{945}{4}} = 30.73 \text{ S. D. } \frac{\sqrt{2}}{\sqrt{4}}$$

$$= 17.73.$$

Value of "t" when  $P = 0.05$  and degrees of freedom 10, is 2.28 and  $17.75 \times 2.28 = 39.6$ .

Hence a difference of 39.6 and above in the means of treatments is significant which again confirms the conclusion that only the third treatment is conspicuously better over the first two.

ALIBAG FARM II.

*To ascertain the effects of fish manure (20 lbs. per acre) over no manure on Rice crop.*

*Plots*—Four gunthas ordinarily, but some times 3 or 4.5 gunthas. But yields are calculated to 4 gunthas.

*Lay-out*—Duplicated.

*Method*—II.

In spite of the high variation in the results of duplicate plots, the experiment yields a fair conclusion.

Years.	Grain yields in lbs. per plot.		Net profits in Rupees per plot.	
	No manure.	Fish.	No manure.	Fish.
1911 .. ..	196	254	3.84	5.12
1912 .. ..	193	282	2.95	4.20
	393	336	6.37	5.70
1913 .. ..	161	212	1.55	1.97
	200	250	3.06	3.52
1914 .. ..	258	303	3.45	3.56
	149	241	1.00	2.57
Average ..	221	268	3.17	3.81

The above were treated as 7 simultaneous replications and the standard error was found as given in—"Engledow and Yule's", page 15. The value of  $\sigma_d$  was found to be 48.18 and  $E_d = 18.2$ . The difference between the means being 47 which is more than twice the standard error, we can say that the fish manure treatment is significantly better than the no-manure treatment.

### ALIBAG FARM III.

To ascertain the effect of increasing doses of Nitrogen on rice crop.

Plots—4 gunthas each.

Lay-out—Duplicated.

Treatments—(1) Fish manure = 20 lbs. N per acre.

(2) Fish manure = 30 lbs. N per acre.

(3) Fish manure = 40 lbs. N per acre.

Year.	20 lbs. N.	30 lbs. N.	40 lbs. N.	Average.	
1915 .. ..	205	249	269	241	Method III was employed in investigating these results. $\sigma_d = 18.91$ $E_d = \frac{18.91}{\sqrt{6}}$
1915 .. ..	245	257	257	253	
1916 .. ..	256	263	248	256	
1916 .. ..	230	231	263	241	
1917 .. ..	207	243	239	230	
1917 .. ..	229	239	233	234	
Average ..	229	247	252	242	



Now the difference between the means of 1st and 2nd treatments is nearly 18 which is about 2.4 times the standard error. Hence we may say that it is significantly better though slightly. But treatment 3 is decidedly significant over 1. But there is no significant difference between 2nd and 3rd treatments.

By taking the average net profits per plot for the three treatments, we have :

	Treatments		
	1	2	3
	20 lbs.	30 lbs.	40 lbs.
Net profits ..	Rs. 1.81	Rs. 1.90	Rs. 1.38

This shows that the application of 40 lbs. of N shows a lesser profit than 30 lbs. and 20 lbs.

#### ALIBAG FARM IV.

To ascertain the effect of the bone-meal (20 lbs. N per acre) as a manure for rice crop.

Plots—4 gunthas each.

Lay-out—Duplicated.

Year.	Grain yields in lbs. per plot.		Net profits in Rupees per plot.	
	No manure.	Bone-meal.	No manure.	Bone-meal.
1913 .. ..	249	263	4.37	2.72
	187	227	2.11	1.87
1914 .. ..	240	286	3.82	3.31
	241	171	4.37	2.71
1915 .. ..	256	298	6.98	6.37
	225	288	5.40	5.68
1916 .. ..	230	276	2.13	0.79
	226	265	1.61	0.16
1917 .. ..	229	257	2.24	0.75
	194	252	1.56	0.34
1918 .. ..	256	270	4.85	2.73
	232	278	3.78	3.43
Average ..	230	269	3.60	2.587

Using method II we get the squares of differences of deviations together equal to 2,546. Hence  $\sigma d = \sqrt{\frac{2546}{12}} = 14.56$

$$E_d = 14.56 = 4.2.$$

$$\sqrt{12}$$

The difference between the means of the treatments = 39 which is more than 9 times the above error. Hence there is a decidedly positive significance of the treatment. But the average net profits in the no-manure plots is Rs. 3.6 per plot whereas in the manured plots it amounts to Rs. 2.57 per plot, which shows that though the treatment may give positive y higher yields, it is not economically advantageous because the bone-meal is costly.

## ALIBAG FARM V.

To ascertain the effect of 20 lbs. of N per acre in terms of Karanj cake on the rice crop.

Plots—4 gunthas each.

Lay-out—Unreplicated.

Year.	Grain yields in lbs. per plot.		Net profits in Rupees per plot.	
	No-manure.	Karanj.	No-manure.	Karanj cake.
1911	195	231	3.84	4.07
1913	190	227	2.38	3.03
1914	268	307	4.39	4.65
1915	283	335	7.70	8.75
1916	247	275	2.87	3.02
1917	236	275	3.03	2.44
1918	264	292	4.93	5.15
Average	240	273	4.16	4.52

By manipulating this by method II

The sum of the squares of the differences in deviations = 1,161

$$\therefore \sigma_d^2 = \frac{1161}{7} \text{ and } \sigma_d = 12.88$$

$$\therefore E_d = \frac{12.88}{\sqrt{7}} = \frac{12.88}{2.65} = 4.86$$

The difference between the two means (273 -- 240) = 33 which is nearly 7 times the standard error and hence the treatment is positively significant.

The average net profits per plot in the no-manure treatment is Rs. 16 and that for the Karanj cake treatment is 4.52 which also favour the above conclusion.

## ALIBAG FARM VI.

To compare the effects of sulphate of ammonia, superphosphate and their combination on rice crop.

Plots—Four gunthas each.

Lay-out—Unreplicated.

Method—III.

Treatments—(1) No manure.

(2) Sulphate of ammonia, 112 lbs. per acre.

(3) Superphosphate 112 lbs. per acre.

(4) Sulphate of ammonia plus superphosphate 112 lbs. each per acre.

Grain yields in pounds per plot.

Treatments.	1916	1917	1918	Average.
1 .. ..	225	215	185	208
2 .. ..	259	240	218	239
3 .. ..	239	241	224	235
4 .. ..	290	256	251	267
Average ..	253	238	220	....

$$sd = 10.31 \text{ and } E_d = \frac{10.3}{\sqrt{3}} = 6.0$$

Hence the significance is equal to  $6.0 \times 2.1 = 12.2$ .

Comparing the means of treatments with the help of this number we see that treatment 2 is positively significant over 1. There is practically no difference between 2 and 3 and that treatment 4 is the best so far as the yields are concerned.

The net profits per plot for the treatments are—

	Rs.
1 .. ..	1.41
2 .. ..	0.99
3 .. ..	2.05
4 .. ..	0.99

From these we see that, though there is no difference statistically between treatments 2 and 3, economically there is a positive difference. Also treatment 4 which is seen to be the best above is no good from the financial point of view. Hence treatment 3 may be favoured both ways.

## ALIBAG FARM VII.

To ascertain the effect of various kinds of manure on the rice crop.

Plots—Four gunthas each.

Lay-out—Unreplicated.

Treatments—(1) No manure.

(2) *Mohua* refuse 90 lbs. per acre.

(3) Rice husk 500 lbs. per acre.

(4) Urine earth 741 lbs. per acre.

(5) Poudrette 222 lbs. per acre.

Grain yields in pounds per plot.

Treatments.	1913	1914	1915	Average.
1 .. .. .	192	200	159	184
2 .. .. .	210	199	278	231
3 .. .. .	185	196	232	204
4 .. .. .	170	185	166	174
5 .. .. .	183	199	243	208
Average ..	189	196	216	.....

By treating this with method III we have the standard error for comparison between two means =  $18.9 \times 2.1 = 39.7$ . Hence any difference more than this can show us the significance of the treatment. Examining the means in this light we can say nothing except that treatment 2 is positively significant over 1 and 4.

Taking the average net profits per plot for the years concerned we have—

	Rs.
1 .. .. .	3.05
2 .. .. .	2.93
3 .. .. .	2.31
4 .. .. .	1.37

which again shows that none of the treated plots give a net profit more than what is given by the non-treated plot.

## ALIBAG FARM.

*Rates of manures in lbs. per rupee.*

	1911	1912	1913	1914	1915	1916	1917	1918	1919
Fish-manure ..	80	20	24	22	16	14	14	28	28
Karanj-leaves ..	56	56	50	56	46	48	48	46	46
Bone-meal ..	21	24	24	24	17	16	16	16	16
Sulphate of Ammonia ..	8·0	8·0	8·0	8·0	6·0	6·0	6·0	6·0	6·0
Superphosphate ..	..	..	..	15	14	14	14	14	14
Maha refuse ..	163·5	163·0	163·0	163·0	163·0	..	..	..	..
Nitre ..	5·3	5·3	..	..	..	..	..	4·0	4·0
Cow-dung ..	1,000	..	..	..	..	..	..	..	..
Crine earth ..	750	750	750	750	750	..	..	..	..
Rice husk ..	..	880	880	880	880	500	500	400	400
Sheep folding ..	200	..	..	..	..	..	..	..	50
Poudrette ..	..	800	800	800	800	800	800	800	800

## ALIBAG FARM.

*Rice—Bhadra Variety.*

Year.	Cost of cultivation per acre in Rupees.	Prices of grain and straw. lbs. per Rupee.
1911 .. ..	32·0	33   133
1912 .. ..	35·0	36   150
1913 .. ..	45·0	36   150
1914 .. ..	45·0	40   150
1915 .. ..	36·0	30   140
1916 .. ..	68·0	32   140
1917 .. ..	73·0	30   120
1918 .. ..	88·0	24   100
1919 .. ..	92·0	22   100

## AMALSAD FARM I.

To compare the effects of local manuring, with and without an addition of 100 lbs. N as a mixture of castor cake and sulphate of ammonia half and half.

Crop—Sugarcane.

Lay-out—Unreplicated.

Manuring—Local manuring is equal to 20 carts F. Y. M. plus san-green.

Grown by Manjri method.

Year.	Manjav Variety.	
	Yields in lbs. of <i>gut</i> per acre.	
	Local.	Local plus 100 lbs. N.
1920-21	6,630	4,288
1921-22	5,008	7,072
1922-23	6,201	7,877
1923-24	3,143	6,275
1924-25	7,000	7,080
1925-26	4,044	5,920
1926-27	4,700	5,820
1927-28	5,571	7,672
1928-29	5,023	3,495
Average	5,258	6,166
Average net profits per acre in rupees	282.2	277.6
	<i>Stripped Mauritius variety.</i>	
1920-21	11,390	8,949
1921-22	5,976	7,456
1922-23	Used as seed.	Used as seed.
1923-24	2,208	4,592
1924-25	4,262	7,572
1925-26	4,440	4,815
1926-27	Sold as seed.	2,525
1927-28	4,607	8,058
1928-29	4,021	5,912
Average	5,272	6,235
Average net profit in rupees	256.4	225.6

For the Manjav variety though the addition of 100 lbs. N gives a slightly higher yield, this advantage is nullified by the cost of addition and we get more or less equal net profits for both treatments.

For Stripped Mauritius variety the addition shows a distinct economical disadvantage though the yield is higher because the Local method alone gives a net profit of about 14 per cent. more than what the other treatment gives.

### AMALSAD FARM II.

To compare the effect of local manuring (20 carts F.Y.M. and then sangreen), with and without 100 lbs. N per acre half as sulphate of ammonia and half as castor cake.

Crop—Sugarcane : " Malbari " variety.

Plots—Varied from 7 to 10 gunthas each.

Lay-out—Unreplicated.

Year.	Yields of <i>gul</i> per acre in lbs. Treatments.	
	Local.	Local plus 100 lbs. N.
1920-21 .. .. .	5,063	6,660
1921-22 .. .. .	5,000	5,720
1922-23 .. .. .	5,493	6,933
1923-24 .. .. .	2,380	3,290
1924-25 .. .. .	5,866	6,520
Average ..	4,860	5,824.6
Average net profit in rupees ..	114.0	165.8

The addition of the nitrogen seems to give a distinctly higher yield and a corresponding better net profit than the local method alone.

### AMALSAD FARM III.

To compare the effects of local manuring (20 carts F.Y.M. and then sangreen), with and without 100 lbs. N half as sulphate of ammonia and half as castor cake.

Lay-out—Unreplicated.

Crop—Sugarcane : (1) Malbari and  
(2) Red sports.

*Grown by Manjri method.*

Years.	(1) Malbari variety.		(2) Red sports variety.	
	Local manuring.	Local manuring plus 100 lbs. N.	Local	Local plus 100 lbs. N.
1920-21 .. ..	6,228	8,340		
1921-22 .. ..	5,080	7,048		
1922-23 .. ..	Whole cane sold for seed.			
1923-24 .. ..	3,800	4,800		
1924-25 .. ..	7,176	7,272	7,702	10,115
1925-26 .. ..	4,696	4,080	Used as seed.	
1926-27 .. ..	5,020	5,670	2,347 plus cane sold.	3,371 plus cane sold.
1927-28 .. ..	3,480	4,785	8,342	10,179
1928-29 .. ..	2,256	2,424	8,696	9,304
1929-30 .. ..	Not grown.		5,974	6,907
Average ..	4,717	5,552	7,679	9,126
Average net profit in rupees ..	154	150	317·3	316·7

*Note.*—In calculating averages the yield results of those years when cane was sold for seeds (partially or wholly) are neglected. But in finding the net profits the results of those years are taken into consideration.

For both the varieties, both treatments show the same net profits in spite of the fact that the addition of N gives a higher yield.

## ARBHAVI FARM I.

To compare the effects of (1) Poudrette 20,000 lbs., (2) F.Y.M. 20,000 lbs., (3) Sheep-dung equivalent to 20,000 lbs. of F.Y.M. in price, on sugarcane.

Variety—"Pundya".

Plots—4 gunthas each.

Lay-out—Duplicated.

Method—III.

Manuring—No previous green manure nor any top-dressing.

Year 1910-11.

Treatments.	Gul yields in lbs. per plot.		Average.	Average net profits per plot in Rs.
	I	II		
1 .. ..	835	902	869	31·0
2 .. ..	722	776	749	21·9
3 .. ..	664	721	693	18·1
Standard error ..	= 4·16		Significance	= 6·24



The error is very small and hence the differences between the treatments as shown by the average yields are quite significant. According to this Poudrette stands first, F.Y.M. comes next and last of all sheep-dung. The difference between the Poudrette and F.Y.M. is more than twice the difference between F.Y.M. and sheep-dung. The same order of efficiency is shown in the same degree even in their net profits by the treatments.

### ARBHAVI FARM II.

To ascertain the comparative effects of using (1) Poudrette, (2) Trash, (3) F.Y.M., all 20,000 lbs. per acre as basic manure, with a common top-dressing of 150 lbs. N as safflower cake, excepting the year 1917-18 when 30 lbs. N was applied as sulphate of ammonia and the remaining as safflower cake.

Crop—Sugarcane : "Pundya" variety.

Plots—5 gunthas.

Lay-out—Unreplicated.

Rotation—Cane, Maize or Chillies.

Treatments.	Gul yields in lbs. per plot.				Average.	Average net profits per plot in Rs.
	1915	1916	1917	1919		
1 .. ..	1,182	1,008	1,158	1,120	1,117	49·10
2 .. ..	747	891	936	754	832	27·90
3 .. ..	860	1,183	1,175	786	1,001	36·50

Both in yields and net-profits the treatments stand in the same order of importance, Poudrette gives the best results throughout. Next comes F.Y.M. and lastly trash.

### ARBHAVI FARM III.

To compare the effects of different top-dressings with common basic manure as follows.

Crop—Sugarcane : "Pundya" variety.

Treatments per acre—Basic : F.Y.M. 20,000 lbs.

Top-dressing—(1) Nil.

(2) Fish manure 150 lbs. N.

(3) Safflower cake 150 lbs. N.

(4) Safflower cake 75 lbs. N plus sulphate of ammonia 75 lbs. N.

(5) Sulphate of ammonia 150 lbs. N.

(6) Sulphate of ammonia 150 lbs. N. plus.

Sulphate of potash 150 lbs.  $K_2O$

Plots—4 gunthas each.

Lay-out—Duplicated.

Method—III.

Treatments.	1910-11.			1911-12.		
	Gul yields lbs. per plot.		Average.	Gul yields lbs. per plot.		Average.
1 ..	722	776	749	607	418	513
2 ..	856	933	895	686	664	675
3 ..	908	949	929	739	629	684
4 ..	817	765	791	649	716	683
5 ..	791	926	859	677	686	682
6 ..	865	749	807	698	522	610
Significance ..	96.8			110.6		

Treatments.	1912-13.		1913-14.			
1 ..	267	161	214	362	249	306
2 ..	467	268	369	..	..	..
3 ..	638	399	519	523	402	463
4 ..	620	333	477	448	419	434
5 ..	553	314	434	322	348	335
6 ..	555	350	453	450	174	312
Significance ..	66.4		119.0			
Treatments ..	1	2	3	4	5	6
Average net profits in rupees per plot.	9.0	12.7	17.0	12.7	10.4	3.6

In the first year treatments 2 and 3 stand best in yields. Next come 5, 4 and 6, and 1 in their order of merit. In the second year treatments 2, 3, 4 and 5 yield more or less equal amounts. Though treatment 6 yields a little lower, yet the difference is not significant. But all the treatments except 6 are significant over 1. In the third year treatments 3 and 4 stand out best. Next to these come 5 and 6. Treatment 2 comes in the third rank and lastly comes treatment 1. In the last year treatments 3 and 4 stand best, the other treatments are equal among themselves because they vary only slightly.

Summing up, treatment 3 has been giving the best yield in all the years throughout. Sometimes it is followed by 4 and occasionally by treatment 2. Treatment 5 has given good yields in two years and very low yields in the other two years. Treatment 6 has been giving low yields amongst the top-dressed treatments, mostly differing from the non-top-dressed treatment by less than the significance figure.

Considering the net profits also we see that the treatments assume the same order of importance as for the yields. Treatment 3 with safflower cake for top-dressing (150 lbs. N) gives the highest net profit. Hence that seems to be the best top-dressing amongst those that were compared. Next come, fish manure, and a combination of safflower and sulphate of ammonia. The other two top-dressings may be ignored as giving low yields and low net profits.

## ARBHAVI FARM IV.

To compare the effects of the following treatments :—

- (1) Basic manure 40,000 lbs., F.Y.M. plus 4,000 to 7,000 sheep folded for one night on one acre plus previous san-green. (Local method.)
- (2) Basic manure 40,000 lbs. F.Y.M. with a top-dressing of mill-pressed safflower cake equal to 150 lbs. N.
- (3) Basic manure 40,000 lbs. F.Y.M. with a top-dressing of safflower cake 75 lbs. N plus sulphate of ammonia 75 lbs. N.

Crop—Sugarcane : "Pundya" variety.

Plots—4 gunthas each.

Lay-out—Duplicated.

Rotation—Cane, cotton, san.

Treatments.	1915-16.			1916-17.			1917-18.		
	Gul yields.		Average.	Gul yields.		Average.	Gul yields.		Average.
	I	II		I	II		I	II	
1 .. ..	725	457	591	616	799	539	961	867	914
2 .. ..	854	618	736	461	909	854	1,319	..	1,319
3 .. ..	919	637	778	768	924	846	1,211	..	1,211
Significance..			25.0		178.0				

Treatments.	1918-19.			1919-20.			Average net profits for all years in Rs. per plot.
1 .. ..	948	982	965	620	636	628	30.9
2 .. ..	949	895	922	834	844	839	41.4
3 .. ..	1,018	936	977	852	861	857	39.8
Significance..		64.2			4.32		

The figures were manipulated by method III. Both in yields as well as net profits treatment 2 has stood well. Though in three years out of 5, treatment 3 has given slightly better yields than 2, its net profit is slightly below that of 2. This makes it inferior to 2.

#### ARBHAVI FARM V.

To ascertain the effect of substituting "country Ghani" safflower cake for "mill pressed" safflower cake in top-dressing manuring per acre.

Basic manure *san-green* F.Y.M. and sheep-folding together with a top-dressing of—

- (1) Nil.
- (2) Mill pressed safflower cake 75 lbs. N plus sulphate of ammonia 75 lbs. N.
- (3) Country "ghani" safflower cake 75 lbs. N plus sulphate of ammonia 75 lbs. N.

Crop—Sugarcane : "Pundya" variety.

Plots—4 gunthas each.

Lay-out—Duplicated except year 1917-18.

Method—III.

Rotation—Cane, cotton, *san*.

Treatments.	1915-16.		1916-17.		1917-18.		Average net profits per plot.	
	Gul yields in lbs. per plot.	Average.	Gul yields in lbs. per plot.	Average.	Gul yield.			
1 .. .. .	725	458	592	616	461	539	961	Rs. 12.4
2 .. .. .	828	763	796	768	924	846	1,211	22.1
3 .. .. .	919	837	778	905	826	866	1,306	23.8
Significance..			128.2			171.9		

As the error is very high, there is no significant difference between the two top-dressed treatments, but the effect of the top-dressing over the no-manure treatment is quite significant in both the years. The net profits show that treatment 3 may prove more profitable than 2.

#### ARBHAVI FARM VI.

To compare the effects of top-dressing with 150 lbs. N as follows :—

- (1) Nil—top-dressing.
- (2) Groundnut cake 150 lbs. N.
- (3) Groundnut cake 75 lbs. N plus sulphate of ammonia 75 lbs. N.

The Basic manure being 40,000 lbs. F.Y.M. plus 4,000 to 7,000 sheep-folded for one night plus previous san-green per acre.

Crop—Sugarcane : "Pundya" variety.

Plots—4 gunthas each.

Lay-out—Duplicated.

Rotation—Cane, cotton, san.

Treatments.	1917-18.			1918-19.			1919-20.		
	Gul yields.		Average.	Gul yields.		Average.	Gul yields.		Average.
	I	II		I	II		I	II	
1 .. ..	961	868	915	948	982	965	620	636	628
2 .. ..	1,298	..	1,298	1,041	978	1,010	808	895	852
3 .. ..	1,222	889	1,056	990	1,046	1,018	642	858	750
Significance ..					66.9			107.5	

The figures were treated by Method III.

Treatments	1	2	3
Average net profits per plot Rs.	46.5	64.7	49.9

The effects of top-dressing are significant in the years 1917-18 and 1919-20. Between the two top-dressings that with groundnut cake alone seems to give uniformly a better yield and a higher net profit than the mixture.

#### ARBHAVI FARM VII.

To compare the effects of (1) Ammophos—grade 20/20 and (2) Groundnut cake, each equivalent to 150 lbs. N per acre, as top-dressing with a basic manure of 10,000 lbs. Poudrette plus 10,000 "Pig-manure".

Crop—Sugarcane : "Pundya" variety.

Plots—5 gunthas each.

Lay-out—Unreplicated.

Rotation—Jowar, cane.

Treatments.	Year 1924-25.	
	Gul yield in lbs.	Net profit.
Ammophos .. ..	785	Rs. 34
Groundnut cake .. ..	689	26

This may indicate that Ammophos is more advantageous than Groundnut cake in yields as well as profits.

## ARBHAVI FARM VIII.

To compare the effects of top-dressing with 150 lbs. N in various forms as given below, the basic manure being *san green* plus 20,000 lbs. Poudrette per acre.

- Top-dressings :—(1) Groundnut cake 150 lbs. N.  
 (2) Ammophos 150 lbs. N.  
 (3) Sulphate of Ammonia 150 lbs. N.  
 (4) Sulphate of ammonia 75 lbs. N plus Groundnut cake 75 lbs. N.  
 (5) Ammophos 75 lbs. N plus Groundnut cake 75 lbs. N.

Crop—Sugarcane : “Pundya” variety.

Plots—4 gunthas each.

Lay-out—Unreplicated.

Treatments.	Year 1926-27.	
	Gal yields.	Net profit.
		Rs.
1 .. .. .	806	30·6
2 .. .. .	883	31·4
3 .. .. .	788	30·0
4 .. .. .	886	36·8
5 .. .. .	892	35·9

In yielding capacity, treatments 2, 4 and 5 tend to prove equal and 1 and 3 might be slightly below them. But the net profits show that treatments 4 and 5 alone as giving the highest net profits and the rest are economically deficient.

## ARBHAVI FARM. IX.

To compare the effects of the following top-dressings :—

- (1) *Gurhal* ashes 20,000 lbs. plus Groundnut cake 75 lbs. N plus Sulphate of ammonia 75 lbs. N.  
 (2) Groundnut cake 75 lbs. N plus Sulphate of ammonia 75 lbs. N.  
 (3) Ammophos No. 2.—150 lbs. N.  
 (4) Ammophos No. 1.—150 lbs. N all these together with a basic manure of *san-green* and F.Y.M. 20,000 lbs.

Crop—Sugarcane : "Pundya" variety.

Plots—5 gunthas.

Lay-out—Unreplicated.

Rotation—San, Sugarcane.

Treatments.	Year 1927-28.	
	Gul yields in lbs. per plot.	Net profit in Rs. per plot.
1 .. .. .	582	7.7
2 .. .. .	718	19.7
3 .. .. .	648	10.6
4 .. .. .	585	0.4

Treatment 2 gives the highest yields followed by treatment 3. Then come treatments 1 and 4 giving equal yields. The net profits also show that the same order is maintained except that treatment 1 gives a higher net profit than 4.

#### ARBHAVI FARM X.

To compare the effects of the following top-dressings :—

(1) A mixture of Safflower and Groundnut cake 75 lbs. N plus Calcium Cyanamide 75 lbs. N.

(2) A mixture of Safflower and Groundnut cake 75 lbs. N plus Sulphate of ammonia 75 lbs. N ;

together with a basic manure of san-green plus 20,000 lbs. of F.Y.M. in 1929-30 and 30,000 lbs. of F.Y.M. alone in 1930-31.

Crop—Sugarcane : "Pundya" variety.

Plots—1 guntha each.

Lay-out—5 replications.

Rotation—San, Sugarcane.

Treatments.	Gul yields in lbs. per plot.					Average.	Significance.
	I	II	III	IV	V		
			Year	1929-30			
1 .. .. .	232	234	210	200	205	216.2	} 18.4
2 .. .. .	267	225	229	250	226	239.4	
			Year	1930-31			
1 .. .. .	293	256	242	220	212	244.6	} 32.3
2 .. .. .	360	306	338	349	244	319.4	

The figures were treated by method II.

The difference between the means of the two treatments is greater than the significance figure for both years. Hence the application of Sulphate of ammonia gives significantly higher yields than Calcium Cyanamide.

### ARBHAVI FARM XI.

To compare the bulky manures for the following crop :—

- |                        |                           |
|------------------------|---------------------------|
| (1) Sheep-dung 5 tons. | (4) Rotted Cactus 5 tons. |
| (2) F.Y.M. 5 tons.     | (5) No manure.            |
| (3) Poudrette 5 tons.  |                           |

All the quantities are given per acre.

Crop—Maize (local variety).

Plots—4 gunthas each.

Lay-out—Duplicated.

Treatments.	1910-11.			1911-12.			Average net profits per plot in Rs.
	Grain yields in lbs. per plot.		Average.	Grain yields in lbs. per plot.		Average.	
	I	II		I	II		
1 .. ..	214	241	228	190	198	194	-0.3
2 .. ..	190	212	201	170	182	186	1.7
3 .. ..	331	702	617	282	264	273	4.9
4 .. ..	202	384	293	144	107	126	1.6
5 .. ..	119	176	148	130	164	146	1.8
Significance ..	157.7			28.3			

The figures were treated by method III.

The use of Poudrette has given the best yield and the highest net profits, for both the years. Hence that stands best. The other treatments 1, 2 and 4 have given more or less equal yields except in the second year where treatment 4 gives low yields. But the net profits show that the use of sheep-dung results in a loss and the use of Farm Yard Manure and Rotted cactus gives the same net profits as the no-manure plot.

### ARBHAVI FARM XII.

To compare the effects of :—

- (1) No manure.
- (2) F.Y.M. 7.5 tons per acre.
- (3) Urine earth 7.5 tons per acre.
- (4) Poudrette 7.5 tons per acre.

Crop—Maize, local variety (irrigated).



Plots—4 gunthas each.

Lay-out—Duplicated.

Rotation—Maize ("kharif") Gram ("rabi").

Treatment.	1913-14.			1915-16.			1916-17.			Average net profit per plot in Rs.
	Grain yields in lbs. per plot.		Average.	Grain yields in lbs. per plot.		Average.	Grain yields in lbs. per plot.		Average.	
	I	II		I	II		I	II		
1 ..	122	85	104	136	96	116	134	81	108	0.1
2 ..	186	202	194	226	186	206	175	190	183	0.7
3 ..	135	152	144	175	175	175	..	..	..	0.2
4 ..	314	284	274	322	315	319	303	354	329	3.9
Significance ..	48.6			22.5			56.0			

The figures were treated by method III.

Poudrette has given the highest average yield as well as the highest net-profits throughout. Farm Yard Manure may be taken as the next; though it gives good yields the profit is very small. The profits derived by the use of Urine earth are quite as negligible as those of the no-manure plot.

#### ARBHAVI FARM XIII.

To ascertain the comparative effects of the following green manures in the kharif season with a fallow before rabi maize:—

- (1) Niger
- (2) San
- (3) Kulthi with the
- (4) fallow.

Crop—Maize, local variety.

Plots—4 gunthas each.

Lay-out—Duplicated.

Treatment.	1910-11.			1911-12.			1913-14.		
	Grain yields in lbs. per plot.		Average.	Grain yields in lbs. per plot.		Average.	Grain yields in lbs. per plot.		Average.
	I	II		I	II		I	II	
1 ..	80	72	76	85	53	69	48	43	46
2 ..	124	150	137	113	109	111	180	150	165
3 ..	121	136	129	124	125	125	100	125	113
4 ..	99	102	101	149	147	148	100	125	113
Significance ..	16.6			17.3			29.9		

Treatment.	1914-15.			Average net profit per plot for all the four years.
	I	II	Average.	
				Rs.
1 .. .. .	57	52	55	-(2.0)
2 .. .. .	114	141	128	-(0.1)
3 .. .. .	35	105	70	-(0.2)
4 .. .. .	41	58	50	+(0.6)
Significance ..		35.5		

The figures were treated by method III.

It is seen that the yielding capacity of *San* stands better than the others in three years out of four. *Kulthi* falls below fallow in this respect whereas Niger has done, very badly in all the years. Only fallow has given a small net profit whereas all the manures have given losses, that due to Niger being the highest loss.

#### ARBHAVI FARM XIV.

To ascertain the effects of increasing the dose of F.Y.M. :—

(1) 5 tons,

(2) 7.5 tons,

(3) 10 tons,

all quantities per acre.

Crop—Maize, local variety.

Plots—12 gunthas each.

Lay-out—Unreplicated.

Treatments.	Grain yields in lbs. per plot.			Average.	Average net profit per plot in Rs.
	1928-29.	1929-30.	1930-31.		
1 .. .. .	1,028	1,179	660	956	12.4
2 .. .. .	1,077	1,162	713	984	9.9
3 .. .. .	1,100	1,176	881	1,052	6.9

The yields increased with the increasing doses of Farm Yard Manure but not sufficient enough to meet the increasing cost of the treatment. Hence the decreasing net-profits show that increasing Farm Yard Manure over five tons per acre is not profitable.

## ARBHAVI FARM XV.

To compare the effects of the following two treatments per acre on the above crop :—

(1) F.Y.M. 7·5 tons.

(2) F.Y.M. 5 tons plus groundnut cake 40 lbs. N. as top-dressing.

Crop—Maize, local variety.

Plots—4 gunthas.

Lay-out—Duplicated in 1919–20 and unreplicated in other years.

Rotation—Maize (*kharif*), Beans (*rabi*).

Treatments.	1919-20.		Average.	Grain yields in lbs. per plot.			Average net profit per plot in Rs.
	Grain yields in lbs. per plot.			1920.	1921.	1922-23.	
	I	II					
1 .. .. .	290	340	315	319	346	294	9·5
2 .. .. .	386	288	337	356	387	302	8·8
Significance ..		30·2					

*Method—II.*

Though the top-dressing has the effect of increasing the yields slightly in all the cases its cost reduces the net-profit making thereby 7·5 tons F.Y.M. alone preferable.

## ARBHAVI FARM XVI.

To ascertain the effects of Calcium cyanamide as a manure for cotton.

Crop—Cotton 'D<sub>1</sub> × R'.

Plots—20 gunthas.

Lay-out—Unreplicated.

Previous crop—Sugarcane.

Treatment.	Year 1927-28.	
	Seed-cotton yields in lbs. per plot.	Net profit per plot in Rs.
Calcium Cyanamide .. .. .	129	—(17·5)
No manure .. .. .	190	—(4·5)

Though this experiment can give us no reliable results yet the difference between the yields of the treated and untreated plots is high enough to show that there is a disadvantage in using Calcium-cyanamide. The plots give losses in both cases, Cyanamide giving the greater loss.

## ARBHAVI FARM XVII.

With 2.5 tons of F.Y.M. as basic manure to compare the effects of 28 lbs. N added in various forms as follows :—

- (1) Nil. (3) Calcium Cyanamide.  
 (2) Nitrate of Soda. (4) Ammophos.

Crop—Cotton 'D<sub>1</sub> × R' variety.

Plots—1 guntha each.

Lay-out—5 replications randomised.

Method—IV.

Rotations—Maize or tur, cotton.

## Seed-cotton yields in lbs. per plot.

Treatments.	Plot yields, in lbs.					Average.	Kind of Variation.	Analysis of Variance.			$\frac{1}{2} \log_e V$
	I	II	III	IV	V			D	Sum of squares.	Variance.	
							Year 1929-30				
1	18	17	14	14	8	14	Treatment.	3	43.35	14.45	1.834
2	18	20	22	17	11	18	Blocks ..	4	154.25	38.56	
3	18	14	23	18	13	17	Error ..	12	79.35	6.61	0.943
4	17	17	13	17	10	15					
	The 5 per cent.					point of	$z$ for $n_1 = 3$ , and $n_2 = 12$ is	0.6250.			
							Year 1930-31				
1	38	24	26	17	24	26	Treatments	3	28.2	9.4	No significance due to treatments.
2	33	30	27	24	28	28	Blocks ..	4	261.5	65.4	
3	33	31	29	24	27	29	} Error ..	12	127.3	10.6	
4	27	30	26	21	31	27					

		Treatment			
		1	2	3	4
Net profits per plot in Rs.	1929 ..	—(1.0)	—(1.1)	—(1.1)	—(1.5)
	1930 ..	0.24	0.18	0.28	—(0.06)

In the first year the difference between the figures of the last column shows that there is no significance due to the treatments. In the second year the same is made evident because the Variance due to treatments is smaller than the variance due to Error. Hence we can safely conclude that the artificial manures have equal yielding capacities not differing much from treatment 1. The net profits also go to show that there is not much difference between the treatments.

## ARBHAVI FARM XVIII.

To compare the effects of the various artificial manures applied equivalent to 28 lbs. N. per acre without any basic manure :—

- (1) No manure. (3) Calcium Cyanamide.  
 (2) Nitrate of Soda. (4) Ammophos.

Crop—Cotton 'D<sub>1</sub> × R' variety.

Plots.—1 guntha each.

Lay-out—5 replications.

Method—IV.

*Yields of Seed-cotton in lbs. per plot.*

	1929-30						1930-31					
	Plot yields					Average.	Plot yields					Average.
	I	II	III	IV	V		I	II	III	IV	V	
1 ...	26	37	34	28	34	32	44	45	27	44	37	39
2 ...	29	38	37	36	40	36	46	35	26	30	35	34
3 ...	19	36	36	34	27	30	33	43	35	25	24	32
4 ...	34	27	23	29	31	29	46	38	21	23	31	32

*Analysis of Variance.*

Kind of Variation.	1929-30				1930-31			
	D.	Sum of square	V	$\frac{1}{2} \log_e V$	Sum of square	V	$\frac{1}{2} \log_e V$	
Treatments	3	143.0	47.70	1.930	187.6	62.53	2.066	
Blocks	4	129.0	32.25	1.735	676.8	169.20	2.543	
Errors	12	311.8	25.98	1.627	460.5	38.38	1.822	

The 5 per cent. point of  $z$  for  $n_1 = 3$  and  $n_2 = 12$  is seen to be 0.6250. As the figures in the last column for treatments and errors differ by less than this in both the years there is no significant effect due to the various treatments.

		Treatments			
		1	2	3	4
Net profits per plot in rupees.	1929-30 ..	0.9	0.6	0.3	-(0.3)
	1930-31 ..	1.7	0.8	0.7	0.4

It is quite probable that the no-manure treatment gives the highest net profits. But among the artificials themselves there is not much difference except that Ammophos gives a loss in one year.

## ARBHAVI FARM XIX.

To compare the effects of:—

(1) F.Y.M. 7 tons per acre.

(2) F.Y.M. 5 tons plus cake 40 lbs N. (top dressing).

Crop—Chillies.

Plots—5 to 10 gunthas each. But yields reduced to 8 guntha plots.

Lay-out—Unreplicated.

Previous crop—Sugarcane.

Treatment.	Yields in lbs. per plot.			Average.	Average net profit per plot in rupees.
	1920-21	1921-22	1922-23		
1	259	189	127	192	—(3.3)
2	359	189	128	225	—(4.3)

The results are too meagre to draw any conclusions from.

Fortnightly rain-fall statement on the Gokak Canal Farm from 1909-10 to 1930-31.

Month.	April		May		June		July		August		September.		
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	
Year.													
1909-10	..	..	1.0	0.50	2.86	0.9	1.52	0.75	0.28	4.1	1.47	2.67	
1910-11	..	..	0.40	1.1	1.10	0.94	0.66	3.14	1.43	5.56	2.26	5.23	
1911-12	..	0.5	1.40	2.40	2.10	2.10	2.55	0.3	0.60	0.90	0.30	0.65	
1912-13	..	0.45	0.80	1.6	0.22	2.19	0.28	0.5	7.29	1.34	1.0	0.12	7.30
1913-14	..	0.14	0.10	..	1.97	2.59	0.47	0.24	1.30	0.37	0.29	..	4.97
1914-15	..	..	3.79	1.70	0.8	0.24	0.39	0.16	7.27	9.90	0.32	0.51	3.43
1915-16	..	0.46	0.81	0.66	0.78	1.6	3.73	0.62	3.90	0.47	0.31	0.81	6.72
1916-17	..	1.83	0.5	0.94	3.81	2.4	0.48	2.76	6.76	1.29	0.15	6.16	0.44
1917-18	..	..	0.39	..	..	4.71	0.25	..	0.40	0.77	2.81	0.88	2.22
1918-19	..	..	0.98	0.56	5.2	1.55	0.25	0.16	0.10	0.46	0.65	0.19	2.54
1919-20	..	0.20	0.20	1.79	0.90	3.83	0.47	0.84	1.16	0.42	0.27	3.84	5.79
1920-21	..	..	0.95	..	0.48	1.59	0.18	2.34	0.52	0.23	0.67	4.27	2.39
1921-22	..	0.26	0.33	1.67	..	0.26	0.94	2.52	2.41	0.34	0.17	0.44	0.24
1922-23	..	0.33	1.20	..	1.20	0.25	0.72	0.70	2.14	0.3	1.37	..	0.14
1923-24	..	1.33	..	..	1.87	0.55	..	5.9	1.66	0.58	0.34	..	1.58
1924-25	..	1.60	1.5	..	0.84	1.67	1.47	1.45	0.38	0.39	3.77	..	5.69
1925-26	..	1.40	0.2	2.40	..	0.68	0.99	2.53	0.83	0.9	0.82	0.7	3.13
1926-27	..	0.36	..	1.51	0.24	2.87	2.16	1.91	0.14	1.70	1.9	2.44	3.34
1927-28	..	..	0.29	..	0.87	0.25	1.86	0.47	2.79	1.17	0.26	2.10	5.18
1928-29	..	2.13	0.16	..	0.86	3.20	0.3	0.30	1.50	0.37	1.10	5.35	3.26
1929-30	..	0.42	1.7	0.91	..	0.17	1.49	0.39	0.62	0.13	..	0.34	6.42
1930-31	..	..	..	2.2	0.41	2.58	1.18	0.35	0.10	0.57	0.21	3.89	2.29

Month.	October		November		December		January		February		March		Total Inches cents.
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	
Year.													
1909-10	3.98	..	..	..	..	..	..	..	..	..	..	..	19.8
1910-11	0.69	6.40	1.66	..	..	..	..	..	..	..	..	0.10	30.58
1911-12	4.25	0.30	..	0.15	1.50	..	..	..	..	..	..	..	19.28
1912-13	3.90	2.11	..	1.30	..	..	..	..	..	..	..	..	29.41
1913-14	2.77	..	..	..	..	..	..	..	..	..	..	..	15.21
1914-15	1.6	..	2.48	..	0.84	..	..	..	..	..	..	..	32.17
1915-16	0.4	4.50	2.59	..	..	0.44	..	..	..	..	..	..	27.80
1916-17	1.90	9.2	12.93	0.22	..	..	..	..	0.52	..	..	0.26	51.56
1917-18	3.9	2.74	..	2.99	..	..	..	0.75	..	..	..	0.41	22.43
1918-19	0.88	1.68	1.23	0.83	..	..	..	..	..	..	..	..	17.3
1919-20	1.16	3.14	8.48	0.5	0.20	..	..	..	..	..	..	..	27.74
1920-21	0.68	0.17	..	..	..	..	..	..	..	..	0.85	0.20	15.62
1921-22	8.2	..	6.15	..	..	..	0.20	..	..	0.22	..	..	24.17
1922-23	3.96	0.25	6.82	3.93	..	..	..	..	..	0.80	0.66	0.60	25.60
1923-24	..	..	..	..	0.34	..	..	..	..	..	..	1.55	14.89
1924-25	1.37	1.75	0.18	0.40	0.10	..	..	..	..	..	0.22	0.2	22.30
1925-26	4.58	..	0.16	..	1.0	0.34	..	0.33	..	..	..	..	18.37
1926-27	1.7	0.34	..	..	..	..	..	..	..	..	0.28	..	19.45
1927-28	2.66	0.22	4.1	..	..	..	..	..	1.30	..	..	..	22.42
1928-29	2.41	4.56	..	..	0.10	..	..	..	0.40	..	..	0.2	25.75
1929-30	3.69	..	0.9	..	..	..	..	..	..	..	..	..	15.64
1930-31	8.87	1.38	1.15	..	0.38	..	..	..	..	..	..	0.5	25.43

## ARBHAVI FARM.

Statement showing the prices of Gul, Cotton, Maize and Chillies in lbs. per rupee.

Year.	Maize.	Gul.	Chillies.	Cotton.
1911-12	..	30	14.0	7.0
1912-13	..	30	14.0	7.0
1913-14	..	36	18.0	10.0
1914-15	..	45	14.5	15.0
1915-16	..	40	16.0	10.0
1916-17	..	40	14.0	7.0
1917-18	..	30	14.0	4.5
1918-19	..	12	10.0	5.5
1919-20	..	16	7.5	5.5
1920-21	..	16	8.0	9.0
1921-22	..	18	7.5	6.5
1922-23	..	26	9.0	4.7
1923-24	..	16	10.0	5.0
1924-25	..	22	9.0	6.0
1925-26	..	25	11.0	7.0
1926-27	..	24	12.5	7.0
1927-28	..	21	14.0	7.0
1928-29	..	33	12.0	8.0
1929-30	..	27	12.2	10.0
1930-31	..	54	19.0	12.0

ARBHAVI FARM.

Statement showing the prices of various manures in lbs. per rupee.

Name of manure.	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	
1. Nitrate of Soda ..	..	..	..	..	..	8	..	6	..	..	..	..	..	..	..	..	..	..	..	18.5	..
2. Sheep-dung ..	186	186	448	448	448	..	448	..	..	..	..	..	..	..	..	..	..	..	..	..	..
3. Poudrette ..	1,800	1,800	746	746	1,000	1,000	500	500	..	250	500	500	333	500	500	..	..	..	..	..	..
4. F. Y. M. ..	800	800	896	896	689	728	689	667	500	500	500	500	250	500	500	500	500	500	500	500	500
5. Rotted Cactus ..	1,200	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
6. Urine earth ..	1,000	..	1,000	..	..	..	..	..	444	444	..	..	..	..	..	..	..	..	..	..	..
7. Trash ..	..	..	..	..	..	1,000	..	1,000	..	1,000	1,000	..	..	1,000	1,000	1,000	..	..	..	..	..
8. Pig manure ..	..	..	..	..	..	..	..	..	..	..	..	..	250	500	500	333	333	..	..	..	..
9. Fish manure ..	27.5	35	35.0	35.0	35	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
10. Safflower cake (ghani) ..	70	60	50	44	45	50	40	..	..	..	30	37	36	25	..	..	..	..	..	28.5	..
11. Safflower cake (mill-pressed) ..	..	..	..	31	34	34	30	30	25	16	..	..	..	..	..	..	..	..	..	..	..
12. Castor cake ..	40	40	40	40	40	..	..	..	..	..	23	20	25	25	24	22	..	23	..	..	..
13. Groundnut cake ..	..	..	..	45	32	30	30	30	20	20	22	20	20	20	20	22	20	20	20	23	26
14. Sulphate of Ammonia ..	10	10	9.5	8.3	7	7	5	5	4	4.5	5	6	6	9	10	11	11	12.5	12.8	14	..
15. Sulphate of Potash ..	15.5	15.5	15.5	15.5	7.1	..	16	Calcium	Cyana	Amide	..	..	..	..	..	..	..	..	..	18.2	13.2
16. Calcium Nitrate ..	..	..	..	..	..	..	7	32	..	18	Ammo	phos	..	8	6	9	..	..	..	9.5	9.5



## BARAMATI FARM I.

To compare the effects of different quantities of F.Y.M. added to san green to make up (1) 20,000, (2) 30,000, and (3) 40,000 lbs. of dry matter per acre for Sugarcane.

Variety—"Pundya".

Manuring per acre :—

- (1) San green alone.
- (2) San green plus F.Y.M. 20,000 lbs. dry matter.
- (3) San green plus F.Y.M. 30,000 lbs. dry matter.
- (4) San green plus F.Y.M. 40,000 lbs. dry matter.

Plots—10 gunthas each.

Lay-out—Unreplicated.

The manures shown above are basic manures. In addition to these each plot received a top-dressing of Sulphate of Ammonia, cake and fish each equivalent to 50 lbs. N per acre.

Treatments.	Gul yields in lbs. per plot.			Average.
	1921-22.	1922-23.	1923-24.	
1 .. .. .	1,834	3,150	2,363	2,449
2 .. .. .	....	2,148	1,809	1,978
3 .. .. .	2,389	2,065	1,943	2,149
4 .. .. .	2,148	2,248	1,933	2,043

San green alone has given the highest average yield.

## BARAMATI FARM II.

To compare the following methods of manuring for sugarcane :—

- (1) San green plus 150 lbs. N top dressing with Sulphate of Ammonia, cake and fish manure each equal to 50 lbs. N.
- (2) San green plus F.Y.M. 12 carts plus 150 lbs. N as top dressing with Sulphate of Ammonia, cake and fish manure each equal to 50 lbs. N.
- (3) 40 carts F.Y.M. plus 5,000 lbs. oil-cakes local method.

Variety—"Pundya".

Plots—10 gunthas.

Lay-out—Unreplicated.

Treatments.	Gul yields in lbs. per plot.			Average.
	1921-22.	1922-23.	1923-24.	
1 .. .. .	1,834	3,150	2,363	2,449
2 .. .. .	2,239	2,112	2,103	2,151
3 .. .. .	2,738	2,206	2,281	2,408

It would seem that treatments 1 and 3 are better than treatment 2. This confirms the results in experiment I where the addition of F.Y.M. to *san green* has given lower yields.

### BARAMATI FARM III.

To compare the following systems of manuring *Sugarcane* :—

(1) *San green plus F.Y.M.* 12 carts with a top-dressing of 150 lbs. N as Sulphate of Ammonia and cake in equal proportions of nitrogen.

(2) 30 carts of F.Y.M. plus 5,000 lbs of oil-cakes.

Variety—(i) "D 109"; (ii) "Pundya".

Plots—10 gunthas.

Lay-out—Replicated from two to four times.

Year.	Treatment.	Gul yields in lbs. per plot.				Average.	Significance.
(i) "D 109"							
1926-27	1	2,721	2,805	2,436	1,979	2,485	Treated by Method II. Significance—150
	2	2,560	2,475	2,256	2,016	2,328	
1927-28	1	1,958	1,492	1,432	..	1,627	No Significance.
	2	1,854	1,658	1,413	..	1,642	
1928-29	1	2,271	2,364	2,149	..	2,261	Treated by Method III. Significance—48·6.
	2	2,665	2,727	2,914	..	2,769	
(ii) "Pundya"							
1929-30	1	2,820	2,744	..	..	2,782	Method II. Significance—150.
	2	3,212	2,931	..	..	3,072	
1930-31	1	3,886	3,010	..	..	3,198	Method II. Significance—very small.
	2	3,729	3,387	..	..	3,558	

For the "D109" variety the results are not consistent. For one year treatment 1 is significantly better than 2. For 1928-29 the case is reversed. For 1927-28 the treatments are practically equal.

But for "Pundya" variety the second treatment shows a definitely better yield in both the years.

### BARAMATI FARM IV.

To ascertain the effects of increasing the doses of Nitrogen for top dressing on *sugarcane*.

Manuring per acre.—Basic manure *san green plus* 12 carts F.Y.M. except in treatment 1, where it is *san green* alone. Top-dressings consisted of  $\frac{1}{3}$  N as Sulphate of Ammonia plus  $\frac{1}{3}$  N as cake plus  $\frac{1}{3}$  N as Fish-manure.

- Treatments* :—(1) 150 lbs. N top-dressing (Basic manure—*San* alone).  
 (2) 150 lbs. N top-dressing (Basic manure—*San plus* F.Y.M.).  
 (3) 200 lbs. N top-dressing (Basic manure—*San plus* F.Y.M.).  
 (4) 250 lbs. N top-dressing (Basic manure—*San plus* F.Y.M.).  
 (5) 300 lbs. N top-dressing (Basic manure—*San plus* F.Y.M.).

*Variety*—“*Pundya*”.

*Plots*—10 gunthas each.

*Lay-out*—Unreplicated.

Treatment.	Gul yields in lbs. per plot.						Average	Average net profits per plot.
	1921-22	1922-23	1923-24	1924-25	1925-26	1926-27		
1 ..	1,834	3,150	2,863	2,739	3,771	3,851	2,961	157·8
2 ..	2,761	2,607	2,575	3,128	4,140	3,718	3,155	195·1
3 ..	2,770	3,014	2,396	2,993	3,545	3,846	3,094	170·4
4 ..	2,689	3,495	2,419	3,197	3,810	3,322	3,155	157·1
5 ..	..	..	..	2,854	4,553	3,797	3,736	159·2

It would seem at first sight that treatment 5 has given a high yield, but as this treatment was tried only for the last three years when the other treatments have done well, by comparing this with the average yields for other treatments also for these three years only, the difference between those and this treatment 5 becomes less noticeable.

Hence we may conclude that all the top-dressings have given more or less the same yields except that the absence of F.Y.M. in the basic manure in treatment 1 has lowered the yields slightly. Considering the financial advantage, it may be said that 150 lbs. N as top-dressing is most profitable. Next comes 200 lbs. N; further increase of N in the top-dressing does not give good profits. Hence 150 lbs. N for the top-dressing combined with F.Y.M. in the basic manure is the most advantageous method.

*N.B.*—In calculating the net profits the figures for 1922-23 are not included as they are not available.

#### BARAMATI FARM V.

*To ascertain the effects of increasing doses of nitrogenous top-dressing for sugarcane with 30 carts F.Y.M. per acre as Basic manure.*

*Variety*—“*Pundya*”.

*Treatments*—

- |                 |  |
|-----------------|--|
| (1) 75 lbs. N.  | } As top-dressing with a mixture of Sulphate of Ammonia and cake in equal proportions of Nitrogen for all. |
| (2) 100 lbs. N. |  |
| (3) 125 lbs. N. |  |
| (4) 150 lbs. N. |  |

Plots—10 gunthas each.

Lay-out—Unreplicated.

Treatments.	Gul yields in lbs. per plot.		Average.	Average net profits per plot.
	1929-30.	1930-31.		
				Rs.
1 .. .. .	3,294	1,831	2,563	94.08
2 .. .. .	3,655	2,128	2,892	117.60
3 .. .. .	3,076	2,039	2,558	85.40
4 .. .. .	3,601	2,249	2,925	113.76

The yields seem to increase with the amount of top-dressing nitrogen except that 125 lbs. N shows no great advantage over 75 lbs. of N. Some explanation must be sought for this. 100 lbs. of N has given the highest net profits with a high yield. 150 lbs N though giving a slightly lower net profits can be taken to be equally efficient.

#### BARAMATI FARM.

Statement showing the Cost of Cultivation and the prices of various manures and "Gul" (in lbs. per Rupee).

Year.	Cost of Cultivation per acre		Prices of manures in lbs. per rupee					Price of Gul. lbs./Rs.	Year.
	Government Farm method.	Local method.	Ammonium Sulphate.	Fish manure.	Safflower cake.	Groundnut cake.	Castor cake.		
	Rs.	Rs.							
1920-21	..	..	5.8	..	15.0	..	22.7	..	..
1921 ..	397.81	475.12	6.6	6.7	20.8	..	22.7	6.4	1921-22
1922 ..	435.00	..	5.8	13.0	..	..	20.8	6.0	1922-23
1923 ..	428.18	..	8.6	10.7	19.0	..	21.7	9.0	1923-24
1924 ..	349.00	..	9.0	24.0	..	..	..	9.2	1924-25
1925 ..	391.12	..	9.0	24.0	16.6	..	20.8	12.5	1925-26
1926 ..	307.25	345.18	10.7	16.0	16.6	..	18.5	10.9	1926-27
1927 ..	310.62	329.00	11.7	..	..	..	21.7	12.5	1927-28
1928 ..	325.25	460.31	12.2	..	17.6	20.8	25.6	9.5	1928-29
1929 ..	315.81	353.87	12.8	..	16.0	20.0	25.0	11.1	1929-30
1930 ..	313.00	360.25	14.5	..	20.0	25.0	27.7	14.7	1930-31

#### DHARWAR FARM I.

To compare the effect of (1) 2.3 tons of F.Y.M. every alternate year—for jowar. (2) 20 tons of F.Y.M. once for all in 1914-15. (3) 20 tons of Nightsoil in furrows once for all in 1914-15, manure given to jowar.

Crop—Rotation of Jowar and Cotton.

Plots—8 gunthas each.

Lay-out—Two sets of three plots are taken one for *Jowar* and the other for cotton. They are rotated with each other.

N.B.—The results of 1920–21 for cotton have been omitted because the crops were affected with Wilt.

### *Jowar.*

Treatment.	Grain yields of <i>Jowar</i> in lbs. per plot.						Average.
	1914	1916	1918	1922	1924		
<i>Set of plots "A".</i>							
1 .. ..	150	117	286	228	248	..	205
2 .. ..	216	142	262	216	170	..	201
3 .. ..	438	216	204	256	198	..	262
<i>Set of plots "B".</i>							
	1915	1917	1919	1921	1923	1925	
1 .. ..	272	178	206	313	137	266	229
2 .. ..	342	188	164	277	69	190	205
3 .. ..	604	217	244	342	155	238	300

### *Cotton.*

Treatment.	Seed cotton yields in lbs. per plot.						Average.
	1914	1916	1918	1920	1922	1924	
<i>Set of plots "B".</i>							
1 .. ..	89	78	84	..	98	91	90
2 .. ..	100	85	79	..	83	84	86
3 .. ..	90	95	110	..	89	87	94
<i>Set of plots "A".</i>							
	1915	1917	1919	1921	1923	1925	
1 .. ..	121	114	52	Bad year	125	141	111
2 .. ..	114	113	52	..	117	128	105
3 .. ..	194	185	58	..	133	127	139

The average net profits per rotation are as follows :—

Treatments.	Average net profit in rupees per rotation.		Average of the two sets of plots.
	Set 'A'.	Set 'B'.	
1 .. .. .	31·6	20·9	26·3
2 .. .. .	29·8	17·5	23·7
3 .. .. .	36·3	25·3	30·8

There are five complete rotations available for each set of plots.

The treatment with heavy F.Y.M. once for all has been giving consistently lower yields and net profits than the ordinary treatment 1, both for cotton and *Jowar* though the difference is not much.

The treatment with crude night-soil has given throughout considerably better yields than either of the other two treatments for both the crops. It has also given a higher net profit and hence it is the most advantageous treatment.

#### DHARWAR FARM II.

##### *Crop—Jowar-Cotton Rotation.*

To ascertain the effects of increasing doses of F.Y.M. on the above.

*Manure*—Given to *Jowar* before sowing as follows :—

- (1) 2·5 tons of F.Y.M. per acre every year.
- (2) 2·5 tons of F.Y.M. per acre every second year.
- (3) 5 tons of F.Y.M. per acre every second year.
- (4) 10 tons of F.Y.M. per acre every second year.
- (5) 10 tons of F.Y.M. per acre every fourth year.
- (5a) 15 tons of F.Y.M. per acre every second year.
- (6) No manure.

*Plots*—4 gunthas each 112' × 55' 7" (including a 6' ring all round).

*Lay-out*—Duplicated.

*Note.*—Two sets of 12 plots are taken and one set is sown with *jowar* and the other with cotton in the first year. The next year the crops are exchanged and so on, the crops are rotated in both the sets of plots.

In both the sets of plots treatment 5 is substituted by 5a from 1920–21 onwards.

In investigating these results statistically it was considered that the calculation of the error and thence the significance for each year will not repay the labour involved and hence the results of a set of years are combined and treated as follows :—

First of all the average yield for each treatment for each year is set down thereby eliminating the influence of the difference between the two duplicate plots. Then these average yields per plot for a number of years which have the treatments in common are taken together and Fisher's method is adopted to ascertain separately the variances due to treatments, variable weather conditions of the years and error, for each set of plots for each crop.

*Plan showing the lay-out of the F.Y.M. experiment on Dharwar Farm II for the years 1908, 1910, 1912, 1914, 1916, 1918, 1920, 1922, 1924, 1926, 1928.*

	B	A
	<i>Cotton.</i>	<i>Jowar.</i>
Originals.	654 1	653 1
	652 2	651 2
	650 3	649 3
	648 4	647 4
	646 6	645 6
	644 5 or 5a	643 5 or 5a
Duplicates.	666 5 or 5a	665 5 or 5a
	664 6	663 6
	662 4	661 4
	660 3	659 3
	658 2	657 2
	656 1	655 1

1. 2.5 tons F.Y.M. per acre every year.
2. 2.5 tons F.Y.M. per acre every second year.
3. 5 tons F.Y.M. per acre every second year.
4. 10 tons F.Y.M. per acre every second year.
5. 10 tons F.Y.M. per acre every fourth year.
- 5a. 15 tons F.Y.M. per acre every second year.
6. N.

*Plan showing the lay-out of the F.Y.M. experiment on Dharwad Farm II for the years 1909, 1911, 1913, 1915, 1917, 1919, 1921, 1923, 1925, 1927, 1929.*

	B	A
	<i>Jowar.</i>	<i>Cotton.</i>
Originals.	654 1	653 1
	652 2	651 2
	650 3	649 3
	648 4	647 4
	646 6	645 6
	644 5 or 5a	643 5 or 5a
Duplicates.	666 5 or 5a	665 5 or 5a
	664 6	663 6
	662 4	661 4
	660 3	659 3
	658 2	657 2
	656 1	655 1

1. 2.5 tons F.Y.M. per acre every year.
2. 2.5 tons F.Y.M. per acre every second year.
3. 5 tons F.Y.M. per acre every second year.
4. 10 tons F.Y.M. per acre every second year.
5. 10 tons F.Y.M. per acre every fourth year.
- 5a. 15 tons F.Y.M. per acre every second year.
6. No manure.



## Jowar.

## Set of plots 'A'.

Grain yields in lbs. per plot—Average of two plots.								Analysis of variance.			
	1908	1910	1912	1914	1916	1918	Average		D	V	$\frac{1}{2} \log_e V$
1	130	109	77	89	69	106	97	Treat	5	2,295.73	3.8650
2	134	103	63	36	64	82	89	Yrs.	5	4,360.4	4.1854
3	138	102	88	96	67	108	100	Er.	25	198.32	2.6420
4	166	113	142	119	77	158	129	The 5 per cent. point of $z$ for $n_1 = 5$ and $n_2 = 25$ is 0.4783.			
5	165	113	71	89	70	116	104	The standard error for comparing two means is 8.13. Hence the significance is 16.75.			
6	128	90	23	67	52	67	70				

From the above it is seen that treatment 4 stands first. Treatments 5, 3 and 1 stand significantly lower than 4. Treatment 2 though not significantly lower than 3 and 1 is better than 6 and hence it can be ranked as the third in order of merit.

## Set of plots 'A'—contd.

Grain yields in lbs. per plot—Average of two plots.							Analysis of variance.			
	1920	1922	1924	1926	1928	Average		D	V	$\frac{1}{2} \log_e V$
1	74	103	72	93	184	105	Tr.	5	4,844.7	4.2380
2	58	83	82	91	178	98	Yrs.	4	12,461.4	4.7098
3	78	107	110	104	195	119	Er.	20	230.97	2.7182
4	90	153	150	128	235	151	The 5 per cent. point of $z$ for $n_1 = 5$ and $n_2 = 20$ is 0.4988, hence there is a significant affect due to treatments.			
5a	68	145	133	148	239	147				
6	40	72	45	73	113	69				

The standard error for comparing two means is 9.61 and the significance is 20.1. Treatments 4 and 5a stand best. Treatments 3 and 1 are significantly lower than the above, and hence stand second. Treatment 2 though not significantly lower than 1 is still inferior to 3 and hence can be ranked as the third in the order of merit. The no-manure treatment is significantly lower than all the treatments.

## Jowar.

Set of plots 'B<sub>1</sub>'.

Grain yields in lbs.—Average of two plots.							Analysis of variance.			
	1909	1913	1915	1917	1919	Average		D	V	$\frac{1}{2} \log_e V$
1	127	155	136	86	124	126	Tr.	5	2,433.7	3.8942
2	113	125	103	65	67	95	Yrs.	4	3,998.2	4.1423
3	119	149	123	91	93	115	Er.	20	114.64	2.3681
4	127	178	158	101	143	141	The 5 per cent. point of $\chi$ for $n_1=5$ and $n_2=20$ is 0.4986. Hence there is a significant effect due to treatments.			
5	121	150	128	86	99	117				
6	101	116	93	46	42	80				

The standard error for comparing two means is 6.77. Hence the significance is 14.15. Judging from this we see that treatment 4 stands first. Treatments 1, 3 and 5 stand equal but significantly below 4. Treatment 2 comes next as usual but above the no-manure treatment.

## Set of plots 'B'—contd.

Grain yields in lbs.—Average of two plots.							Analysis of variance.			
	1921	1923	1925	1927	1929	Average		D	V	$\frac{1}{2} \log_e V$
1	149	97	106	136	156	129	Tr.	5	2,141.6	3.8304
2	132	56	84	112	229	123	Yrs.	4	13,776.8	4.7601
3	154	96	113	171	205	148	Er.	20	757.2	3.3111
4	128	139	144	218	282	182	The 5 per cent. point of $\chi$ for $n_1=5$ and $n_2=20$ is 0.4986. Hence there is a significant effect due to treatments.			
5a	185	154	151	257	317	213				
6	96	41	72	75	126	82				

The standard error for comparing two means is 17.4. The significance is 36.4. Judging from this it is seen that treatments 4 and 5a stand best though 5a might be slightly better than 4. Treatments 1, 2 and 3 come next and seem to be equal though 3 is slightly better than the other two. Of course all the treatments are significantly better than the no-manure treatment.

## Cotton.

## Set of plots 'A'.

Cotton yields in lbs.—Average for two plots.							Analysis of variance.			
	1909	1911	1913	1915	1917	Average		D	V	$\frac{1}{2} \log_e V$
1	48.3	30.4	51.9	52.5	48.3	46.3	Tr.	5	76.48	2.1662
2	51.7	28.1	52.7	46.5	42.8	44.4	Yrs.	4	625.30	3.2155
3	60.3	25.5	54.1	49.5	40.0	45.7	Er.	20	38.76	1.8265
4	51.6	17.9	57.7	55.0	55.8	47.6				
5	46.8	26.9	53.8	48.4	55.0	46.2				
6	53.7	30.1	35.9	32.5	32.0	36.8				

The 5 per cent. point of  $z$  for  $n_1=5$  and  $n_2=20$  is 0.4986. Hence there seems to be no significance due to treatments but on calculating the standard error and thence the significance which is equal to 8.3 it is seen that all the treatments are significantly better than the no-manure treatment except treatment 2 which falls short by a small margin.

## Set of plots 'A'—contd.

Cotton yields in lbs.—Average for two plots.							Analysis of variance.			
	1921	1923	1925	1927	1929	Average		D	V	$\frac{1}{2} \log_e V$
1	22.0	57.5	51.3	50.8	58.5	48.0	Tr.	5	456.8	3.0598
2	16.0	55.0	54.0	44.3	53.6	44.6	Yrs.	4	1,705.7	3.7167
3	22.8	57.0	36.8	52.5	60.0	49.8	Er.	20	28.3	1.6694
4	19.8	66.0	56.0	52.8	74.0	33.9				
5a	25.3	65.0	66.0	58.5	84.0	59.8				
6	6.3	43.5	34.5	40.3	33.5	31.6				

The 5 per cent. point of  $z$  for  $n_1=5$  and  $n_2=20$  is 0.4986. Hence there is significant effect due to the treatments.

The standard error for comparing two means is 3.35, and the significance is 7.04. Judging from this we see that treatments 4 and 5a stand out best though the former is slightly better than the latter. Treatments 1, 2 and 3 stand equal in the second rank. All treatments are significantly better than the no-manure treatment.

## Cotton.

## Set of plots 'B'.

Cotton yields in lbs.—Average of two plots.								Analysis of variance.			
	1910	1912	1914	1916	1918	1920	Average		D	V	$\frac{1}{2} \log_e V$
1	41.5	47.3	51.0	31.5	33.5	25.8	33.4	Tr.	5	106.8	2.3329
2	38.1	38.2	41.8	25.6	24.3	27.8	32.6	Yrs.	5	274.2	2.8038
3	42.9	44.0	54.3	32.8	32.2	23.0	38.2	Er.	25	28.7	1.6757
4	42.6	41.2	50.8	37.0	41.5	28.0	40.2	The 5 per cent. point of $z$ for $n_1 = 5$ and $n_2 = 25$ is 0.4783. Hence there is a significant effect due to treatments.			
5	42.6	46.9	41.5	45.5	44.2	32.5	42.2				
6	41.5	39.3	31.5	27.3	25.8	24.0	31.6				

The standard error for comparing two means is 3.09 and the significance is 6.4. Judging from this treatments 5, 4, 3 and 1 differ only by an amount less than the significance. Treatment 2 and no-manure treatment are both equal, both being significantly lower than the other treatments.

## Set of plots 'B'—contd.

Cotton yields in lbs.—Average of two plots.						Analysis of variance			
	1922	1924	1926	1928	Average		D	V	$\frac{1}{2} \log_e V$
1	59.8	36.3	40.3	51.8	47.1	Tr.	5	225.56	2.7061
2	49.0	34.8	40.0	43.7	41.9	Yrs.	3	498.04	3.1018
3	57.0	39.5	44.0	61.0	50.4	Er.	15	66.52	2.0904
4	67.8	49.5	30.8	45.8	48.5	The 5 per cent. point of $z$ for $n_1 = 5$ and $n_2 = 15$ is 0.5326. Hence there is a significant effect due to treatments.			
5a	67.8	49.8	33.3	69.8	55.2				
6	41.0	27.5	38.0	27.8	33.6				

The standard error for comparing the two means is 5.8 and the significance is equal to 12.3. Judging from this treatments 5a, 4, 3 and 1 stand foremost more or less equal to one another. Treatment 2 is just above the no-manure treatment but not significantly so. As the error is very high, in this case, there is no clear margin between the superior and inferior treatments.

The following statement gives the average yields for plot of *Jowar* and Cotton for the whole experiment, both the plots combined together; and the average net profit per plot for one rotation of two yields :—

Treatment.	Average yield of crop per plot in lbs.		Average net profit per rotation in rupees.
	<i>Jowar</i> .	Cotton.	
1	114	45.2	10.1
2	101	40.9	9.7
3	120	46.0	11.1
4	151	47.5	12.1
5	111	44.2	11.0
5a	180	57.5	11.8
6	75	33.4	7.3

The above summary of figures gives us the definite idea about the comparative effects of the treatments. As found in the individual cases treatment 5a stands out best in yields. Treatment 4 comes next but in giving net profits the latter proves to be equal if not better than the former. Hence we will not be far wrong if we say that treatments 5a and 4 are equally efficient both being better than the other treatments.

Among the other treatments 3, 1 and 5 are more or less equal both in yields and net profits. Treatment 2 is hardly better than the no-manure treatment and hence may be ignored.

In the calculation it was observed that the treatments on the whole produced more effect on *Jowar* than on Cotton.

### DHARWAR FARM III.

#### *Crop—Cotton-Jowar Rotation.*

To ascertain the comparative-effects of the following treatments for the above rotation.

#### *Treatments per acre :*

(1) No manure. (2) 5 tons F.Y.M. (3) 5 tons cactus. (3a) 2.5 tons F.Y.M. (4) 5 tons poudrette. (5) 5 tons town sweepings.

#### *Plots—4 gunthas each.*

4 Blocks A<sub>1</sub>, A<sub>2</sub>, B<sub>1</sub>, B<sub>2</sub> of 5 plots each are taken as shown in the plan for the experiment. Blocks A<sub>1</sub> and A<sub>2</sub> are treated with manures as detailed above and cropped with *Jowar* for the years 1908-09, 1910-11, 1912-13, 1914-15, 1916-17, 1918-19, 1920-21. This set is cropped with cotton in the other years. Blocks B<sub>1</sub> and B<sub>2</sub> are treated with manures and sown with *Jowar* in years 1909-10, 1911-12, 1913-14, 1915-16, 1917-18, 1919-1920 and 1921-22 and with cotton in other years.

#### *Lay-out—Duplicated.*

*Note.*—The experiment extends from 1908-09 to 1921-22. The manures are always applied to *Jowar* and hence in the year of cotton, there is no manure applied. The treatments are the same throughout the period except that treatment 3 is substituted by 3a from 1916-17 onwards.

Since the treated plots within each block remain the same throughout, each block has been taken separately and the results of all years for the same crop are tabulated and analysed by method IV.

The experiment has been divided into 2 parts : (i) from 1908-09 to 1915-16 and (ii) from 1916-17 to 1921-22.

*Lay-out of the experiments on Dharwar Farm for the years 1908-09, 1910-11, 1912-13, 1914-15, 1916-17, 1918-19, 1920-21.*

		B <sub>1</sub> Cotton.	A <sub>2</sub> Jowar.
		312	311 V
		314	313 IV
B <sub>1</sub>	A <sub>1</sub>	316	315 III
Cotton.	Jowar.	318	317 II
610	609 I	320	319 I
608	607 II		
606	605 III		
604	603 IV		
602	601 V		

I—No manure.

II—5 tons F.Y.M.

III—5 tons cactus.

IIIa—2·5 tons F.Y.M.

IV—5 tons pouquette.

V—5 tons town sweeping.

*Note.*—From 1916-17 onwards the treatment IIIa (2½ tons F.Y.M.) is substituted for the treatment III (5 tons cactus).

*Lay-out of the experiments on Dharwar Farm for the years 1909-10,  
1911-12, 1913-14, 1915-16, 1917-18, 1919-20, 1921-22.*

		B <sub>1</sub> Jowar.	A <sub>1</sub> Cotton.
		312 V	311
		314 IV	313
		316 III	315
		318 II	317
B <sub>1</sub>	A <sub>1</sub>	320 I	319
Jowar.	Cotton.		
610 I	609		
608 II	607		
606 III	605		
604 IV	603		
602 V	601		

I—No manure.

II—5 tons F.Y.M.

III—5 tons cactus.

IIIa—2.5 tons F.Y.M.

IV—5 tons poudrette.

V—5 tons town sweepings.

MO-III Bk Q 7-9

Crop—Jowar. Set of plots  $A_1$ . 1908-09 to 1914-15.

Grain yields in pounds per plot.

Treatments.				1908	1910	1912	1914
1	..	..	..	108	70	40	54
2	..	..	..	132	97	65	83
3	..	..	..	115	68	54	58
4	..	..	..	181	109	102	94
5	..	..	..	136	86	56	91

*Analysis of variance.*

Kind of variation.				D	Sum of squares.	Mean square or Variance.	$\frac{1}{2} \log_e V$
Treatments	..	..	..	4	7053.70	1763.43	3.7375
Years	..	..	..	3	14454.55	4818.28	4.2401
Error	..	..	..	12	1018.70	84.89	2.2207
Total				19	22526.95	1185.63	....

$$S. D. = \sqrt{84.89} = 9.2136.$$

*Mean yields.*

	Treatments.				
	1	2	3	4	5
Mean yields	68.00	94.25	73.75	121.50	92.25

$$\text{Mean S. E.} = \sqrt{\frac{84.89}{4}} = 4.6068.$$

The 5 per cent. point of "Z" for  $n_1 = 4$  and  $n_2 = 12$  is 0.5907 while in the present case it is found to be 1.5168 indicating thereby significance due to treatments. The standard error of comparison of two treatment means is 6.514 and hence the significance in the difference of treatment



means is 14·194. Judging from this figure, we see that treatment 4 (i.e., poudrette) is significantly better than the rest of the treatments. Treatments 2 and 5 are significantly better than treatments 1 and 3. Cactus and no-manure have the same effect on the crop. There is a distinct effect of all the treatments except 3 over the no-manure treatment.

*Crop -Jowar. Set of plots A<sub>1</sub>. 1916-17 to 1920-21.*

*Grain yields in pounds per plot.*

Treatments.					1916-17	1918-19	1920-21
1	..	..	..	..	42	80	36
2	..	..	..	..	60	127	54
3a	..	..	..	..	50	90	36
4	..	..	..	..	65	140	76
5	..	..	..	..	58	124	60

*Analysis of variance.*

Kind of variation.					D	Sum of squares.	Mean square or Variance.	$\frac{1}{2} \text{Log}_e V$
Treatments..	..	..	..	..	4	3475·07	868·77	3·3836
Years	..	..	..	..	2	11424·40	5712·20	4·3252
Error	..	..	..	..	8	668·93	83·62	2·2132
Total					14	15568·40	1112·03	....

$$S. D. = \sqrt{83 \cdot 62} = 9 \cdot 144.$$

*Mean yields.*

	Treatments.				
	1	2	3a	4	5
Mean yields	52·67	80·33	58·67	93·67	80·67

$$\text{Mean S. E.} = \frac{\sqrt{83 \cdot 62}}{\sqrt{3}} = 5 \cdot 2792.$$

The 5 per cent. point of "Z" for  $n_1 = 4$  and  $n_2 = 8$  is 0.6725 while in the present case, it is found to be 1.1706. Hence there is significance due to the treatments. The standard error for comparing the means is 7.465 and hence the significance in the difference of treatments means is 17.214. From this, we see that the treatments 2, 4, 5 are significantly better than treatments 1 and 3a.

Crop—Cotton. Set of plots  $A_1$ . 1909-10 to 1915-16.

Cotton yield in lbs. per plot.

Treatments.				1909-10	1911-12*	1913-14	1915-16
1	..	..	..	57	....	52	41
2	..	..	..	64	....	70	65
3	..	..	..	63	....	67	57
4	..	..	..	65	....	79	67
5	..	..	..	64	....	69	67

\* The results of 1911-12 were omitted as they were abnormally low.

Analysis of variance.

Kind of variation.				D	Sum of squares.	Mean square or Variance.	$\frac{1}{2} \text{Log}_e V$
Treatments..	..	..	..	4	743.06	185.77	2.6123
Years	..	..	..	2	162.13	81.07	2.1977
Error	..	..	..	8	170.54	21.32	1.5298
Total ..				14	1075.73*	76.84	

$$\text{S. D.} = \sqrt{21.32} = 4.517.$$

Mean yields.

	Treatments.				
	1	2	3	4	5
Mean yields ..	50.00	66.33	62.33	70.33	66.67

$$\text{Mean S. E.} = \sqrt{\frac{21.32}{3}} = 2.666.$$

The 5 per cent. point of "Z" for  $n_1=4$  and  $n_2=8$  is 0.6725. In the present case, it is found to be 1.0825 indicating thereby significance due to treatments. The standard error for comparing the two means is 3.77 and hence the significance in the difference of treatment means is 8.69. From this figure, we see that all the treatments are significantly better than the no-manure treatment. Treatment 4 however gives better yield than the rest.

*Crop—Cotton. Set of plots A<sub>1</sub>. 1917-18 to 1921-22.*

*Cotton yield in lbs. per plot.*

Treatments.				1917-18	1919-20	1921-22
1	..	..	..	40	34	26
2	..	..	..	66	41	16
3a	..	..	..	55	46	30
4	..	..	..	62	48	30
5	..	..	..	58	48	32

*Analysis of variance.*

Kind of variation.				D	Sum of squares.	Mean square or Variance.	$\frac{1}{2} \text{Log}_e V$
Treatments..	..	..	..	4	349.73	87.43	2.2354
Years ..	..	..	..	2	2172.93	1086.46	3.4955
Error ..	..	..	..	8	355.07	44.38	1.8964
Total ..				14	2877.73	205.55	....

$$S. D. = \sqrt{44.38} = 6.6618.$$

*Mean yields.*

	Treatments.				
	1	2	3	4	5
Mean yields ..	33.33	41.00	43.67	46.67	46.00

$$\text{Mean S. E.} = \frac{\sqrt{44.38}}{3} = 3.8458.$$

The 5 per cent. point of "Z" for  $n_1=4$  and  $n_2=8$  is 0.6725 but in the present case, the same is found to be 0.3390; hence there seems to be no significance due to treatments.

But on calculating the standard error and hence the significance, the significance comes to 12.54 we see that the treatments 4 and 5 are alone significantly better than the no-manure treatment. The rest, viz., 2 and 3a have the same effect as that of no-manure.

Crop—Cotton. Set of plots B<sub>1</sub>. 1908–09 to 1914–15.

Cotton yield in lbs. per plot.

Treatments.				1908	1910	1912	1914
1	..	..	..	58	54	57	51
2	..	..	..	59	51	62	58
3	..	..	..	60	53	60	56
4	..	..	..	63	54	69	72
5	..	..	..	70	57	66	64

Analysis of variance.

Kind of variation.				D.	Sum of squares.	Mean square or Variance.	$\frac{1}{2} \text{Log}_e V$
Treatments..	..	..	..	4	306.70	76.68	2.1698
Years	..	..	..	3	249.80	83.27	2.2611
Error	..	..	..	12	157.70	13.14	1.2878
Total ..				19	714.20	37.59	..

$$S. D. = \sqrt{13.14} = 3.625.$$

Mean yields.

	Treatments.				
	1	2	3	4	5
Mean yields ..	55.00	57.50	57.25	64.50	64.25

$$\text{Mean S. E.} = \sqrt{13.14} = 1.812.$$

The 5 per cent. point of "Z" for  $n_1=4$  and  $n_2=12$  is 0.5907. In the present case, the value of "Z" is found to be 0.8820; hence there is significant effect due to treatments. The standard error for comparing the means is 2.56 and hence the significance in the difference of the treatment means is 5.57. Judging from this figure we see that treatments 4 and 5 alone are significantly better than the rest of the treatments.

Crop—Cotton. Set of plots B<sub>1</sub>. 1916-17 to 1920-21.

Cotton yield in lbs. per plot.

Treatments.					1916	1918	1920
1	..	..	..	..	40	41	44
2	..	..	..	..	45	44	52
3a	..	..	..	..	44	32	54
4	..	..	..	..	52	50	56
5	..	..	..	..	50	48	56

Analysis of variance.

Kind of variation.				D.	Sum of squares.	Mean square or Variance.	$\frac{1}{2}$ Lodg <sub>e</sub> V
Treatments ..	..	..	..	4	277.73	69.43	2.1202
Years ..	..	..	..	2	228.40	114.20	2.3805
Error ..	..	..	..	8	114.27	14.28	1.3294
Total ..				14	620.40	45.74	....

$$S. D. = \sqrt{14.28} = 3.779.$$

Mean yields.

	Treatments.				
	1	2	3a	4	5
Mean yields ..	41.67	47.00	43.33	52.67	51.33

$$\text{Mean S. E.} = \sqrt{14.28} = 2.184.$$

$$\sqrt{3}$$

The 5 per cent. point of "Z" for  $n_1 = 4$  and  $n_2 = 8$  is 0.6725 but in the present case, it is found to be 0.7908 indicating thereby significance due to treatments. The standard error for comparing the means is 3.09 and hence the significance in difference of treatment means is 7.12. Judging from this figure, we see that treatments 4 and 5 are significantly better than the treatments 1 and 3a. The treatments 1, 2 and 3a have the same effect on the crop.

*Crop—Jowar. Set of plots B<sub>1</sub>. 1909-10 to 1915-16.*

*Grain yields in lbs. per plot.*

Treatments.				Years.			
				1909	1911	1913	1915
1	..	..	..	109	48	105	81
2	..	..	..	126	80	140	126
3	..	..	..	105	64	98	72
4	..	..	..	131	74	142	120
5	..	..	..	114	68	158	100

*Analysis of variance.*

Kind of variation.			D.	Sum of squares.	Mean square or variance.	Half Log <sub>e</sub> V
Treatments	..	..	4	4374.70	1093.68	3.4987
Years	..	..	3	10860.15	3620.05	4.0971
Error	..	..	12	1596.10	133.01	2.4452
Total	..	..	19	16830.95	885.84	....

$$S. D. = \sqrt{133.01} = 11.533.$$

$$\text{Mean S. E.} = \sqrt{\frac{133.01}{4}} = 5.767.$$

The 5 per cent. point of "Z" for  $n_1 = 4$  and  $n_2 = 12$  is 0.5907; in the present case, the same is found to be 1.0535. This shows that there is significance due to treatments. The standard error for comparing the means is 8.15 and hence the significance in the difference of treatment means is 17.77. Judging from this figure, we see that treatments 2, 4 and 5 are significantly better than 1 and 3.

Crop—Jowar. Set of plots B<sub>1</sub>. 1917-18 to 1921-22.

Grain yields in lbs. per plot.

Treatments.	Years.		
	1917	1919	1921
1	53	53	87
2	92	84	116
3a	57	56	105
4	100	93	145
5	90	89	122

*Analysis of variance.*

Kind of variation.	D	Sum of squares.	Mean square or variance.	$\frac{1}{2} \text{Log}_e V$
Treatments .. ..	4	4896.40	1224.10	3.5550
Years .. ..	2	4918.53	2459.27	3.9034
Error .. ..	8	272.80	34.10	1.7647
Total ..	14	10087.73	720.55	....

$$S. D. = \sqrt{34 \cdot 10} = 5.84.$$

*Mean yields.*

	Treatments.				
	1	2	3a	4	5
Mean yields .. ..	64.33	97.33	72.67	112.67	100.33

$$\text{Mean S. E.} = \sqrt{\frac{34 \cdot 10}{3}} = 3.37.$$

The 5 per cent. point of "Z" for  $n_1 = 4$  and  $n_2 = 8$  is 0.6725, but in the present case, it is found to be 1.7903 indicating thereby significance due to treatments. The standard error for comparing the means is 4.82 and the significance in the difference of treatment means is 11.11. Judging from this figure, we see that treatments 2, 4 and 5 are significantly better than 1 and 3a. Amongst treatments 2, 4 and 5, treatment 4 is significantly better than 2 and 5.

Crop—Jowar. Set of plots A<sub>2</sub>. 1908-09 to 1914-15.

Grain yields in lbs. per plot.

Treatments.				Years.			
				1908	1910	1912	1914
1	..	..	..	138	102	56	67
2	..	..	..	147	108	100	105
3	..	..	..	108	83	77	84
4	..	..	..	140	119	140	114
5	..	..	..	131	80	100	91

*Analysis of variance.*

Kind of variation.		D.	Sum of squares.	Mean square or variance.	$\frac{1}{2} \log_e V$
Treatments	.. ..	4	4606.50	1151.62	3.5245
Years	.. ..	3	5037.00	1679.00	3.7131
Error	.. ..	12	3059.50	254.96	2.7706
Total ..		19	12703.00	668.58	....

$$S. D. = \sqrt{254.96} = 15.96.$$

*Mean yields.*

		Treatments.				
		1	2	3	4	5
Mean yields	.. ..	90.75	115.00	88.00	128.25	100.50

$$\text{Mean S. E.} = \sqrt{\frac{254.96}{4}} = 7.98.$$

The 5 per cent. point of "Z"  $n_1 = 4$  and  $n_2 = 12$  is 0.5907 while in the present case, it is found to be 0.7539. This indicates that there is significance due to treatments. The standard error for comparing the means is 11.28 and hence the significance in the difference of treatment means is 24.58. From this figure, we see that treatments 2 and 4 are significantly better than treatments 1 and 3. Treatment 4 is best yielding one being significantly better than the rest except 2.



*Crop—Jowar.* Set of plots  $A_2$ . 1916-17 to 1920-21.  
*Grain yields in lbs. per plot.*

Treatments.	Years.		
	1916	1918	1920
1 .. .. .	50	62	33
2 .. .. .	66	118	55
3a .. .. .	43	64	31
4 .. .. .	55	107	56
5 .. .. .	52	103	33

*Analysis of variance.*

Kind of variation.	D.	Sum of squares.	Mean square or variance.	$\frac{1}{2} \text{Log } e V$
Treatments .. .. .	4	2607.06	651.76	3.2399
Years .. .. .	2	6614.93	3307.46	4.0520
Error .. .. .	8	1021.74	127.72	2.4249
Total .. .. .	14	10243.73	731.69	.....

$$S. D. = \sqrt{127.72} = 11.305.$$

*Mean yields.*

	Treatments.				
	1	2	3	4	5
Mean yields .. .. .	48.33	79.67	46.00	72.67	62.67

$$\text{Mean S. E.} = \sqrt{\frac{127.72}{3}} = 6.525.$$

The 5 per cent. point of "Z" for  $n_1 = 4$  and  $n_2 = 8$  is 0.6725 while in the present case, it is found to be 0.8150, indicating thereby the significance due to treatments. The standard error for comparing the two means is 9.23 and hence the significance in the difference of treatment means is 21.28. From this figure, we see that treatments 2 and 4 alone are significantly better than the rest of the treatments. Amongst 1, 3a and 5 the last one gives better—though not significantly—yield than 1 and 3a. It may be noted that treatment 3a gives lower yield than the check itself.

Crop—Cotton. Set of plots A<sub>2</sub>. 1909-10 to 1915-16.  
Yields in lbs. per plot.

Treatments.				Years.			
				1909	1911*	1913	1915
1	..	..	..	58	..	71	44
2	..	..	..	63	..	68	52
3	..	..	..	52	..	54	36
4	..	..	..	58	..	58	48
5	..	..	..	56	..	54	44

\* The results of 1911-12 are omitted as they are abnormally low.

*Analysis of variance.*

Kind of variation.				D	Sum of squares.	Mean square or variance.	$\frac{1}{2} \text{Log}_e V$
Treatments	..	..	4	340.97	85.24	2.2227	
Years	..	..	2	723.60	361.80	2.9456	
Error	..	..	8	119.03	14.88	1.3501	
Total	..	..	14	1183.60	84.54	....	

$$S. D. = \sqrt{14.88} = 3.858.$$

*Mean yields.*

				Treatments.				
				1	2	3	4	5
Mean yields	..	..	..	57.67	61.00	47.33	54.67	51.33

$$\text{Mean S. E.} = \sqrt{\frac{14.88}{3}} = 2.227.$$

The 5 per cent. point of "Z" for  $n_1 = 4$  and  $n_2 = 8$  is 0.6725 while in the present case, it is found to be 0.8726. This indicates that there is a significant effect due to treatments. The standard error for comparing the means is 3.15 and hence the significance in the difference of treatment means is 7.26. From this, we see that treatment 2 is the best yielding one being significantly better than 3 and 5. The interest lies in this that no-manure gives better yield—in the case of treatment 3 significantly better—than the last 3 of the treatments. Treatment 4 is significantly better than treatment 3.

Crop—Cotton. Set of plots A<sub>2</sub>. 1917-18 to 1921-22.

Yield in lbs. per plot.

Treatments.					Years.		
					1917	1919	1921
1	..	..	..	..	36	36	23
2	..	..	..	..	46	44	27
3a	..	..	..	..	30	36	31
4	..	..	..	..	48	43	35
5	..	..	..	..	34	36	35

*Analysis of variance.*

Kind of variation.				D.	Sum of squares.	Mean square or variance.	$\frac{1}{2} \text{Log}_e V.$
Treatments	..	..	4	234.67	58.67	2.0273	
Years	..	..	2	252.40	126.20	2.4190	
Error	..	..	8	186.93	23.37	1.5758	
Total	..	..	14	674.00	48.14	....	

$$S. D. = \sqrt{23.37} = 4.834.$$

*Mean yields.*

	Treatments.				
	1	2	3a	4	5
Mean yields .. ..	31.67	39.00	32.33	42.00	35.00

$$\text{Mean S. E.} = \sqrt{\frac{23.37}{3}} = 2.791.$$

The 5 per cent. point of "Z" for  $n_1 = 4$  and  $n_2 = 8$  is 0.6725 while in the present case, the same is found to be 0.4515. This indicates that there is no significant effect due to treatments on the whole.

The significance in difference of treatment means comes to 9.11. From this figure, we see that treatment 4 alone is significantly better than the treatments 1 and 3a. It may be noted that the treatments 2, 3a and 5 give better yields—though not significantly—than the check.

Crop—Cotton. Set of plots B<sub>2</sub>. 1908-09 to 1914-15.  
Yields in lbs. per plot.

Treatments.				Years.			
				1908	1910	1912	1914
1	..	..	..	58	51	56	50
2	..	..	..	56	54	60	58
3	..	..	..	53	52	53	48
4	..	..	..	44	36	51	53
5	..	..	..	40	46	44	50

*Analysis of variance.*

Kind of variation.			D.	Sum of squares.	Mean square or variance.	$\frac{1}{2} \text{Log}_e V$
Treatments	..	..	4	416.80	104.20	2.3232
Years	..	..	3	71.35	23.78	1.5344
Error	..	..	12	241.40	20.12	1.5009
Total	..	..	19	729.55	38.39	....

$$S. D. = \sqrt{20.12} = 4.486.$$

*Mean yields.*

		Treatments.				
		1	2	3	4	5
Mean yields	..	53.75	57.00	51.50	46.00	45.00

$$\text{Mean S. E.} = \sqrt{\frac{20.12}{4}} = 2.243.$$

The 5 per cent. point of "Z" for  $n_1 = 4$  and  $n_2 = 12$  is 0.5907 while in the present case, it is found to be 0.8223 indicating thereby the significant effect due to treatments. The standard error for comparing the means is 3.17 and hence the significance in the difference of treatment means is 6.91.

From this figure, we see that treatments 1 and 2 are significantly better than treatments 4 and 5. Treatment 3 gives better yield (though not significantly) than treatments 4 and 5. The important point to be noted here is that the no-manure gives higher yield than the last three treatments.

Crop—Cotton. Set of plots B<sub>2</sub>. 1916-17 to 1920-21.

Yield in lbs. per plot.

Treatments.					Years.		
					1916-17	1918-19	1920-21
1	..	..	..	..	36	33	43
2	..	..	..	..	36	39	49
3a	..	..	..	..	32	36	43
4	..	..	..	..	32	51	48
5	..	..	..	..	29	28	33

*Analysis of variance.*

Kind of variation.	D.	Sum of squares.	Mean square or variance.	$\frac{1}{2} \log_e V$
Treatments .. .. .	4	325.73	81.43	2.1999
Years .. .. .	2	261.73	130.86	2.4371
Error .. .. .	8	168.27	21.03	1.5230
Total .. .. .	14	755.73	53.98	....

$$S. D. = \sqrt{21.03} = 4.586.$$

*Mean yields.*

		Treatments.				
		1	2	3a	4	5
Mean yields .. .. .	..	37.33	41.33	37.00	43.67	30.00

$$\text{Mean S. E.} = \sqrt{\frac{21.03}{3}} = 2.648.$$

The 5 per cent. point of "Z" for  $n_1 = 4$  and  $n_2 = 8$  is 0.6725; in the present case, it is found to be 0.6769 indicating thereby significance due to treatments. The standard error for comparing the means is 3.74 and hence the significance in the difference of treatment means is 8.63. From this we see that treatments 2 and 4 are significantly better than treatment 5. Treatments 3a and 1 give better yields—though not significantly—than treatment 5.

*Crop—Jowar.* Set of plots B<sub>2</sub>. 1909-10 to 1915-16.  
Grain yields in lbs. per plot.

	Treatment.	Years.		
		1909	1913	1915
1	.. .. .	94	86	78
2	.. .. .	101	126	122
3	.. .. .	78	82	87
4	.. .. .	119	130	129
5	.. .. .	92	112	121

The results of 1911-12 were omitted as they were abnormally low.

*Analysis of variance.*

Kind of variation.	D.	Sum of squares.	Mean square or Variance.	$\frac{1}{2}$ Loge V.
Treatment .. .. .	4	4,344.40	1,086.10	3.4952
Years .. .. .	2	367.60	183.80	2.6069
Error .. .. .	8	676.40	84.55	2.2187
Total .. .. .	14	5,388.40	384.88	....

$$S. D. = \sqrt{84.55} = 9.1951.$$

*Mean yields.*

	Treatments.				
	1	2	3	4	5
Mean yields .. .. .	86.00	116.33	82.33	126.00	108.33

$$\text{Mean S. E.} = \frac{\sqrt{84.55}}{\sqrt{3}} = 5.2085.$$

According to Fisher's Table, the 5 per cent. point of 'Z' for  $n_1 = 4$  and  $n_2 = 8$  is 0.6725 while in the present case the same is found to be 1.2765. This indicates that there is a significant effect due to treatments. The standard error for comparing the means is 7.36 and hence the significance in the difference of treatment means is 16.98. Judging from this figure, we see that treatment 4 is the best yielding one, being significantly better than the rest except treatment 2. Treatments 2 and 5 are significantly better than treatments 1 and 3. It may be noted that no-manure gives higher (not significantly) yield than treatment 3.

*Crop—Jowar.* Set of plots B<sub>2</sub>. 1917-18 to 1921-22.

*Grain yields in lbs. per plot.*

Treatments.	Years.		
	1917.	1919.	1921.
1 .. .. .	52	48	50
2 .. .. .	67	58	108
3a .. .. .	52	51	88
4 .. .. .	82	86	132
5 .. .. .	72	100	107

*Analysis of variance.*

Kind of variation.	D	Sum of squares.	Mean square or Variance.	‡ Log V.
Treatments .. .. .	4	5,076.40	1,269.10	3.5730
Years .. .. .	2	3,072.53	1,536.26	3.6685
Error .. .. .	8	1,474.80	184.35	2.6058
Total .. .. .	14	9,623.73	687.41	....

$$S. D. = \sqrt{184.35} = 13.578.$$

*Mean yields.*

	Treatments.				
	1	2	3a	4	5
Mean yields .. .. .	50.00	77.67	63.67	100.00	93.00

$$\text{Mean S. E.} = \sqrt{\frac{184.34}{3}} = 7.839.$$

According to Fisher's Table, the 5 per cent. point of 'Z' for  $n_1 = 4$  and  $n_2 = 8$  is 0.6725, while in the present case, the same is found to be 0.9672. This clearly shows that the treatments had a significant effect on the whole. The standard error for comparing the means is 11.08 and hence the significance in the difference of treatment means is 25.56. Judging from this figure, we see that the treatments 4 and 5 have the best yielding capacity, being significantly better than the rest except 2. Treatment 2 gives significantly better results than the check. Thus, all the treatments except 3a give significantly better results than check.

To summarize the effects of the various manures on the *Jowar-Cotton* rotation, the results stand as follows:—

On *Jowar*.—Treatments 2, 4, 5 have a distinct effect on the crop. Throughout the whole period of the experiment, these treatments have shown a significantly better result than the rest of the treatments. Among themselves treatment 4 (*Poudrette*) is the best yielding one followed by 5 and 2 in order. The treatments 3 and 3a do not show any advantage at all over the check. In fact in 3 years out of 4, treatment 3 (*cactus*) has given lower yield than the check itself and hence the use of *cactus* should be avoided.

On *Cotton*.—The treatments 2, 4, and 5 show a decided advantage over the rest of the treatments. Among these three treatments, treatment 4 (*Poudrette*) is the best yielding one, being significantly better than 2 and 5 in some years. As in the case of *Jowar*, the treatments 3 and 3a show no advantage. In two years out of four treatment 3 has given lower yield than the check itself.

Thus, treatments 2, 4 and 5 have a significantly better effect on the *jowar* and *cotton* rotation, treatment 4 being the best in the whole lot.

#### DHARWAR FARM IV.

To ascertain the effects of (1) no manure, (2) 5 tons *Mohua* refuse per acre every year.

*Crop*—*Jowar-cotton* rotation.

*Plots*—4 gunthas each.

*Lay-out*—Duplicated in 1911-12 and 1912-13, and unreplicated thereafter.

Treatment.	1911-12 : <i>Jowar</i> .			1912-13 : <i>Cotton</i> .			Net profits per rotation.
	Yields in lbs.	Average.	Significance.	Yields in lbs.	Average.	Significance.	
1	42 55	49	} 10·3 {	50 49	50	} 2·3 {	5·2
2	62 60	61		53 49	51		4·9

The above figures show that the effect of the treatment is not significant for *cotton*. Total net profit for the rotation is less in the case of the treated plot than for the untreated plot.

The experiment was continued on single plots the results of which are given below:—

Treatment.	1913-14	1914-15	Net profit for the rotation.	1913-14	1914-15	Net profit for the rotation.
	<i>Jowar</i> .	<i>Cotton</i>		<i>Cotton</i> .	<i>Jowar</i> .	
			Rs.			Rs.
1	122	50	6·4	50	79	4·3
2	121	46	4·5	39	89	2·8



Throughout the experiment the treatment has given a consistently lower net profit for the rotation than the unmanured plot. This tends to show that the manure is not efficient.

### DHARWAR FARM V.

#### Crop—Jowar-Cotton Rotation.

*Experiment V(a).*—To compare the effects of—

- (1) No-manure.
- (2) Safflower-cake 20 lbs. N. per acre.
- (3) *Karanj* cake do.
- (4) Castor cake do.
- (5) Crushed cotton seed do.

All these given as top-dressings without any basic manure.

*Experiment V(b).*—The same five treatments as above with a basic manure of 2 tons of F.Y.M. per acre for all the plots except the no-manure plot.

*Note.*—In both the experiments the manures both basic as well as the top-dressings are applied in alternate years, so that only *Jowar* receives the manure.

*Plots*—4 gunthas each.

*Lay-out*—Duplicated.

#### *Experiment V(a)*—Jowar.

##### Set 'A'.

Treatment.	1908-09			1910-11		
	Grain yields.		Average.	Grain yields.		Average.
	(i)	(ii)		(i)	(ii)	
1 ..	138	107	123	102	70	86
2 ..	136	122	129	106	104	105
3 ..	146	128	137	105	93	99
4 ..	134	123	129	112	88	100
5 ..	120	109	115	85	99	92
Significance ..	8·8			19·3		

#### *Experiments V(a)*—Cotton.

##### Set 'A'.

Treatment.	1909-10			1911-12			Average net profit per rotation.
	Seed-cotton yields in lbs.		Average	Seed-cotton yields in lbs.		Average	
	(i)	(ii)		(i)	(ii)		
1 ..	58	57	58	28	32	30	Rs. 7·7
2 ..	62	58	60	29	29	29	7·8
3 ..	62	67	60	26	32	29	7·7
4 ..	59	58	59	30	28	29	6·6
5 ..	55	56	56	29	31	30	5·3
Significance ..	2·6			3·4			

The figures were treated by method III.

From the above it is seen that the treatments have practically no significant effect on the cotton crop, whereas the *Jowar* crop shows some effect in favour of treatments 2, 3 and 4. But the net profit for treatment 4 is very low and hence treatments 2 and 3 may be said to be the most favourable of the lot. But it may be noted that the difference between the treated and the untreated plots is always just equal to the significant figure and even less sometimes. In the net profits the two favourable treatments give only equal figures with the no-manure plot.

*Experiment V(a)—Cotton.*

Set 'B'.

Treatment.	1908-09			1910-11			1912-13		
	Seed-cotton yields in lbs.		Average	Seed-cotton yields in lbs.		Average	Seed-cotton yields in lbs.		Average.
	(i)	(ii)		(i)	(ii)		(i)	(ii)	
1 ..	58	58	58	51	54	53	56	57	57
2 ..	61	59	60	54	51	53	63	62	63
3 ..	65	49	57	54	52	53	62	61	62
4 ..	67	52	60	50	47	49	67	60	64
5 ..	60	42	51	54	45	50	61	61	61
Significance ..	9.0			4.6			3.3		

*Experiment V(a)—Jowar.*

Set 'B'.

Treatment.	1909-10			1911-12			Average net profit per rotation.
	Grain yields in lbs.		Average	Grain yields in lbs.		Average	
	(i)	(ii)		(i)	(ii)		
1 ..	94	109	103	46	48	47	Rs. 6.4
2 ..	105	115	110	46	53	49	5.7
3 ..	106	121	114	50	50	50	5.7
4 ..	111	109	110	62	54	58	5.7
5 ..	96	111	104	64	54	59	4.8
Significance ..	7.7			7.7			

The figures were treated by method III.

In calculating the net profits for complete rotations the cotton yields of 1908-09 had to be neglected as it had no counterpart of *jowar*. It is seen from the above that the treatments seem to have practically the same effect, and especially treatments 2, 3 and 4 differ very slightly from each other for both crops. The net profits also show that these three treatments are equally profitable though less than the no-manure plot.

## Experiment V (b)—Jowar.

## Set 'A'.

Treatment.	1912-13			1914-15		
	Grain yields in lbs. per plot.		Average.	Grain yields in lbs. per plot.		Average.
	(i)	(ii)		(i)	(ii)	
1 ..	66	41	49	57	54	56
2 ..	77	75	76	89	85	87
3 ..	72	71	72	96	94	95
4 ..	79	77	78	83	77	80
5 ..	59	62	61	73	88	81
Significance ..	7.6			9.0		

## Cotton.

## Set 'A'.

Treatment.	1913-14			1915-16			Average net profit per rotation.
	Seed-cotton yields in lbs.		Average.	Seed-cotton yields in lbs.		Average.	
	(i)	(ii)		(i)	(ii)		
1 ..	71	52	62	44	41	43	Rs. 5.1
2 ..	66	58	62	52	47	50	5.2
3 ..	71	54	63	55	47	51	5.4
4 ..	69	58	64	62	46	54	5.4
5 ..	59	61	60	56	42	49	4.4
Significance ..	5.0			6.0			

The figures were treated by method III. In the above cases also treatments 2, 3 and 4 continue to maintain their equality in giving net profits as well as yields. Though they give slightly better yields than the no-manure in net profits they become equal to the latter. It must be noted that treatment 5 has been uniformly giving low yields and low net profits.

## Jowar.

## Set 'B'.

Treatment.	Grain yields in lbs. per plot.		Average.	Grain yields in lbs. per plot.		Average.
	(i)	(ii)		(i)	(ii)	
1 ..	86	105	96	79	81	80
2 ..	129	119	124	109	133	121
3 ..	118	113	116	111	115	113
4 ..	133	114	124	128	116	122
5 ..	134	138	136	100	129	115
Significance ..	15.4			17.9		

*Cotton.*  
Set 'B'.

Treatment.	1914-15.			Average net profit for the rotation.
	Seed-cotton yields in lbs. per plot.		Average.	
	(i)	(ii)		
1	50	51	51	5.4
2	60	62	61	6.0
3	55	53	54	5.1
4	62	56	59	6.1
5	63	56	60	5.4
Significance	4.3			

The figures are treated by method III.

In the above data, that for *jowar* in 1915-16 had to be omitted as there was no counterpart of cotton for that set of plots to calculate the net profit per rotation. Hence we have only one complete rotation here. In this case there is a distinct difference between treatment 3 and 2 and 4 both in yields and net profits. Treatment 3 falls below the other two.

Summing up we can say that the effects of applying oil-cakes to the extent of 20 lbs. N. per acre are not perceptible in many cases as the yields and the net profits of the treated plots are equal to those of the untreated plots. Among the treatments, treatments 2, 3 and 4 have been giving equal yields and equal net profits in most cases. Treatment 5 where crushed cotton seed is used is proved useless because it has been giving consistently low yields and net profits.

It seems to make no difference whether the cakes are applied with or without a basic manure so far as the yields are concerned, hence it is observed that the net profits are lower when the basic manure is used.

On the whole whether the use of oil-cakes is economical or not is doubtful.

### DHARWAR FARM VI.

#### *Crop—Jowar and Cotton Rotation.*

To ascertain the comparative effects of (1) Sulphate of ammonia 10 lbs. N. per acre, and (2) F.Y.M. equal in value to the above. The above manures are applied every year in addition to the basic manure of 2.5 tons of F.Y.M. once in two years for the *Jowar* crop.

Plots—4 gunthas each.

Lay-out—Unreplicated.

Jowar.

Set of Plots 'A'.

Treatments.	Grain yields in lb. per plot					Average net profits per plot.
	1908.	1910.	1912.	1914.	Average.	
1 .. ..	106	72	68	90	84	Rs. 2.1
2 .. ..	110	64	101	100	94	2.5

Jowar.

Set of Plots 'B'.

Treatments.	Grain yields in lbs. per plot.					Average net profits per plot.
	1909.	1911.	1913.	1915.	Average.	
1 .. ..	82	55	143	..	93	Rs. 2.7
2 .. ..	87	52	133	..	91	2.5

Cotton.

Set of Plots 'A'.

Treatments.	Seed-cotton yields per plot.					Average net profit per plot.
	1908.	1910.	1912.	1914.	Average.	
1 .. ..	..	45	57	47	50	Rs. 2.5
2 .. ..	..	50	60	64	58	3.0

Cotton.

Set of Plots 'B'.

Treatments.	Seed-cotton yields per plot.					Average net profits per plot.
	1909.	1911.	1913.	1915.	Average.	
1 .. ..	50	22	58	48	45	Rs. 2.6
2 .. ..	55	23	58	53	47	2.9

In set of Plots 'A', there is a distinct evidence that F.Y.M. may prove better than Sulphate of ammonia both in yields and net profits for the above rotation. But in set of plots 'B', the difference is not so marked but yet F.Y.M. is slightly better than the other here also in giving the net profits.

## DHARWAR FARM VII.

*Crop—Jowar and Cotton, in rotation.*

To ascertain the comparative effects of:—

- (1) Superphosphate 100 lbs. per acre.
- (2) Sulphate of potash 100 lbs. per acre.
- (3) Sulphate of ammonia 100 lbs. per acre.
- (4) No manure.
- (5) Sulphate of potash 100 lbs. *plus* superphosphate 100 lbs. per acre\*
- (6) Sulphate of ammonia 100 lbs. *plus* superphosphate 100 lbs. per acre.
- (7) Sulphate of ammonia 100 lbs. *plus* sulphate of potash 100 lbs. per acre.
- (8) Sulphate of ammonia, sulphate of potash, and superphosphate, each 100 lbs. per acre.

*Plots—4 gunthas each.*

*Lay-out—Unreplicated.*

Seed-cotton yields in lbs. per plot.						Average.	Grain yields of <i>Jowar</i> in lbs. per plot.					Average.	Average net profit per rotation.
1908	1910	1912	1914	1916	1909		1911	1913	1915	1917			
1	23	32	54	55	41	41	112	36	131	104	55	88	Rs. 3.7
2	33	38	44	46	38	39	113	52	105	105	52	85	4.1
3	25	30	49	54	42	40	123	55	110	110	48	89	4.2
4	36	53	57	50	34	46	107	55	108	94	51	83	5.7
5	28	34	59	57	48	45	104	40	136	119	59	92	3.7
6	20	30	71	65	54	48	119	45	133	125	69	98	4.1
7	29	29	65	50	41	43	121	53	114	113	66	93	4.0
8	11	29	74	68	49	46	112	35	123	124	64	92	3.1

The above results are not much encouraging; the first three treatments are higher than the non-treated plots, the net profits show that the non-treated plot stands foremost. This fact questions the utility of the application of the manures.

## Set of Plots "B".

Treatments.	Seed-cotton yields in lbs. per plot.				Average	Grain yields in lbs. per plot.			Average	Net profit per rotation.
	1911	1913	1915	1917		1912	1914	1916		
1	32	71	57	61	55	51	72	49	67	Rs. 3.2
2	32	62	57	54	51	37	58	45	47	3.7
3	31	68	54	52	49	31	70	46	49	3.1
4	30	53	45	44	43	26	56	38	40	3.7
5	31	46	50	49	44	34	67	43	48	0.9
6	33	53	55	57	50	42	78	42	54	1.1
7	28	49	45	49	43	30	49	44	41	1.6
8	30	54	54	45	46	52	72	42	55	0.5

Though the combination of manures gives slightly higher yields, their prohibitory costs make them far inferior to the no-manure plot economically. Again when these combinations are compared with the single-manure treatments, they go down still lower both economically and in yields. The application of sulphate of potash alone gives a net profit equal to that of no-manure. The other two single-manures give lower net profits than the no-manure. Hence the manures show no advantage.

## DHARWAR FARM VIII.

To ascertain the comparative effects of the following treatments of 10 lbs. N. in various forms applied in addition to the basic of 2 tons of F.Y.M. per acre on alternate years :—

- (1) Nitre.
- (2) Calcium cyanamide.
- (3) Sulphate of amonia.
- (4) F.Y.M. 10 lbs. N.
- (5) No-manure.
- (6) Calcium nitrate.
- (7) Nitrate of soda.

Plots—4 gunthas each.

Lay-out—Duplicated.

Note.—The basic dose is applied in alternate years to *jowar* alone. The artificials are given every year to both cotton and *jowar*. All the artificials are given half at the time of sowing and the remaining half six weeks later.

The experiment extends from 1908-09 to 1917-18. Four blocks A, B, C and D of 7 plots each are taken as shown in the plan for the experiment. Blocks A, B and C are cropped with cotton in the years 1908-09, 1910-11, 1912-13, 1914-15, 1916-17 and sown with *jowar* in other years.

Blocks B and D are cropped with cotton in 1909-10, 1911-12, 1913-14, 1915-16 and 1917-18 and with *jowar* in other years.

Since the treated plots within each block remain the same throughout, each block has been taken separately and the results of all the years for the crop are tabulated and analysed by method IV.

*Lay-out of the experiment on Dharwar Farm VIII for the years 1908-09, 1910-11, 1912-13, 1914-15, 1916-17.*

A	B	C	D
Cotton.	<i>Jowar.</i>	Cotton.	<i>Jowar.</i>
642 1	641 1	330 7	329 7
640 2	639 2	332 6	331 6
638 3	637 3	334 5	333 5
636 4	635 4	336 4	335 4
634 5	633 5	338 3	337 3
632 6	631 6	340 2	339 2
630 7	629 7	342 1	341 1

1. Nitre.
2. Calcium cyanamide.
3. Sulphate of ammonia.
4. 10 lbs. N. F.Y.M.
5. No artificial.
6. Calcium nitrate.
7. Nitrate of soda.



*Lay-out of the experiment on Dharwar Farm VIII for the years  
1909-10, 1911-12, 1913-14, 1915-16, 1917-18.*

A	B	C	D
Jowar.	Cotton.	Jowar.	Cotton.
642 1	641 1	330 7	329 7
640 2	639 2	332 6	331 6
638 3	637 3	334 5	333 5
636 4	635 4	336 4	335 4
634 5	633 5	338 3	337 3
632 6	631 6	340 2	339 2
630 7	629 7	342 1	341 1

1. Nitre.
2. Calcium cyanamide.
3. Sulphate of ammonia.
4. 10 lbs. N. F.Y.M.
5. No artificial.
6. Calcium nitrate.
7. Nitrate of soda

## DHARWAR FARM VIII.

\* Crop—Cotton. Set of Plots "A."

Seed-cotton yield in lbs. per plot.

Treatments.	Years.				
	1908	1910	1912	1914	1916
1 .. ..	71	51	75	68	48
2 .. ..	70	54	61	84	47
3 .. ..	56	46	76	60	46
4 .. ..	57	58	72	58	40
5 .. ..	40	52	50	48	35
6 .. ..	50	57	58	53	36
7 .. ..	49	50	58	54	42

*Analysis of variance.*

Kind of variation.	D	Sum of squares.	Mean square or variance.	$\frac{1}{2}$ Loge V.
Treatments .. ..	6	1,130.74	188.46	2.6194
Years .. ..	4	1,875.03	468.76	3.0751
Error .. ..	24	830.97	34.62	1.7722
Total .. ..	34	3,836.74	112.84	....

$$S. D. = \sqrt{34.62} = 5.844.$$

*Mean yields.*

	Treatments.						
	1	2	3	4	5	6	7
Mean yields ..	62.60	59.20	56.80	57.00	44.60	50.80	50.60

$$\text{Mean S. E.} = \sqrt{\frac{34.62}{5}} = 2.631.$$

The 5 per cent. point of "Z" for  $n_1 = 6$  and  $n_2 = 24$  is 0.4598 while in the present case, it is found to be 0.8472. This indicates clearly that there is a significant effect due to treatments on the whole. The standard error for comparing any two means is 3.72 and hence the significance in difference of treatment means is 7.68. Judging from this figure, we see that the first four treatments are significantly better than the no-manure. The first two treatments—nitre and calcium cyanamide—are also significantly better than the last two. All the treatments give better yields than the check.

## DHARWAR FARM VIII.

Crop—Jowar. Set of Plots "A".

Grain yields in lbs. per plot.

Treatments	Years.				
	1909	1911	1913	1915	1917
1 .. .. .	111	76	162	109	84
2 .. .. .	98	72	127	104	81
3 .. .. .	98	60	147	104	84
4 .. .. .	77	54	142	96	76
5 .. .. .	78	50	125	77	70
6 .. .. .	95	60	147	102	82
7 .. .. .	89	56	132	118	71

*Analysis of variance.*

Kind of variation.	D	Sum of squares.	Mean square or variance.	$\frac{1}{2}$ Loge V.
Treatments .. .. .	6	2,325.88	387.65	2.9801
Years .. .. .	4	24,705.59	6,176.40	4.3642
Error .. .. .	24	1,322.41	55.10	2.0046
Total .. .. .	34	28,353.88	833.93	....

$$S. E. = \sqrt{55 \cdot 10} = 7.423.$$

*Mean yields.*

	Treatments.						
	1	2	3	4	5	6	7
Mean yields ..	108.4	96.4	98.6	88.8	80.6	97.2	93.2

$$\text{Mean S. E.} = \sqrt{\frac{55 \cdot 10}{5}} = 3.320.$$

The 5 per cent. point of "Z" for  $n_1 = 6$  and  $n_2 = 24$  is 0.4598 while in the present case, it is found to be 0.9755. This indicates that there is a significant effect due to treatments. The standard error for comparing the means is 4.69 and hence the significance in the difference of treatment means is 9.69. From this figure, we see that treatment 1 (Nitro) is the best yielding treatment, being significantly better than the rest. Treatments 2, 3, 6 and 7 are all significantly better than the no-manure.

Treatment 4 though not significantly better than no-manure gives higher yield than the check. Thus all the treatments show a significant effect over the no-manure except that treatment 4 falls short by a small margin.

DHARWAR FARM VIII.

Crop—Jowar. Set of Plots "B".

Grain yields in lbs. per plot.

Treatments.	Years.				
	1908	1910	1912	1914	1916
1 .. .. .	156	61	52	86	60
2 .. .. .	116	64	60	68	52
3 .. .. .	137	71	74	84	46
4 .. .. .	131	57	54	70	52
5 .. .. .	139	54	52	66	53
6 .. .. .	140	53	62	81	48
7 .. .. .	144	61	57	84	54

Analysis of variance.

Kind of variation.	D	Sum of squares.	Mean square or variance.	$\frac{1}{2}$ Loge V.
Treatments .. .. .	6	671.94	111.99	2.3592
Years .. .. .	4	34,346.68	8,586.67	4.5091
Error .. .. .	24	376.92	15.70	1.3770
Total .. .. .	34	35,395.54	1,041.45	....

$$S. D. = \sqrt{15.70} = 3.96.$$

Mean yields.

	Treatments.						
	1	2	3	4	5	6	7
Mean yields ..	83.00	72.00	82.40	72.80	72.80	76.80	80.00

$$\text{Mean S. E.} = \sqrt{\frac{15.70}{5}} = 1.77.$$

The 5 per cent. point of "Z" for  $n_1 = 6$  and  $n_2 = 24$  is 0.4598 while in the present case, it is found to be 0.9822. Hence there is significant effect due to treatments. The standard error for comparing the two means is 2.50, while the significance comes to 5.16. Hence we see that treatments 1, 3 and 7 are significantly better than treatments 2, 4, 5 and 6 except in one case where treatment 7 falls short by a small margin.

Crop—Cotton. Set of Plots "B".

Seed-cotton yield in lbs. per plot.

Treatments.	Years.			
	1909	1913	1915	1917
1 .. .. .	67	82	59	63
2 .. .. .	68	78	59	74
3 .. .. .	63	71	58	60
4 .. .. .	57	63	58	58
5 .. .. .	55	55	47	48
6 .. .. .	60	65	60	60
7 .. .. .	58	67	60	60

The results of 1911 were omitted as they were abnormally low.

Analysis of variance.

Kind of variation.	D	Sum of squares.	Mean square or variance.	$\frac{1}{2} \text{Loge } V.$
Treatment .. .. .	6	878.93	146.49	2.4936
Years .. .. .	3	493.25	164.42	2.5547
Error .. .. .	18	255.50	14.19	1.3262
Total .. .. .	27	1,627.68	60.28	....

$$S. D. = \sqrt{14.19} = 3.77.$$

Mean yields.

	Treatments.						
	1	2	3*	4	5	6	7
Mean yields ..	67.75	69.75	63.00	59.00	51.25	61.25	61.25

$$\text{Mean S. E.} = \sqrt{\frac{14.19}{4}} = 1.89.$$

The 5 per cent. point of "Z" for  $n_1 = 6$  and  $n_2 = 18$  is 0.4894, while in the present case, it is found to be 1.1674 this shows that there is significant effect due to treatments. The standard error for comparing two means being 2.67, the significance comes to 5.62. Judging in the light of this figure, we see that all treatments are significantly better than the no-manure. Also treatments 1 and 2 are significantly better than 3, 4, 6 and 7, except that in one case treatment 1 falls short by a small margin.

## DHARWAR FARM VIII.

Crop—Cotton. Set of Plots C.

Seed-cotton yield in lbs. per plot.

Treatments.	Years.				
	1908	1910	1912	1914	1916
1 .. ..	48	41	64	63	47
2 .. ..	56	60	62	58	56
3 .. ..	58	53	63	57	43
4 .. ..	57	52	62	70	50
5 .. ..	60	55	64	53	50
6 .. ..	59	43	62	66	47
7 .. ..	62	54	68	65	48

## Analysis of variance.

Kind of variation.	D	Sum of squares.	Mean square or variance.	$\frac{1}{2} \text{Log}_e V.$
Treatments .. ..	6	171.09	28.51	1.6751
Years .. ..	4	1,168.40	292.10	2.8385
Error .. ..	24	559.20	23.30	1.5743
Total ..	34	1,898.69	55.84	.....

$$S. D. = \sqrt{23.30} = 4.73.$$

## Mean yields.

	Treatments.						
	1	2	3	4	5	6	7
Mean yields ..	52.60	58.40	54.80	58.20	56.40	55.40	59.40

$$\text{Mean S. E.} = \sqrt{\frac{23.30}{5}} = 2.16.$$

The 5 per cent. point of "Z" for  $n_1 = 6$  and  $n_2 = 24$  is 0.4598 while in the present case, it is found to be 0.1008 indicating thereby the non-significance of the treatments on the whole. The standard error for comparing the means is 3.05 and the significance comes to 6.30. From this, we see that treatment 7 alone is significantly better than treatment 1. No two other treatments differ by this amount and so they show no significance. It may be noted that the no-manure treatment gives higher yield than treatments 1, 4 and 6.

## DHARWAR FARM VIII.

Crop—Jowar. Set of Plots C.

Grain yields in lbs. per plot.

Treatments.	Years.				
	1909	1911	1913	1915	1917
1 .. ..	117	51	166	116	88
2 .. ..	100	53	138	113	68
3 .. ..	99	58	143	98	73
4 .. ..	103	63	140	111	72
5 .. ..	100	65	130	74	58
6 .. ..	116	60	139	100	84
7 .. ..	111	66	156	102	86

## Analysis of variance.

Kind of variation.	D	Sum of squares.	Mean square or variance.	$\frac{1}{2} \text{Log}_e V.$
Treatments .. ..	6	1,595.37	265.895	2.7916
Years .. ..	4	29,739.31	7,434.828	4.4570
Error .. ..	24	1,801.49	75.062	2.1591
Total .. ..	34	33,136.17	974.593	....

$$S. D. = \sqrt{75.062} = 8.664.$$

## Mean yields.

	Treatments.						
	1	2	3	4	5	6	7
Mean yields ..	107.60	94.40	94.20	97.80	85.40	99.80	104.20

$$\text{Mean S. E.} = \sqrt{\frac{75.062}{5}} = 3.873.$$

The 5 per cent. point of "Z" for  $n_1 = 6$  and  $n_2 = 24$  is 0.4598 while in the present case, it is found to be 0.6325. Hence there is significance due to treatments. The standard error for comparing the means is 5.48. The significance comes to 11.30. Judging from this figure, we see that the treatments 1, 4, 6 and 7 are significantly better than the no-manure. Treatment 1 is also significantly better than treatments 2 and 3.

## DHARWAR FARM VIII.

Crop—Jowar. Set of Plot D.

Grain yields in lbs. per plot.

Treatments.	Years.				
	1908	1910	1912	1914	1916
1 .. ..	114	68	51	82	26
2 .. ..	105	75	53	58	44
3 .. ..	122	74	63	79	46
4 .. ..	115	69	53	71	53
5 .. ..	115	72	38	51	48
6 .. ..	134	80	36	80	54
7 .. ..	130	72	48	76	58

## Analysis of variance.

Kind of variation.	D	Sum of squares.	Mean square or variance.	$\frac{1}{2} \text{Log}_e V.$
Treatments .. ..	6	800.80	133.47	2.4459
Years .. ..	4	23,786.46	5,946.61	4.3453
Error .. ..	24	1,944.34	81.01	2.1974
Total .. ..	34	26,531.60	780.34	....

$$S. D. = \sqrt{81.01} = 9.001.$$

## Mean yields.

	Treatments.						
	1	2	3	4	5	6	7
Mean yields ..	68.20	67.00	76.80	72.20	64.80	76.80	76.80

$$\text{Mean S. E.} = \sqrt{\frac{81.01}{5}} = 4.025.$$



The 5 per cent. point of "Z" for  $n_1 = 6$  and  $n_2 = 24$  is 0.4598 while in the present case, it is found to be 0.2485. This shows that there is no significant effect due to treatments on the whole. The standard error for comparing the means is 5.69 while the significance comes to 11.75. In light of this figure, we see that treatments 3, 6 and 7 alone are significantly better than the no-manure.

**DHARWAR FARM VIII.**  
*Crop—Cotton. Set of Plots D.*  
*Seed-cotton yield in lbs. per plot.*

Treatments.				Years.			
				1909	1913	1915	1917
1	..	..	..	54	64	51	46
2	..	..	..	56	65	52	52
3	..	..	..	54	69	55	56
4	..	..	..	62	77	63	55
5	..	..	..	62	73	57	57
6	..	..	..	46	80	57	67
7	..	..	..	62	73	63	63

Results of 1911 were omitted as they were abnormally low.

*Analysis of variance.*

Kind of variation.			D	Sum of squares.	Mean square or variance.	$\frac{1}{2} \text{Log}_6 V.$
Treatments	..	..	6	445.43	74.24	2.1539
Years	..	..	3	1452.39	484.13	3.0911
Error	..	..	18	116.86	6.49	0.9351
Total	..	..	27	2014.68	74.62	....

$$S. D. = \sqrt{6.49} = 2.548.$$

*Mean yields.*

	Treatments.						
	1	2	3	4	5	6	7
Mean yields	53.75	56.25	58.50	64.25	62.25	62.50	65.25

$$\text{Mean S. E.} = \sqrt{\frac{6.49}{4}} = 1.274.$$

The 5 per cent. point of "Z" for  $n_1 = 6$  and  $n_2 = 18$  is 0.4894 while in the present case, it is found to be 1.2188. This indicates that there is a significant effect due to treatment. The standard error for comparing two treatment means is 1.80 and hence the significance in the difference of treatment means is 3.78. Judging from this figure, we see that the last 4 treatments are significantly better than the first 3. Among the first three, treatment 3 gives better yield, being significantly better than 1. It may be noted that the no-manure treatment gives significantly better yield than the first three treated plots.

To summarize the effects of the various artificials on *jowar-cotton* rotation the results are as follows:—

The additional N has given increased yields for *jowar* over basic manure. The nitre treatment is the best yielding one followed by treatments 2, 3, 6 and 7 which are all more or less equal. In cotton there is only very slight increase in yield due to treatments. There seems to be no significant difference between the treatments.

### DHARWAR FARM IX.

#### *Crop—Jowar-Cotton Rotation.*

To ascertain the comparative effects of (1) Ammophos, (2) Sulphate of Ammonia, (3) Safflower-cake, (4) Nil, each of the manures being applied equivalent to 20 lbs. N per acre to cotton on alternate years, in addition to the basic F.Y.M. 2.5 tons per acre, applied to *jowar*.

*Plots*—4 gunthas each.

*Lay-out*—Unreplicated.

#### *Jowar grain and seed-cotton yields in lbs. per plot.*

#### Set of Plots "A".

Treatments.				Cotton 1924-25.	<i>Jowar</i> 1925-26.	Cotton 1926-27.	<i>Jowar</i> 1927-28.	Average net profits per rotation.
								Rs.
1	..	..	..	42	107	47	133	6.1
2	..	..	..	47	96	43	145	8.3
3	..	..	..	40	97	54	146	9.3
4	..	..	..	44	77	60	84	6.3

## Set of Plots "B".

Treatments.				Cotton 1925-26.	Jowar 1926-27.	Cotton 1927-28.	Net profits for the rotation.
							Rs.
1	..	..	..	61	82	36	7.7
2	..	..	..	67	81	31	9.5
3	..	..	..	67	79	65	8.0
4	..	..	..	55	85	29	9.3

The average yields of *Jowar* and Cotton for the sets of plots are as follows :—

Treatments.				Cotton.	Jowar.
1	..	..	..	47	107
2	..	..	..	47	107
3	..	..	..	57	107
4	..	..	..	47	82

These figures show that all the treatments are equally effective over the nil treatment for *Jowar*, whereas Safflower-cake alone seems to be effective for cotton. Considering the net profits the results show different conclusions for the two sets of plots. Treatments 2 and 3 may be better than 1.

## DHARWAR FARM X.

*Crop—Jowar-Cotton Rotation.*

To ascertain the comparative effects of (1) F.Y.M. 3 tons per acre, (2) F.Y.M. 1.5 tons plus Superphosphate 224 lbs. plus Potassium Chloride 80 lbs. plus Sulphate of Ammonia 60 lbs., (3) F.Y.M. 1.5 tons plus Superphosphate 224 lbs. plus Sulphate of Ammonia 60 lbs. Manures are given to cotton alone.

Plots—4 gunthas each.

Lay-out—Duplicated.

Note.—Out of the data available results for *Jowar* for 1912-13 and cotton for 1914-15 had to be neglected in taking complete rotations. Hence only two rotations were available.

*First Rotation.*

Treatments.	1912-13—Cotton.			1913-14—Jowar.			Net profit for the rotation.
	Plot yields.		Average.	Plot yields.		Average.	
	(i)	(ii)		(i)	(ii)		
1 ..	64	68	66	157	158	158	Rs. 10.4
2 ..	63	51	57	146	150	148	7.4
3 ..	58	52	54	149	153	151	8.2
Significance ..		8.5			1.8		

*Second Rotation.*

	1913-14—Cotton.			1914-15—Jowar.			Rs.
	(i)	(ii)	Average.	(i)	(ii)	Average.	
1 ..	64	66	65	103	89	96	6.7
2 ..	53	60	56.5	101	88	94.5	2.4
3 ..	49	44	46.5	98	78	88	2.2
Significance ..		6.4			4.4		

The figures were treated by method III.

In all the cases treatment 1 with F.Y.M. alone has given the highest yields and net profits.

## DHARWAR FARM XI.

*Crop—Jowar-Cotton Rotation.*

To compare the effects of—

- (1) F.Y.M. 5 tons per acre.
- (2) F.Y.M. 5 tons *plus* Superphosphate 201 lbs. *plus* Sulphate of Ammonia 67 lbs.
- (3) Cotton waste 5 tons per acre.
- (4) Cotton waste 5 tons *plus* Superphosphate 201 lbs. *plus* Sulphate of Ammonia 67 lbs. per acre.
- (5) No-manure.

Plots—10 to 20 gunthas each, but the yields were reduced to plots of 4 gunthas.

Lay-out—Unreplicated.

## Sets of Plots "A"—Three rotations.

	Seed cotton yields.				Jowar grain yields.				Average net profit.
	1911	1913	1915	Average.	1912	1914	1916	Average.	
		in lbs.			in lbs.				Rs.
1	30	68	81	60	50	44	69	54	4.5
2	26	90	83	66	51	57	66	58	3.9
3	23	49	79	50	90	58	35	64	2.0
4	25	83	82	63	71	63	59	64	2.0
5	33	65	58	52	42	37	46	42	4.1

## Set of Plots "B"—two rotations.

	1912	1914			1913	1915			
1	74	69	..	72	152	144	..	148	7.3
2	78	71	..	75	161	152	..	157	6.2
3	72	70	..	71	163	144	..	154	4.1
4	77	71	..	74	173	181	..	177	3.1
5	62	49	..	56	144	101	..	123	5.8

Though all manures yield more quantities of *jowar* and cotton than the no-manure treatment, when it comes to a question of economy all the treatments fall down except the first. Treatment 2 may be said to have given equal net profits with the no-manure treatment. The other two treatments are distinctly disadvantageous, since they give losses in the first set, and lower net profits below the no-manure in the other.

## DHARWAR FARM XII.

*Crop*—Cotton. " $D_1 \times D_2$ " Variety.

To ascertain the comparative effects of the following additions of artificials with a basic 2.5 tons of F.Y.M. per acre—

- (1) Ammophos 28 lbs. N per acre.
- (2) Safflower-cake 28 lbs. N per acre.
- (3) Calcium Cyanamide 28 lbs. N per acre.
- (4) Nitrate of Soda 28 lbs. N per acre.
- (5) Sulphate of Ammonia 28 lbs. N per acre.
- (6) Nitrate of Soda 28 lbs. N per acre plus F.Y.M. 14 lbs. N.
- (7) No addition.

*Plots*—4 gunthas each.

*Lay-out*—Duplicated.

## Year 1928-29.

Treatments.	Seed-cotton yields.		Average.	Average net profit per plot.
	(i)	(ii)		
	lbs.	lbs.	lbs.	Rs.
1 .. ..	42	45	43.5	5.8
2 .. ..	38	45	41.5	6.2
3 .. ..	42	52	47.0	6.7
4 .. ..	46	55	50.5	8.8
5 .. ..	41	52	46.5	8.9
6 .. ..	52	50	51.0	7.1
7 .. ..	50	44	47.0	12.1
Significance .. ..	..	6.9	..	..

The figures were treated by Method III. No treatment gives significantly better yields than the no addition treatment. The utility of the treatments itself is questioned when we look at the net profits where the non-treated plot gives the highest result.

## DHARWAR FARM XIII-A.

## Crop—Jowar 'Fulgar' Yellow Variety.

To ascertain the comparative effects of the following additions to the basic manure of 2.5 tons per acre :—

- (1) Nil.
- (2) Sodium nitrate 14 lbs. N plus 2.5 tons of F. Y. M.
- (3) Sodium nitrate 14 lbs. N.
- (4) Sulphate of ammonia 14 lbs. N.
- (5) Calcium cyanamide 14 lbs. N.
- (6) Safflower cake 14 lbs. N.

Plots—4 gunthas each.

Lay-out—Duplicated.

Treatments.	Year 1928-29. Plot yields in lbs.		Average.	Average net profit per plot.	Year 1929-30. Plot yields in lbs.		Average.
	(i)	(ii)			(i)	(ii)	
	lbs.	lbs.	lbs.	Rs.	lbs.	lbs.	lbs.
1 .. ..	180	247	214	14.0	168	183	176
2 .. ..	211	278	245	14.6	210	238	224
4 .. ..	203	267	235	15.9	194	226	210
3 .. ..	207	276	242	16.7	191	229	210
5 .. ..	189	303	246	16.3	203	237	220
6 .. ..	182	274	228	15.4	195	224	210
Significance .. ..	..	21.2	..	..	..	8.6	..

The figures were treated by Method III.

From the above it is seen that in the first year treatments 5, 2, 3 and 4 have given more or less equal yields all significantly higher than treatment 1. In the second year where the error is less treatments 2 and 5 show significantly better yields than treatments 3, 4 and 6 which are equal and in their turn significantly better than 1. Hence treatments 5 and 2 seem to stand out best for this crop.

### DHARWAR FARM XIII-B.

#### Crop—Jowar-Cotton Rotation.

To ascertain the comparative effects of all the treatments as in XIII-A for the rotation.

Plots—4 gunthas each.

Lay-out—Duplicated.

Note.—In this case the manures were applied to cotton in addition to those applied in the previous year to *jowar* on the same plots, the artificial manures being applied equivalent to 28 lbs. N. per acre as against 14 lbs. per acre applied to *jowar* in this previous year.

The results of *jowar* yields below are taken from the plots of 1928-29 in XIII-A above.

	1928-29, <i>Jowar</i> . Plot yields.			Average.	1929-30 Cotton. Plot yields.		Average.	Net Profit per rotation.
	(i)	(ii)			(i)	(ii)		
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	Rs.	
1 .. ..	180	247	214	36	44	40	12·7	
2 .. ..	211	278	245	65	55	60	12·1	
3 .. ..	203	267	235	69	60	65	13·5	
4 .. ..	207	276	242	63	59	61	14·4	
5 .. ..	189	393	246	58	52	55	13·2	
6 .. ..	182	274	228	52	50	51	11·2	
Significance .. ..	..	21·2	..	..	6·8	..	..	

The figures were treated by Method III.

Though treatment 5 gives the highest yield for *jowar* it falls down for cotton. Treatments 2, 3 and 4 give best yields for cotton. Considering the net profits treatment 4 stands first closely followed by 3 and 5. The others are not useful.

## DHARWAR FARM.

*Statement showing the cost of cultivation for no-manure plots in rupees per acre.*

Year.				Jowar.	Cotton.
				Rs.	Rs.
1908-09	..	..	..	8·90	27·69
1909-10	..	..	..	16·90	12·62
1910-11	..	..	..	14·57	16·42
1911-12	..	..	..	10·28	10·02
1912-13	..	..	..	11·40	16·65
1913-14	..	..	..	14·52	19·50
1914-15	..	..	..	11·90	12·81
1915-16	..	..	..	14·67	13·48
1916-17	..	..	..	11·03	14·08
1917-18	..	..	..	10·39	16·16
1918-19	..	..	..	23·50	17·99
1919-20	..	..	..	35·59	19·48
1920-21	..	..	..	26·50	19·68
1921-22	..	..	..	22·15	10·34
1922-23	..	..	..	15·00	16·00
1923-24	..	..	..	17·00	16·00
1924-25	..	..	..	13·00	18·00
1925-26	..	..	..	15·00	15·00
1926-27	..	..	..	8·00	6·00
1927-28	..	..	..	16·20	15·52
1928-29	..	..	..	10·13	15·53
1929-30	..	..	..	12·91	16·21



## DHARWAR FARM.

*Statement giving prices of the produce in lbs. per rupee.*

Year.	Jowar.			Cotton.			
	Grain.	Fodder.	Kumta.	Kumta-cross.	Dharwar No. 1.	Dharwar No. 2.	
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	
1908-09	25.5	122	12.0	..	..	..	
1909-10	33.0	150	10.0	..	..	..	
1910-11	30.0	150	10.0	8.0	..	..	
1911-12	27.0	150	9.0	8.0	..	..	
1912-13	30.0	150	9.0	..	..	..	
1913-14	32.0	170	10.3	9.5	..	..	
1914-15	32.0	200	10.0	9.0	..	..	
1915-16	24.0	350	9.0	8.3	..	..	
1916-17	34.0	200	7.1	6.3	..	..	
1917-18	22.0	150	3.3	3.3	..	..	
1918-19	11.0	40	4.8	4.4	..	..	
1919-20	16.0	160	4.8	4.4	..	..	
1920-21	16.0	100	7.8	..	6.8	..	
1921-22	23.0	200	4.9	..	4.5	..	
1922-23	24.0	104	4.3	..	3.8	3.9	
1923-24	16.0	75	4.3	..	3.9	4.1	
1924-25	22.0	150	5.7	..	5.3	5.5	
1925-26	25.0	150	7.7	..	7.1	8.0	
1926-27	22.0	160	7.7	..	6.9	7.7	
1927-28	22.0	150	6.3	..	5.9	6.1	
1928-29	29.0	320	7.3	..	6.8	7.1	
1929-30	27.0	240	8.1	..	7.5	7.9	

## Fortnightly Rainfall Record of the Dharwar Farm.

Month.	January.		February.		March.		April.		May.		June.	
Fortnight	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Years.												
1904	..	..	..	..	..	..	0·11	0·01	0·06	5·13	3·79	2·44
1905	..	..	..	..	..	0·30	..	0·28	1·31	0·88	2·18	0·57
1906	..	..	..	..	..	0·13	..	0·23	1·92	..	1·93	1·66
1907	..	0·11	..	..	..	..	2·18	1·78	..	0·00	0·85	2·30
1908	0·03	..	..	..	..	..	0·66	..	4·95	0·09	2·98	0·41
1909	..	..	..	..	..	0·17	0·14	..	2·79	0·62	2·18	0·89
1910	..	..	..	..	..	0·57	0·41	..	1·03	1·46	0·07	2·50
1911	..	..	..	..	..	0·97	0·18	0·24	1·56	1·91	1·49	0·41
1912	..	..	..	..	..	..	0·92	1·69	1·62	1·21	1·15	0·84
1913	..	..	..	..	..	..	0·18	1·11	0·14	1·32	5·43	0·50
1914	..	..	..	..	..	..	..	1·43	2·37	2·23	..	1·09
1915	..	0·53	..	..	0·26	0·71	..	2·00	1·03	1·66	0·53	4·55
1916	..	..	..	..	..	..	1·88	1·05	1·16	0·99	0·95	1·50
1917	..	..	0·44	..	..	0·24	0·00	0·00	..	0·72	3·73	0·85
1918	0·07	..	..	..	..	..	0·13	1·08	5·15	1·75	0·91	3·02
1919	..	..	..	..	..	..	..	0·63	2·34	1·08	6·92	1·56
1920	..	..	..	..	..	..	0·91	1·56	..	1·70	2·47	0·25
1921	..	..	..	..	..	..	0·24	0·65	..	0·04	1·30	1·73
1922	1·43	..	..	..	..	..	0·23	2·54	0·60	0·88	0·52	1·25
1923	..	..	..	..	0·20	0·95	2·35	..	..	4·17	0·30	0·44
1924	..	..	..	..	..	0·33	2·11	1·28	0·17	0·15	1·43	1·54
1925	..	..	..	..	..	..	2·04	1·34	1·47	0·53	1·54	2·74
1926	0·20	..	..	..	..	..	0·03	..	0·59	0·02	0·57	0·85
1927	..	..	..	..	..	..	0·09	0·67	0·06	2·35	0·96	1·60
1928	..	..	1·30	..	..	..	1·41	1·38	2·11	0·14	2·82	0·11
1929	..	..	..	..	..	..	3·09	1·27	2·55	0·64	2·17	1·83
1930	..	..	..	..	..	..	0·10	0·02	0·49	1·70	1·47	2·74

## Fortnightly Rainfall Record of the Dharwar Farm—contd.

Month.	July.		August.		September.		October.		November.		December.		Total.
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	
1904 ..	4.40	1.26	2.35	0.82	0.61	0.56	0.78	2.34	0.07	..	1.09	..	26.72
1905 ..	0.38	1.17	0.92	0.27	0.33	0.50	2.47	0.96	..	0.24	..	..	12.76
1906 ..	0.51	4.11	0.10	9.54	0.13	3.25	4.65	3.78	0.22	..	..	..	34.16
1907 ..	0.76	2.88	6.63	1.51	0.37	3.71	0.06	0.35	0.17	0.24	..	2.38	31.37
1908 ..	2.76	2.79	1.97	0.72	0.08	2.80	1.45	1.66	0.16	..	..	..	23.51
1909 ..	3.98	2.69	0.63	2.61	1.82	2.35	1.81	0.37	0.78	0.23	..	..	23.87
1910 ..	2.24	1.78	2.34	2.20	0.88	1.73	1.75	2.56	1.04	..	..	..	22.56
1911 ..	1.59	0.54	0.84	0.94	1.05	0.17	4.43	0.32	..	0.68	0.35	..	17.74
1912 ..	0.57	9.10	3.98	2.26	0.05	5.18	2.70	4.56	..	0.73	..	..	36.56
1913 ..	1.36	1.63	1.97	0.54	0.03	3.96	3.52	..	..	0.72	..	..	22.41
1914 ..	1.78	11.41	12.17	1.44	1.32	4.31	3.48	..	1.53	..	0.02	0.03	44.61
1915 ..	0.40	5.11	1.53	0.27	0.70	4.84	0.08	1.71	2.48	..	..	..	28.39
1916 ..	1.55	3.40	2.69	0.26	0.82	0.21	1.04	3.63	6.92	0.61	..	..	28.66
1917 ..	0.13	1.56	0.06	3.20	1.82	3.31	1.19	4.41	..	4.27	..	..	25.93
1918 ..	0.25	0.39	0.98	0.87	..	3.49	0.38	0.81	5.11	0.51	0.07	..	24.97
1919 ..	1.83	0.98	1.41	0.69	1.59	0.64	3.46	5.39	1.46	0.68	0.07	..	36.73
1920 ..	2.50	1.72	0.81	0.53	0.56	3.50	3.11	0.65	..	..	..	..	20.33
1921 ..	2.03	4.34	1.92	1.00	1.12	0.11	5.36	0.02	3.17	..	..	..	23.03
1922 ..	2.55	4.32	0.82	1.21	0.05	1.10	5.09	2.39	2.86	0.15	..	..	27.99
1923 ..	3.95	5.89	3.49	0.89	0.15	2.88	0.71	0.04	..	..	0.38	..	26.39
1924 ..	8.16	1.92	0.84	2.52	0.09	5.13	0.14	0.72	0.38	0.18	..	..	26.53
1925 ..	2.27	2.56	0.22	1.53	..	2.57	4.68	..	1.00	..	1.70	..	26.19
1926 ..	3.84	1.33	3.83	1.33	3.16	2.31	1.68	0.61	..	..	..	..	20.35
1927 ..	4.41	3.30	0.96	0.80	4.33	3.41	0.07	0.03	2.16	..	..	..	27.20
1928 ..	1.13	5.44	1.05	3.65	0.80	0.45	0.16	5.81	..	..	0.24	..	28.02
1929 ..	3.33	1.61	0.48	0.56	0.25	7.33	1.60	0.55	1.38	0.48	..	..	29.12
1930 ..	2.27	1.11	1.38	0.20	0.88	2.75	5.31	3.19	0.49	..	0.09	..	24.04





## DHULIA FARM I-A AND B.

*Crop—Cotton.*

*I-a.* To compare the effects of (1) No-manure (2) 7.5 tons F.Y.M. and (3) 1 cwt. sulphate of ammonia, all per acre.

*Plots*—10 to 30 gunthas : Yields are given per acre.

*Lay-out*—Unreplicated.

*Year* 1906-07.

Treatment.					Seed-cotton yields per acre.	Net profits per acre in Rs.
1	..	..	..	..	740	45.67
2	..	..	..	..	908	49.90
3	..	..	..	..	714	33.38

Sulphate of ammonia falls below no-manure, and F.Y.M. does not show any clear advantage over the no-manure.

*Experiment I-b.*

To compare the effects of (1) No-manure, (2) 10 tons F.Y.M.

*Plots*—10 gunthas each : Yields are given in lbs. per acre.

*Year* 1907-08.

Treatments.					Seed-cotton yields per acre.	Net profits per acre in Rs.
1	..	..	..	..	276	14.40
2	..	..	..	..	360	2.98

F.Y.M., though giving a higher yield gives a lower net profit and hence has no advantage over the no-manure.

## DHULIA FARM II.

*Crop—Cotton.*

To compare the effects of (1) No-manure, (2) Sulphate of ammonia 20 lbs. N per acre, and (3) Sulphate of ammonia 10 lbs. N per acre.

*Plots*—4 gunthas each.

*Lay-out*—Duplicated.

Year 1912-13.

Treatments.	Seed-cotton yields per plot.		Average.	Average net profits per plot in Rs.
	(i)	(ii)		
1 .. .. .	37	42	39.5	3.78
2 .. .. .	31	34	32.5	1.91
3 .. .. .	22	29	25.5	1.61

The treated plots give distinctly lower yields and lower net profits. Hence there seems to be no advantage in the treatments.

## DHULIA FARM III.

*Crop—Jowar.*

To compare the effects of (1) 10 tons F.Y.M., and (2) No-manure.

Plots—10 gunthas.

Year 1907-08.

Treatments.	Grain yields in lbs. per plot.	Net profits per plot in Rs.
1 .. .. .	104	— (2.31)
2 .. .. .	107	1.37

Treated plot gives a loss and hence the treatment is not advantageous.

## DHULIA FARM IV.

*Crop—Sugarcane.*

To compare the effects of :—

(1) 20 tons F.Y.M. per acre.

(2) 20 tons F.Y.M. plus 50 lbs. N as Castor cake, per acre.

(3) 20 tons F.Y.M. plus 50 lbs. N as Safflower cake, per acre.

Plots—10 gunthas each : Yields are given per acre.

Treatments.	Cane yields in lbs. per acre.		Average.	Average net profits in Rs. per acre.
	1908-09	1910-11		
1 .. .. .	43,488	38,808	41,148	— (3·45)
2 .. .. .	49,440	70,364	59,902	157·56
3 .. .. .	46,236	45,216	45,726	— (2·70)

F.Y.M. with Castor cake seems to give by far better yields and a high net profit.

### DHULIA FARM V.

#### *Crop—Chillies.*

To compare the effects of various artificials applied equivalent to 20 lbs. of  $K_2O$  per acre.

Plots—4 gunthas each.

Year 1910-11.

Treatments.	Yields in lbs. per plot.			
Castor cake .. .. .	..	..	..	99
Safflower cake .. .. .	..	..	..	106
Sulphate of Potash .. .. .	..	..	..	183
Nitrate of Potash .. .. .	..	..	..	196
F.Y.M. .. .. .	..	..	..	190
No-manure .. .. .	..	..	..	148

Obviously there is no advantage in using other manures over the F.Y.M.

### DHULIA FARM VI.

#### *Crop—Chillies.*

To compare the effects of (1) 2 tons F.Y.M., (2) 2 tons F.Y.M. plus 100 lbs. of Superphosphate plus 200 lbs. Nitre, per acre.

Plots—2 to 2·5 gunthas; Yields reduced to 2-guntha plots.

Lay-out—Duplicated.

	1911-12			1912-13			1913-14			Average net profit per plot in Rs.
	Plot yields.		Average.	Plot yields.		Average.	Plot yields.		Average.	
	i	ii		i	ii		i	ii		
1 .. .. .	263	314	289	416	440	428	252	185	219	— (0·14)
2 .. .. .	260	269	265	430	458	449	258	218	238	— (4·80)
Significance .. .. .	31·5			3·0			19·0			



Treated by method III.

Though the second treatment has given significantly better yields than the first in two years, it gives more loss than the first on the whole.

### DHULIA FARM VII.

#### Crop—Wheat.

To compare the effects of (1) F.Y.M. 3 tons, (2) F.Y.M. 3 tons plus 10 lbs. N as Sulphate of ammonia, (3) F.Y.M. 3 tons plus 20 lbs. N as Sulphate of ammonia, all per acre.

Plots—4 gunthas each.

Lay-out—Duplicated.

Treatments.	1912-13			1911-12			Average net profits in Rs. per plot.
	Grain yields.		Average.	Grain yields.		Average.	
	i	ii		i	ii		
1 .. ..	249	255	252	217	205	256	3.33
2 .. ..	247	265	256	185	230	208	2.25
3 .. ..	241	280	261	227	240	234	2.50

The addition of Sulphate of ammonia does not seem to give any increased yields and hence the net profits are lowered. Hence F.Y.M. alone may be preferable.

### DHULIA FARM.

Statement showing the prices of various manures and produce from year to year in lbs. per rupee.

Year.	Cotton.	Wheat.	Jowar.	Chillies dry.	Nitre.	Super-phosphate.	Sulphate of Ammonia	F.Y.M.
1906-07 .. ..	11	..	..	..	..	..	..	..
1907-08 .. ..	12	..	..	..	..	..	..	..
1908-09 .. ..	12	..	..	..	..	..	..	..
1909-10 .. ..	9	..	..	..	..	..	..	..
1910-11 .. ..	..	..	..	..	..	..	..	..
1911-12 .. ..	12	20	20	8	9	25	..	600
1912-13 .. ..	8	20	16	9.5	9	25	10	600
1913-14 .. ..	10	20	..	11.0	7	25	10	700
1914-15 .. ..	15	16	..	6.0	5	16	7	1,100

Statement showing the fortnightly rainfall at the Agricultural Station, Dhulia, for the years 1906 to 1913.

Year.	Fortnight	June.		July.		August.		September.		October.		November.		December.		Total.
		1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	
1906	..	7.77	..	5.68	..	7.19	..	2.24	..	0.16	..	..	..	..	..	22.99
1907	..	3.03	..	8.90	..	3.46	..	0.89	..	..	..	..	..	..	..	16.28
1908	..	Not available		Not available		Not available		Not available		Not available		Not available		Not available		
1909	..	5.40	1.35	2.25	2.10	1.50	3.00	1.20	6.20	1.05	..	..	..	0.10	0.30	24.45
1910	..	2.85	12.60	2.90	3.80	2.65	0.90	0.15	2.90	2.30	..	..	1.00	..	..	32.05
1911	..	..	1.25	1.05	0.04	..	1.23	0.04	..	..	..	3.23	..	..	..	6.84
1912	..	..	1.80	2.25	4.25	2.25	0.10	0.10	..	0.20	0.25	..	..	..	..	11.20
1913	..	5.75	1.85	3.15	3.70	1.20	0.35	2.56	1.95	..	..	..	..	0.60	..	21.10

N.B.—Figures for 1906 and 1907 are monthly, fortnightly figures being not available.

## DOHAD FARM I.

Crop—“*Jiresal*” Paddy (Irrigated).

To compare (1) 10 carts of F.Y.M. per acre with (2) *San green*.

Plots—15 to 16 gunthas. But yields have been reduced to half acre plots, in lbs.

Treatments.	Grain yields in lbs. per plot.		Average.	Average net profits per plot.
	1929-30	1930-31		
				Rs.
F.Y.M. .. ..	792	1,360	1,076	24·56
<i>San green</i> .. ..	1,035	1,363	1,199	34·11

This tends to show that in giving high yields and economically also *San green* may be preferable to F.Y.M.

## DOHAD FARM II.

Crop—Paddy (Irrigated).

(Variety varies from year to year.)

To compare the effects of (1) 30 carts of F.Y.M. per acre with (2) Castor cake 600 lbs. per acre.

Grain yields in lbs. per half acre plots.

Year.						
1918-19	..	<i>Kamod</i>	..	..	522	44b
1919-20	..	<i>Kamod</i>	..	..	970	1,188
1920-21	..	<i>Sutarsal</i>	..	..	781	483
1921-22	..	<i>Jiresal</i>	..	..	1,211	1,221
				Average ..	871	833
				Average net profits in rupees per plot ..	12·1	20·17

Though F.Y.M. yields slightly better than Castor cake, the latter gives a considerably higher net profit and hence Castor cake is preferable.

## DOHAD FARM III.

*Crop—"Jiresal" Paddy.*

To compare the effects of (1) Castor cake, (2) Sulphate of ammonia and (3) *San* green, all equivalent to 15 lbs. N per acre.

*Plots*—10 gunthas each.

*Lay-out*—Unreplicated.

Treatments.	Grain yields in lbs. per plot.		Average.	Average net profits per plot in Rs.
	1929-30	1930-31		
1 .. .. .	567	580	574	13.43
2 .. .. .	477	675	576	14.71
3 .. .. .	463	600	532	12.99

The differences between the treatments are not considerable enough to say anything definite. But on the whole Sulphate of ammonia seems to be more profitable.

## DOHAD FARM IV.

*Crop—"Jiresal" Paddy (Irrigated).*

To compare the effects of (1) 20 carts of F.Y.M., (2) 20 carts of F.Y.M. plus Sulphate of ammonia 50 lbs., (3) *San* green, and (4) *San* green plus Castor cake 400 lbs.

*Plots*—13 gunthas each.

*Lay-out*—Unreplicated.

Treatments.	Grain yields in lbs. per plot.		Average.	Average net profits per plot in Rs.
	1929-30	1930-31		
1 .. .. .	733	950	842	20.5
2 .. .. .	783	790	787	17.35
3 .. .. .	864	1,115	990	32.40
4 .. .. .	765	750	768	19.09

*San* green alone has given the highest yield as well as the highest net profits. F.Y.M. alone comes next and the remaining two treatments

may be ignored as they give comparatively low yields with larger quantities of manures and hence very low net profits.

#### DOHAD FARM V-A.

*Crop—Maize (Sameria Variety), "kharif".*

To compare the effects of (1) No-manure, (2) 20 carts F.Y.M. per acre and (3) 40 carts F.Y.M. per acre.

The "kharif" Maize is rotated with "rabi" wheat the same year if possible without any irrigation.

*Grain yields in lbs. per plot of 20 gunthas.*

Treatment.	Grain yields in lbs.				Average.	Average net profit per plot.
	1918	1919	1920	1921		
						Rs.
1 .. ..	355	222	401	297	319	1.35
2 .. ..	581	474	1,245	922	806	18.92
3 .. ..	633	717	1,737	304	848	15.10

The effect of increasing F.Y.M. to 30 cart loads is not profitable. Hence 20 carts becomes the advantageous treatment. The effect of the manure is distinctly visible.

#### DOHAD FARM V-B.

Treatments are the same as in V-a except that the no-manure treatment is substituted by 15 carts F.Y.M. every two years.

Treatment.	Grain yields in lbs. per half acre plot.				Average.	Average net profits per plot.
	1922	1923	1925	1927		
						Rs.
1 .. ..	204	324	462	304	324	— (0.07)
2 .. ..	203	566	545	365	420	2.06
3 .. ..	224	750	1,150	438	641	7.95

In this case 30 carts of F.Y.M. has given the highest yields and the highest net profits. This contradicts the results of 'V-a'. But this seems to have been a set of bad years.

## DOHAD FARM VI.

*Crop—Maize “Sameria”—“Kharif”.*

To compare the effects of (1) urine earth—10 bullocks for three months and (2) Cow-dung, also 10 bullocks for three months.

*Grain yields in lbs. per  $\frac{1}{2}$  acre plot.*

Treatments.	1912	1915	1916	1917	1918	1919	Average	Average net profits per plot.
								Rs.
1 ..	1,136	1,491	803	534	503	482	825	38·6
2 ..	1,006	1,458	1,056	648	437	580	864	39·5

*N.B.*—The net profits of 1918 and 1919 are not available and hence the average of four years only is given.

The treatments do not seem to show any appreciable difference both in yields and net profits.

## DOHAD FARM VII.

*Crop—Maize “Sameria”—“Kharif”.*

To compare the effects of (1) no-manure, (2) nitrate of soda 150 lbs. per acre, (3) nitrate of soda 300 lbs. per acre.

*Plots—18·75 gunthas, but the yields are reduced to  $\frac{1}{2}$  acre.*

Treatments.	1917	1918	1920	1921	Average.	Average net profits per plot.
						Rs.
1 ..	153	355	401	297	301	— (0·14)
2 ..	..	635	533	257	475	— (2·50)
3 ..	340	593	1,006	392	583	— (12·12)

The years have been very bad. Though the treatments give considerably higher yields than the no-manure treatment, financially viewed they give greater losses.

*Statement showing Fortnightly Rainfall on the Munalia Farm, Dohad,  
district Panch Mahals, from 1893 to 1930.*

Months.	January.		February.		March.		April.		May.		June.	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Years.												
1893	..	..	..	..	..	..	..	0·10	0·08	4·09	1·04	8·70
1894	..	0·25	..	..	..	..	..	..	..	..	0·89	4·82
1895	..	0·05	..	..	0·04	..	..	..	..	..	0·96	5·05
1896	..	..	..	0·02	..	..	..	..	..	..	0·63	2·88
1897	..	..	..	..	..	..	..	0·02	..	..	0·61	2·21
1898	..	..	1·62	..	..	..	..	..	..	..	1·40	1·59
1899	..	..	..	..	..	..	..	..	0·04	0·25	0·94	6·46
1900	..	..	..	..	..	..	0·10	..	..	..	0·55	..
1901	..	0·16	..	..	0·01	..	..	..	..	..	1·53	1·33
1902	..	1·01	..	..	..	..	0·02	..	..	..	0·03	0·21
1903	..	..	..	..	..	..	..	..	..	0·34	1·39	1·02
1904	..	0·06	..	0·78	..	..	..	..	..	0·60	1·23	3·25
1905	..	..	..	..	..	..	..	..	..	..	0·13	1·93
1906	..	..	0·06	..	..	..	..	..	..	..	0·27	2·53
1907	..	..	0·10	..	..	..	..	0·06	..	..	1·72	0·46
1908	..	0·24	..	..	..	..	0·03	..	..	..	0·66	1·35
1909	..	..	0·04	..	..	..	..	0·79	..	..	1·40	3·94
1910	..	0·03	..	..	..	..	..	..	..	..	1·74	11·28
1911	..	..	..	..	..	..	..	..	..	..	4·15	0·87
1912	..	..	..	..	..	..	..	..	..	0·08	..	5·14
1913	..	..	..	..	..	..	..	..	..	1·15	3·54	8·00
1914	..	..	..	..	..	0·07	..	..	..	..	3·26	1·95
1915	..	0·89	0·77	..	..	..	..	..	..	..	..	4·61
1916	..	..	..	..	..	..	..	..	..	0·13	3·89	2·43
1917	..	0·25	0·24	..	..	..	0·11	..	3·18	1·40	2·14	4·71
1918	..	..	..	..	..	..	..	..	..	0·25	..	2·09
1919	..	..	..	..	..	..	0·11	..	0·35	..	7·35	2·06
1920	..	1·08	0·04	..	..	..	..	..	1·12	1·71	0·81	6·70
1921	..	0·16	..	..	..	..	..	..	..	..	2·52	0·73
1922	..	0·06	..	..	..	..	..	..	..	..	0·20	1·86
1923	..	..	0·05	0·03	..	..	..	..	..	..	..	..
1924	..	..	..	..	..	..	..	..	..	..	1·64	4·49
1925	..	..	..	..	..	..	..	..	1·25	2·25	2·50	3·10
1926	..	0·03	1·86	..	0·02	..	0·01	0·05	..	..	..	1·82
1927	..	..	..	..	..	..	..	..	0·30	..	0·43	2·46
1928	..	..	0·04	..	..	..	..	..	..	..	3·56	3·00
1929	..	0·05	..	..	..	..	..	..	..	..	0·02	4·21
1930	..	..	..	..	..	..	..	..	..	0·16	0·10	2·96

*Statement showing Fortnightly Rainfall on the Munalia Farm, Dohad,  
district Panch Mahals, from 1893 to 1930—contd.*

Months.	July.		August.		September.		October.		November.		December.		Total
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	
Years.													
1893 ..	5.10	3.35	0.01	8.01	5.00	3.69	..	..	..	1.38	..	..	47.95
1894 ..	7.14	11.09	0.92	1.99	5.06	1.86	..	6.83	..	..	0.15	..	40.99
1895 ..	0.64	3.51	3.20	5.29	1.05	3.40	..	1.01	..	..	..	..	24.20
1896 ..	1.70	9.54	9.93	1.46	0.18	0.13	..	..	..	0.69	..	0.43	27.89
1897 ..	4.60	2.55	2.48	4.43	1.52	4.17	..	..	..	..	..	..	22.69
1898 ..	6.62	6.49	0.36	9.76	3.69	2.92	..	..	..	..	0.26	..	35.21
1899 ..	1.34	0.56	..	..	4.95	..	..	..	..	..	0.28	..	15.32
1900 ..	2.83	1.82	2.20	3.96	2.98	0.42	..	..	..	..	..	..	24.87
1901 ..	0.87	3.36	6.85	2.18	0.08	..	..	0.17	..	..	..	..	16.54
1902 ..	3.67	5.48	0.11	9.47	7.72	3.61	..	0.39	0.02	..	0.81	..	32.55
1903 ..	2.15	7.46	1.25	2.17	8.81	1.09	0.21	..	..	..	..	..	25.80
1904 ..	4.94	1.44	0.30	0.26	2.97	1.63	..	..	..	..	..	0.48	17.94
1905 ..	9.09	10.54	0.25	1.17	4.30	..	..	..	..	..	..	..	27.00
1906 ..	5.47	4.38	1.12	11.16	5.91	0.98	1.02	0.05	..	..	..	..	32.97
1907 ..	2.93	6.89	4.45	3.60	1.14	..	..	..	..	..	..	..	21.35
1908 ..	7.52	6.51	2.44	3.73	0.24	0.05	..	..	..	..	..	..	22.77
1909 ..	0.84	4.55	4.88	3.75	3.18	3.74	..	..	..	..	0.17	..	27.28
1910 ..	8.09	0.72	6.91	1.51	..	2.36	2.38	..	1.34	..	..	..	36.56
1911 ..	1.14	0.07	0.73	9.44	0.87	0.11	..	..	..	0.09	..	..	34.47
1912 ..	0.84	7.71	5.93	3.46	0.81	..	0.01	..	..	1.95	..	..	25.93
1913 ..	3.06	16.06	2.22	2.26	3.99	0.56	..	..	..	0.06	..	..	42.31
1914 ..	6.14	3.41	1.97	1.37	2.44	4.19	0.26	..	0.05	..	..	..	27.38
1915 ..	..	5.14	3.80	0.10	0.23	1.49	9.38	..	..	..	..	..	26.41
1916 ..	2.48	3.12	2.76	10.52	0.89	3.47	..	0.70	..	1.06	..	..	30.91
1917 ..	3.71	4.20	4.28	5.58	4.46	3.30	7.30	1.35	..	..	..	..	46.11
1918 ..	1.15	0.37	0.62	6.46	0.42	..	..	..	..	0.06	..	..	11.42
1919 ..	3.25	6.82	8.79	12.04	1.52	2.41	0.88	..	..	0.29	..	..	47.67
1920 ..	2.31	3.96	1.74	0.84	0.93	..	..	..	..	..	..	..	21.24
1921 ..	1.26	10.68	7.33	0.77	13.24	6.96	..	..	..	..	..	..	43.55
1922 ..	3.30	5.23	0.66	1.77	2.46	5.83	1.15	..	0.01	..	..	..	22.53
1923 ..	1.57	7.56	0.98	2.12	1.72	5.52	..	..	..	..	..	..	19.55
1924 ..	2.83	4.93	1.44	4.04	1.40	4.28	5.01	..	..	..	0.15	..	30.21
1925 ..	2.99	2.53	0.78	0.25	1.82	..	..	..	0.04	0.13	..	..	16.43
1926 ..	4.49	2.14	2.90	10.74	1.65	0.54	..	..	..	..	..	..	25.75
1927 ..	7.10	19.36	0.82	2.98	0.54	3.25	1.91	..	1.59	..	..	0.25	40.94
1928 ..	4.14	0.81	11.86	0.40	4.32	1.46	0.54	0.09	0.10	0.05	..	..	29.97
1929 ..	5.39	4.44	0.28	5.74	..	1.65	0.60	..	..	..	..	0.10	22.48
1930 ..	5.28	8.68	5.08	0.40	10.42	..	..	3.48	..	..	..	..	36.66



## JALGAON FARM I.

To ascertain the comparative effect of the following per acre on cotton.

Crop—Cotton.

Plots—Treated plots varied from 20 to 60 acres and non-treated plots from 1 to 5 acres.

Treatments per acre—

- (1) Crude night soil 30 carts.
- (2) Sheep folding (2,000 sheep 1 night).
- (3) Castor cake 400 lbs.
- (4) F.Y.M. 15 carts.
- (5) No-manure.

Treatments.	Yields in lbs. per acre.				Average.	Average net profits per acre.
	1919-20	1920-21	1921-22	1922-23		
						Rs.
1 ..	703	738	869	683	748	25.50
2 ..	374	737	735	499	586	20.63
3 ..	517	546	620	422	526	25.12
4 ..	778	646	634	512	643	8.31
5 ..	634	255	472	693	514	53.97

The no-manure treatment has given high net profit. Among the treated plots treatment (1) has given the highest yield and highest net profit. Though treatment 4 gives a considerably high yield the net profit has fallen down much. Treatment 3 gives good net profit in spite of its low yield.

## JALGAON FARM II-A AND B.

II-A—To compare the effects of (1) 15 carts of F.Y.M., (2) 7.5 carts of F.Y.M. plus 360 lbs. castor cake, the value of the cake being equal to that of 7.5 cart F.Y.M.

Crop—Cotton.

Plots—10 gunthas each.

Lay-out—Duplicated.

Yields of Seed-cotton in lbs. per plot.

	1927-28				Signific- ance.	1928-29			Average net profits per plot.
	Yields.		Average.	Per cent.		Yields.		Average.	
	i	ii				i	ii		
1 ..	92	106	99	100	18.0	130	196	163	Rs. — 4.2
2 ..	144	128	136	137		174	154	164	— 1.9

The figures were treated by method I for the 1st year, and because the average yields for the second year are almost equal no attempt was made to find the error for that year. It may be said that the substitution of castor cake for the 7.5 carts of F.Y.M. gives better yields and hence reduces the net loss.

*II-B—To compare (1) 15 carts F.Y.M., (2) Ground-nut husk, equal in weight to 15 carts F.Y.M., put under the feet of bullocks for one month.*

*Plots—10 gunthas each.*

*Lay-out—Duplicated in 1928-29 alone.*

*Yields of Seed-cotton in lbs. per plot.*

	1927-28	Yields.		1928-29		Significance.	1929-30	Average for 3 years.	Average net profit per plot in Rs.
		i	ii	Average.	Per cent.				
1	40	107	125	116	100	18.7	152	103	— (33.9)
2	60	118	124	121	104		160	114	— (12.7)

Method I has been used to find the significance in 1928-29. Though the ground-nut husk does not give significantly higher yields even in the one year when the plots were duplicated, yet the slightly better yields due to this reduces the net loss to a great extent.

**JALGAON FARM III.**

*To compare the effects of increasing doses of castor cake for the cotton crop.*

*Crop—Cotton.*

*Plots—8 Gunthas in 1920-21 and 10 gunthas in 1921-22. But the yields are calculated to 10 guntha plots.*

*Lay-out—Duplicated.*

*Manipulated by method I.*

	Treatments.	1920-21		Average.	Percentage.	Significance.
		Yields in lbs. per plot.				
		1	2			
1	400 lbs. castor cake..	174	176	175	100	8.2
2	500 lbs. castor cake..	187	197	192	110	
3	600 lbs. castor cake..	198	198	198	113	
4	700 lbs. castor cake..	181	214	198	113	

Treatments.	1921-22		Average.	Percent- age.	Signi- ficance.	
	Yield in lbs. per plot.					
	1	2				
1	400 lbs. castor cake..	214	208	211	100	9·5
2	500 lbs. castor cake..	184	208	196	93	
3	600 lbs. castor cake..	216	226	221	105	
4	700 lbs. castor cake..	214	230	222	105	

Treatments.		Average net profits per plot. Rs.	
1	.. ..	..	10·50
2	.. ..	..	8·51
3	.. ..	..	10·13
4	.. ..	..	9·26

The first year results show that an increase over 500 lbs. of cake has no significant effect on the yield. The net profits of 1 and 3 are more or less equal and the net profit of treatment 2 has gone down due to the low yield in this treatment.

#### JALGAON FARM IV.

*To compare the effects of 400 lbs. and 800 lbs. of mohua cake for the above crop.*

*Crop—Crop.*

*Plots—16 Gunthas in 1920-21 and 10 gunthas in 1921-22. But the yields are calculated to 10 guntha plots throughout.*

*Lay-out—Duplicated.*

Treatments.	1920-21			1921-22			Net profit per plot. Rs.	
	Plot yields.			Plot yields.				
	1	2	Average.	1	2	Average.		
1	Mohua cake. 400 lbs. ..	199	161	180	164	184	170	10·56
2	800 lbs. ..	187	165	176	172	..	172	5·17

The use of 800 lbs. has no distinct advantage over 400 lbs. in yielding capacity and hence the net profit when 800 lbs. is used is very low. Hence we can decide in favour of using 400 lbs.

## JALGAON FARM V.

To ascertain which of the two cakes, castor or mohua is more advantageous when used in equal dose.

Crop—Cotton.

Plots—1 to 3 acres each.

Treatment per acre.	1923-24			Average.	Net profits per acre.
	Yields in lbs. per acre.				
	1	2	3		
Castor cake 400 lbs. ..	521	482	356	453	Rs. 38.71
Mohua cake 400 lbs. ..	530	568	344	481	56.75

The use of *mohua* cake seems to give higher yields and a definitely higher profit. Hence it may be preferred.

## JALGAON FARM VI.

To ascertain the comparative effects of (1) 7.5 carts of *F.Y.M.* plus groundnut cake 250 lbs. plus 44 lbs. nitrate of soda; (2) the above plus 40 lbs. sulphate of ammonia; (3) 15 carts *F.Y.M.*, on cotton.

Crop—Cotton.

Plots—10 gunthas each.

Lay-out—Duplicated.

Manipulated by method I.

## Yields in lbs. per acre.

Plot yield. (1927-28)		Average	Percent- age.	Signi- ficance.	Plot yields (1928-29)		Average	Percent- age.	Signi- ficance.	Average net profit per plot.
1	2				1	2				
132	124	128	109	12.64	172	174	173	108	4.96	Rs. -2.77
120	118	119	102	..	160	164	162	101	..	-4.12
106	128	117	100	..	165	154	160	100	..	-3.71

All the treatments are statistically equal in effects in the first year. In the second year treatment No. 1 alone shows a significantly better yield than the other.

All the treatments have given net losses for both the years. But the loss is the least with treatment No. 1.

## JALGAON FARM VII.

To compare (1) *Ammophos* (20/20 grade) 80 lbs. per acre and (2) castor cake 400 lbs. on equal basis of Nitrogen, for cotton.

Crop—Cotton.

Plots—10 gunthas each.

Lay-out—Duplicated.

Note.—The experiment was conducted for four years from 1924 to 1927, but the results of 1926-26 and 1927-28 being abnormal have been omitted.

## Yields in lbs. per acre.

Treatments.	1924-25			1926-27			Net profit per plot.
	Plot. 1	Yields. 2	Average.	Plot. 1	Yields. 2	Average.	
1 ..	130	162	146	188	204	196	9.02
2 ..	160	131	146	208	192	200	6.70

There is no difference in yields between the two treatments in both the years and hence the treatment which gives the greater net profit (*Ammophos* treatment) may be preferred.

## JALGAON FARM VIII.

To ascertain the comparative effect of (1) *F.Y.M.* 15 carts plus nitrate of soda 100 lbs.; (2) *F.Y.M.* 15 carts plus nitrate of soda 150 lbs.; (3) *F.Y.M.* 15 carts alone.

Crop—Cotton.

Plots—20 gunthas each.

Lay-out—Duplicated, except in 1926-27.

## Seed cotton yields in lbs. per plot.

	1924-25				1926-27				Average for the 3 years.	
	I	II	Average.	Per cent.	I	II	Average.	Per cent.		
1	290	232	261	120	258	196	227	115	240	243
2	288	304	296	136	214	190	203	102	364	287
3	212	222	217	100	210	186	198	100	292	236
Significance .....	15.2						24.2			
Average net profits in Rs. (1)	16.25				(2)	13.12	(3)	11.44		

The figures were treated by method I.

In the first year the combinations show distinctly better yields than *F.Y.M.* alone. The increase in the Nitrate of soda also

gives a significantly better yield. In the second year the results are not significant. Taking the average of three years for each treatment we find that treatment 2 is far better than either of the others, and treatment 1 does not show much difference from 3.

All the treatments have given losses and the least of them is that due to F.Y.M. alone. Hence during the loss giving years the combinations are not useful.

### JALGAON FARM IX (A) AND (B).

*IX-a. To compare the effects of (1) Groundnut cake 200 lbs. plus Sulphate of ammonia 40 lbs.; (2) Groundnut cake 200 lbs. plus Nitrate of Soda 50 lbs.; (3) Castor cake 400 lbs. all per acre.*

*Crop—Cotton.*

*Plots—10 gunthas each.*

*Lay-out—Duplicated.*

#### *Seed cotton yields in lbs. per plot.*

	1927-28				1928-29				Average net profits per plot.
	I	II	Average	Per cent.	I	II	Average	Per cent.	
									Rs.
1	124	134	129	115	114	100	107	103	— (2·5)
2	103	134	121	108	112	100	109	105	— (3·3)
3	105	119	112	100	115	92	104	100	— (4·8)
Significance ..			19·6						

Method I.

*Note.*—There were two sets of duplicate plots for treatment three in each year and the average per plot of the two sets has been taken.

In the second year the difference in the yields of the various treatments being too small no attempt was made to find the significance. Even in the first year where method I was used practically there is no significance in the difference in yields of treatments. But treatment 1 gives the least loss.

*IX-b. To compare the effects of the following (1) Groundnut cake 200 lbs. plus Nitrate of Soda 50 lbs.; (2) Castor cake 300 lbs. all per acre.*

*Plots—10 gunthas each.*

*Lay-out—Duplicated.*

#### *Seed cotton yields in lbs. per plot.*

	1924-25				1926-27				Average net profit per plot.
	I	II	Average	Per cent.	I	II	Average	Per cent.	
									Rs.
1	170	164	167	119	236	206	226	105	10·03
2	148	132	140	100	238	194	216	100	9·33
Significance ..	..	..	10·7	..	..	..	26·8	..	....

Treated by method I. In the first year there is some significance of treatment 1 over 2. But in the second year no significance can be seen. The first treatment gives a very slightly higher net profit than 2.

### JALGAON FARM XA.

To compare the effects of the following manurial treatments on cotton :—

- Treatments— (1) 100 lbs. of castor cake alone.  
 (2) 100 lbs. of castor cake plus 60 lbs. of ammophos.  
 (3) 100 lbs. of castor cake plus 30 lbs. of sulphate of ammonia.

Crop—Cotton.

Plots—1 guntha each.

Lay-out—Randomised blocks with 4 replications.

Method—IV.

Yields of seed-cotton in lbs. per plot.

Year 1929-30.

Plot yields.

Treatments.	Blocks.			
	1	2	3	4
1 .. .. .	25	27	23	17
2 .. .. .	25	28	25	11
3 .. .. .	27	26	23	14

Analysis of variance.

Kind of variation.	D.	Sum of squares.	Mean square or Variance.	$\frac{1}{2} \text{Log}_e V$
Treatments .. .. .	2	1.17	0.585	
Blocks .. .. .	3	311.59	103.863	
Error .. .. .	6	24.16	4.027	
Total .. .. .	11	336.92	30.630	

$$S. D. = \sqrt{4.027} = 2.007.$$

## Mean Yields.

	Treatment.		
	1	2	3
Mean yields .. .. .	23.00	22.25	22.50

$$\text{Mean S. E.} = \frac{\sqrt{4 \cdot 027}}{\sqrt{4}} = \frac{2 \cdot 007}{2} = 1 \cdot 0035.$$

Variance due to treatments is 0.585 while that due to error is 4.027. This very fact shows that there is absolutely no significance due to treatments.

## JALGAON FARM XA.

Crop—Cotton.

Year—1930-31.

Yields of seed-cotton in lbs. per plot.

Treatments.	Blocks.			
	1	2	3	4
1 .. .. .	19	13	14	11
2 .. .. .	20	22	13	12
3 .. .. .	19	16	18	14

## Analysis of variance.

Kind of variation.	D.	Sum of squares.	Mean square or Variance.	$\frac{1}{2} \text{Log}_e V$
Treatments .. .. .	2	16.67	8.33	1.059
Blocks .. .. .	3	89.59	29.89	1.696
Error .. .. .	6	34.66	5.78	0.876
Total .. .. .	11	140.92	12.81	

$$\text{S. D.} = \sqrt{5.78} = 2.404.$$

## Mean yields.

	Treatment.		
	1	2	3
Mean yields .. .. .	14.25	16.75	16.75

$$\text{Mean S. E.} = \frac{\sqrt{5.78}}{\sqrt{4}} = \frac{2.404}{2} = 1.202.$$



The 5 per cent. point of "Z" for  $n_1 = 2$  and  $n_2 = 6$  is 0.8188 but in the present case, it is found to be only 0.1830 showing thereby the non-significance of the treatments on the whole.

Hence in both the years (1929-30 and 1930-1931) the treatments had more or less the same effect on the crop.

### JALGAON FARM XB.

Crop—Cotton.

Year—1929-30.

To compare the effects of the following manurial treatments on Cotton.

Treatments—(1) Ammophos 100 lbs.

(2) Sulphate of ammonia 50 lbs.

(3) No manure.

Plots—1 Guntha each 33' × 33'

Lay-out—Randomised blocks with 4 replications.

Method—IV.

Plot yields in lbs.

Treatments.	Blocks.			
	1	2	3	4
1 .. .. .	16	19	22	16
2 .. .. .	24	17	18	21
3 .. .. .	21	20	18	11

Analysis of variance.

Kind of variation.	D.	Sum of squares.	Mean square or Variance.	$\frac{1}{2} \text{Log}_e V$
Treatments .. .. .	2	13.17	6.585	
Blocks .. .. .	3	30.92	10.310	
Error .. .. .	6	84.83	14.140	
Total .. .. .	11	128.92	11.720	

S. D. =  $\sqrt{14.14} = 3.76.$

*Mean yields.*

	Treatments.		
	1	2	3
Mean yields .. .. .	18.25	20.00	17.50

$$\text{Mean S. E.} = \sqrt{\frac{14.14}{4} \cdot \frac{3.76}{2}} = 1.88.$$

Variance due to treatments is 6.585 while the variance due to error is 14.140. From this, it follows that there is absolutely no significance due to treatments.

**JALGAON FARM XB.***Crop—Cotton.**Year—1930-31.**Plot yields in lbs.*

Treatments.	Blocks.			
	1	2	3	4
1 .. .. .	21	22	18	16
2 .. .. .	18	21	16	14
3 .. .. .	18	18	10	14

*Analysis of variance.*

Kind of variation.	D.	Sum of squares.	Mean square or Variance.	$\frac{1}{2} \text{Log}_e V$
Treatments .. .. .	2	36.17	18.09	1.946
Blocks .. .. .	3	77.67	25.89	1.625
Error .. .. .	6	15.83	2.64	0.485
Total .. .. .	11	129.67	11.79	

$$\text{S. D.} = \sqrt{2.64} = 1.625.$$

## Mean yields.

	Treatments.		
	1	2	3
Mean yields .. .. .	19.25	17.25	15.00

$$\text{Mean S. E.} = \sqrt{\frac{2.64}{4}} = 0.812.$$

The 5 per cent. point of "Z" for  $n_1 = 2$  and  $n_2 = 6$  is 0.8188 while in the present case, it is found to be 1.4610. This shows that there is significance due to treatments. The standard error of comparison of two means is 1.148, and hence the significance in difference of treatment means is 2.727. This indicates that only treatment (1) Ammophos treatment is significantly better than the no-manure treatment.

## JALGAON FARM XIA.

Crop—Cotton.

Year—1929-30.

To ascertain the comparative effects of the following manures per acre on cotton :—

(1) 100 lbs. castor-cake plus 112 lbs. calcium cyanamide. (2) 100 lbs. castor-cake plus 100 lbs. of sulphate of ammonia. (3) 100 lbs. castor-cake alone.

Plots—1 Guntha each 33' × 33'.

Lay-out—Randomised blocks with 4 replications.

Method—IV.

## Plot yields in lbs.

	Treatments.	Blocks.			
		1	2	3	4
1	.. .. .	27	27	13	21
2	.. .. .	27	25	26	13
3	.. .. .	26	25	18	18

## Analysis of variance.

Kind of variation.	D.	Sum of squares.	Mean square or Variance.	$\frac{1}{2} \text{Log}_e V$
Treatments .. .. .	2	2.17	1.08	
Blocks .. .. .	3	197.67	65.89	
Error .. .. .	6	119.83	19.97	
Total .. .. .	11	319.67	29.06	

$$\text{S. D.} \pm \sqrt{19.97} = 4.469.$$

## Mean yields.

	Treatments.		
	1	2	3
Mean yields .. .. .	22.00	22.75	21.75

$$\text{Mean S. E.} = \sqrt{\frac{19.97}{4}} = 2.234.$$

There is no significance due to treatments as the variance due to treatments is very small as compared with that due to errors.

## JALGAON FARM XIA.

Crop—Cotton.

Year—1930-31.

Yield of seed-cotton in lbs. per plot.

Treatment.	Blocks.			
	1	2	3	4
1 .. .. .	18	21	16	15
2 .. .. .	19	21	13	15
3 .. .. .	13	15	10	18

## Analysis of variance.

Kind of variation.	D.	Sum of squares.	Mean square or variance.	$\frac{1}{2} \text{Log}_e V$
Treatments .. .. .	2	28.67	14.34	1.3301
Blocks .. .. .	3	55.00	18.33	1.4527
Error .. .. .	6	40.00	6.67	0.9476
Total .. .. .	11	123.67	11.24	

$$\text{S. D.} = \sqrt{6.67} = 2.583.$$

## Mean yields.

	Treatments.		
	1	2	3
Mean yields .. .. .	17.50	17.00	14.00

$$\text{Mean S. E.} = \frac{\sqrt{6.67}}{\sqrt{4}} = 1.291.$$

The 5 per cent. point of "Z" for  $n_1 = 2$  and  $n_2 = 6$  is 0.8,188 but in the present case, it is found to be 0.3825 indicating thereby the non-significance of the treatments on the whole. Hence in both the years (1929-30, 1930-31) the treatments afford no differential effects.

## JALGAON FARM XII.

Crop—Cotton.

Year—1929-30.

To ascertain the comparative effects of the following manures per acre on cotton :—

- (1) 112 lbs. of calcium cyanamide.
- (2) 100 lbs. of sulphate of ammonia.
- (3) No manure.

Plots—1 Guntha each. 33' × 33'.

Lay-out—Randomised blocks with 4 replications.

Method—IV.

## Plot yields in lbs.

Treatments.	Blocks.			
	1	2	3	4
1 .. .. .	19	13	6	18
2 .. .. .	21	14	8	23
3 .. .. .	18	14	8	18

## Analysis of variance.

Kind of variation.	D.	Sum of squares.	Mean square or Variance.	$\frac{1}{2} \text{Log}_6 V$
Treatments .. .. .	2	14.00	7.00	0.972
Blocks .. .. .	3	303.33	101.11	2.306
Error .. .. .	6	10.67	1.78	0.288
Total .. .. .	11	328.00	29.82	

$$S. D. = \sqrt{1.78} = 1.334.$$

*Mean yields.*

	Treatments.		
	1	2	3
Mean yields .. .. .	14.0	16.5	14.5

$$\text{Mean S. E.} = \frac{\sqrt{1.78}}{\sqrt{4}} = 0.667.$$

The 5 per cent. point of "Z" for  $n_1 = 2$  and  $n_2 = 6$  is 0.8188 while in the present case, it is found to be 0.6840 indicating thereby the non-significance of the treatments on the whole.

## JALGAON FARM XII.

Crop—Cotton.

Year—1930-31.

*Yield of seed-cotton in lbs. per plot.*

Treatments.	Blocks.			
	1	2	3	4
1 .. .. .	18	18	13	16
	17	21	14	17
	15	17	8	10

*Analysis of variance.*

Kind of variation.	D.	Sum of squares.	Mean square or variance.	$\frac{1}{2} \text{Log}_{10} V$
Treatments .. .. .	2	50.17	25.09	1.609
Blocks .. .. .	3	82.00	27.33	1.652
Error .. .. .	6	12.50	2.08	0.366
Total .. .. .	11	144.67	13.15	

$$\text{S. D.} = \sqrt{2.08} = 1.442.$$

*Mean yields.*

	Treatments.		
	1	2	3
Mean yields .. .. .	16.25	17.25	12.50

$$\text{Mean S. E.} = \frac{\sqrt{2.08}}{\sqrt{4}} = 0.721.$$

The "Z" test reveals that there is some significance due to treatments. Hence, proceeding further we see that the standard error of comparison of two treatment means is 1.020. On multiplying this by 2,447, the value of "t" corresponding to the number of degrees of freedom due to error viz., 6 and  $P = .05$ , we see that the significance in difference between treatment means comes to 2.727. This figure shows that the manures had a significant effect for the crop when compared with the no-manure plot.

### JALGAON FARM XIII.

*Crop*—Groundnut.

*Year*—1929-30.

*Object.*—To ascertain the comparative effects of the following manures per acre on Groundnut :—

- (1) 100 lbs. castor cake plus 60 lbs. Ammophos.
- (2) 100 lbs. castor cake plus 30 lbs. Sulphate of ammonia.
- (3) 100 lbs. castor cake alone.

*Plots*—1 guntha each. 33' × 33'.

*Lay-out*—Randomised blocks with 4 replications.

*Method*—IV.

#### *Plot yields in lbs.*

Treatments.					Blocks.			
					1	2	3	4
1	..	..	..	..	30	37	34	28
2	..	..	..	..	32	31	34	27
3	..	..	..	..	30	37	33	32

#### *Analysis of variance.*

Kind of variation.	D.	Sum of squares.	Mean square or Variance.	$\frac{1}{2} \text{Log}_e V$
Treatments .. ..	2	8.17	4.085	
Blocks .. ..	3	67.59	22.530	
Error .. ..	6	33.16	5.527	
Total .. ..	11	108.92	9.901	

$$S. D. = \sqrt{5.527} = 2.351.$$

*Mean yields.*

	Treatments.		
	1	2	3
Mean yields .. .. .	32.25	31.00	33.00

$$\text{Mean S. E.} = \frac{\sqrt{5.527}}{\sqrt{4}} = \frac{2.351}{2} = 1.176.$$

Variance due to treatments is less than the variance due to error. This shows that there is no significance whatever due to treatments. Sulphate of ammonia however seems to lower the yields.

JALGAON FARM XIA.

*Crop*—Groundnut.

*Year*—1930–31.

*Plot yields in lbs.*

Treatment.	Blocks.			
	1	2	3	4
1 .. .. .	50	50	46	66
2 .. .. .	49	50	49	58
3 .. .. .	46	54	53	58

*Analysis of variance.*

Kind of variation.	D.	Sum of squares.	Mean square or Variance.	$\frac{1}{2} \text{Log}_e V$
Treatments .. .. .	2	5.17	2.585	
Blocks .. .. .	3	286.25	95.417	
Error .. .. .	6	81.50	13.583	
Total .. .. .	11	372.92	33.902	

$$\text{S. D.} = \sqrt{13.583} = 3.685.$$

*Mean yields.*

	Treatments.		
	1	2	3
Mean yields .. .. .	53.00	51.50	52.75

$$\text{Mean S. E.} = \frac{\sqrt{13.583}}{\sqrt{4}} = \frac{3.685}{2} = 1.842.$$



variance due to treatments is less than that due to error, hence there is no significance due to treatments at all. Sulphate of ammonia however seems to lower the yield.

### JALGAON FARM XII B.

*Crop*—Groundnut.

*Year*—1929-30.

*Object*—To ascertain the comparative effects of the following manures per acre on Groundnut :—

(1) Ammophos 100 lbs. (2) Sulphate of ammonia 50 lbs. (3) No manure.

*Plots*—1 guntha each. 33' × 33'

*Lay-out*—Randomised blocks with 4 replications.

*Method*—IV.

#### *Plot yields in lbs.*

	Treatments.	Blocks.			
		1	2	3	4
1	.. .. .	28	34	29	26
2	.. .. .	36	37	34	33
3	.. .. .	39	35	29	32

#### *Analysis of variance.*

Kind of variation.	D.	Sum of squares.	Mean square or Variance.	$\frac{1}{2} \text{Log}_e V$
Treatments .. .. .	2	73.42	36.71	1.7,998
Blocks .. .. .	3	58.25	19.42	1.4,815
Error .. .. .	6	41.25	6.87	0.9,625
Total .. .. .	11	172.92	15.72	

$$S. D. = \sqrt{6.87} = 2.623.$$

#### *Mean yields.*

	Treatments.		
	1	2	3
Mean yields .. .. .	29.25	35.00	33.75

$$\text{Mean S. E.} = \frac{\sqrt{6.87}}{\sqrt{4}} = \frac{2.623}{2} = 1.311.$$

According to Fisher's Table the 5 per cent. point of "Z" for  $n_1=2$  and  $n_2 = 6$  is 0.8188 while in the present case, it is found to be 0.8373. This shows that there is significance due to treatments. The standard error of comparison of two treatment means is 1.854 and hence the significance in difference of treatment means is 4.537. This figure indicates that sulphate of ammonia and no-manure are better than ammophos.

### JALGAON FARM XIII.

Year—1930-31.

Plot yields in lbs.

Treatments..	Blocks.			
	1	2	3	4
1 .. .. .	45	43	54	64
2 .. .. .	40	49	47	53
3 .. .. .	50	49	39	48

### Analysis of variance.

Kind of variation.	D.	Sum of squares.	Mean square or Variance.	$\frac{1}{2} \text{Log}_e V$
Treatments .. .. .	2	58.17	29.085	
Blocks .. .. .	3	179.97	59.990	
Error .. .. .	6	262.85	43.810	
Total .. .. .	11	500.99	45.540	

$$S. D. = \sqrt{43.81} = 6.519.$$

### Mean yields.

	Treatments.		
	1	2	3
Mean yield .. .. .	51.50	47.25	46.50

$$\text{Mean S. E.} = \sqrt{\frac{43.81}{4}} = \frac{6.519}{2} = 3.259.$$

The treatments have no significant effect, since the variance due to treatments is less than the variance due to error.

## Fortnightly Rainfall on the Jalgaon Farm from 1913-31.

Month	January		February		March		April		May		June	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Year.												
1913	..	..	..	..	..	..	..	..	..	0-02	2-30	2-28
1914	..	..	..	..	..	..	..	..	1-12	..	2-66	5-62
1915	..	0-15	..	0-78	2-50	..	0-15	0-03	0-17	..	..	8-57
1916	..	..	..	..	..	..	..	..	..	0-15	2-22	1-38
1917	..	..	2-03	..	..	0-36	..	..	..	1-11	1-01	1-03
1918	..	..	..	..	..	..	..	..	..	0-99	..	3-99
1919	..	..	..	..	..	..	..	..	0-80	..	7-33	2-50
1920	2-63	0-07	..	..	..	..	..	..	..	0-07	..	2-13
1921	..	0-10	..	..	..	..	..	..	..	..	1-70	4-76
1922	3-05	..	..	0-10	..	..	..	..	..	..	0-36	3-95
1923	..	..	..	..	..	0-65	0-13	..	..	..	..	0-42
1924	0-35	..	..	..	..	..	..	..	..	0-53	1-15	5-06
1925	..	..	..	..	..	..	..	..	..	1-60	0-65	2-45
1926	1-25	0-85	..	..	..	..	0-10	..	..	..	1-52	0-80
1927	..	..	..	0-34	0-32	..	..	..	..	..	1-21	2-74
1928	..	..	1-13	..	..	..	..	..	..	..	0-35	2-39
1929	..	..	1-26	..	0-11	..	..	0-41	..	..	0-90	8-68
1930	..	..	..	..	..	..	..	..	..	0-68	0-45	5-84
1931	..	..	..	..	..	..	..	..	..	..	1-80	8-03

Month	July		August		September		October		November		December		Total.
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	
Year.													
1913	3-90	8-92	2-13	1-51	6-37	0-09	..	..	..	..	0-45	..	28-57
1914	2-69	9-16	1-47	2-00	8-04	4-06	..	..	0-48	0-36	..	..	37-66
1915	1-08	5-73	2-78	0-43	4-73	2-81	6-05	..	..	..	..	0-41	34-37
1916	9-59	5-01	4-45	2-05	4-51	0-54	0-27	2-08	..	0-86	..	..	33-11
1917	1-88	1-77	2-05	4-99	2-50	6-61	3-54	0-86	..	..	..	..	30-64
1918	3-05	1-54	1-83	2-08	0-46	0-36	0-05	..	..	1-59	..	..	15-94
1919	0-91	6-13	1-24	4-92	0-02	3-39	..	2-03	..	1-70	..	..	30-47
1920	2-97	4-63	1-02	1-02	0-42	1-27	..	..	..	..	..	..	16-23
1921	2-72	6-28	4-65	0-92	2-12	2-31	..	..	..	..	..	..	25-56
1922	4-83	7-18	0-65	0-79	4-98	4-18	..	..	1-62	..	..	0-33	31-52
1923	7-51	10-80	3-43	1-04	1-90	3-01	..	..	..	..	..	..	28-65
1924	6-41	2-14	1-08	4-75	1-00	2-65	2-21	2-47	0-23	..	..	..	30-63
1925	1-33	4-00	1-85	2-82	1-75	0-85	..	..	2-07	1-12	..	0-10	20-59
1926	5-59	0-89	6-79	4-45	1-68	0-29	..	..	0-62	..	..	..	24-83
1927	2-14	5-01	1-26	2-60	0-29	2-94	1-71	..	2-19	..	..	0-38	29-13
1928	3-58	3-41	0-30	2-41	0-17	5-19	2-63	0-50	..	..	..	5-84	27-90
1929	4-92	0-74	0-73	0-45	0-36	1-21	0-86	..	..	..	..	..	20-33
1930	4-50	2-21	3-96	0-35	18-71	0-11	..	0-18	..	..	..	..	36-99
1931	2-27	5-76	5-75	7-14	0-06	6-00	12-93	0-61	..	..	..	..	50-54

## JALGAON FARM.

## Statement of rates for seed cotton.

Year.	Lbs. per rupee
1915-16 .. .. .	7.14
1916-17 .. .. .	3.19
1917-18 .. .. .	..
1918-19 .. .. .	3.32
1919-20 .. .. .	4.35
1920-21 .. .. .	8.50
1921-22 .. .. .	6.40
1922-23 .. .. .	8.00
1923-24 .. .. .	6.00
1924-25 .. .. .	8.75
1925-26 .. .. .	8.33
1926-27 .. .. .	6.85
1927-28 .. .. .	8.00
1928-29 .. .. .	6.00
1929-30 .. .. .	8.00

## Statement showing rates of various manures.

(Lbs. per Rupee)

Year	1920	1921	1922	1923 to 1925	1926	1927	1928	1929	1930
Castor-cake .. .. .	28.0	29.0	27.5	27.1	23.0	23.5	27.0	30.0	30.0
Molua-cake .. .. .	89.0	102.0	102.0	..	..	..	..	..	..
Groundnut cake .. .. .	..	..	..	..	..	..	23.6	20.8	20.0
Sulphate of ammonia .. .. .	..	..	..	..	..	..	11.2	12.5	..
Bone-meal .. .. .	..	..	..	..	..	..	..	17.2	16.0
Superphosphate .. .. .	..	..	..	..	..	..	10.0	11.2	11.2
Nitrate of Soda .. .. .	..	..	..	..	..	..	..	11.5	..
Ammophos 20/20 .. .. .	..	..	..	..	..	..	..	7.3	..

## Statement showing the cost of cultivation per acre.

(No manure plots)

Year.	Cotton.				Groundnut.	Jowar.	Wheat.
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
1917-18 .. .. .	49.00	..	..	..	..	..	..
1918-19 .. .. .	78.38	..	..	..	..	..	..
1919-20 .. .. .	84.53	..	..	..	..	..	..
1920-21 .. .. .	45.85	..	..	..	..	..	..
1921-22 .. .. .	51.57	..	..	..	..	..	..
1922-23 .. .. .	45.70	..	..	..	..	..	..
1923-24 .. .. .	51.98	..	..	..	..	..	..
1924-25 .. .. .	55.12	71.70	..	..	..	..	..
1925-26 .. .. .	51.38	73.63	57.52	..	..	..	..
1926-27 .. .. .	55.45	74.38	56.40	..	..	..	..
1927-28 .. .. .	53.20	65.60	56.35	61.52	..	..	..
1928-29 .. .. .	56.56	69.03	50.22	69.57	..	..	..
1929-30 .. .. .	53.30	65.90	55.90	51.90	..	..	..

## KARJAT FARM I.

To ascertain the effect of increasing doses of nitrogen as sulphate of ammonia.

Rice—Kolamba variety.

Plots—1/100 acre.

Layout—Duplicated.

Treatments—(1). No manure.

(2) 40 lbs. N. as sulphate of ammonia.

(3) 60 lbs. N. do.

(4) 80 lbs. N. do.

(5) 100 lbs. N. do.

Method—I.

Treatments.		Grain yields in lbs. per plot.		Aver- age.	Percent- age.	Percent- age error.	Signi- ficance.	Net profit in Rs. per plot.
(1923)								
1	..	31	31	31	100	0.0	15.4	1.30
2	..	41	38	39.5	127	3.6		1.62
3	..	46	38	42	135	9.0		1.68
4	..	46	39	42.5	137	7.8		1.48
5	..	45	40	42.5	137	5.6		1.38
(1926)								
1	..	31	31	31	100	....	5.04	1.44
2	..	39	38	38.5	124	1.2		1.68
3	..	41	39	40	129	2.3		1.70
4	..	39	36	37.5	121	3.7		1.47
5	..	40	41	40.5	130	1.2		1.63
(1927)								
1	..	33	32	32.5	100	1.5	4.8	1.48
2	..	38	41	39.5	122	3.6		1.77
3	..	40	41	40.5	125	1.2		1.73
4	..	40	40	40.0	123	0.0		1.61
(1928)								
1	..	26	27	26.5	100	1.8	11.1	0.98
2	..	32	29	30.5	115	4.6		1.07
3	..	32	35	33.5	126	4.2		1.18
4	..	36	33	34.5	130	4.1		1.18
Taking average of all years:—								
Treatment-								
1	..			100			9.1	
2	..			122				
3	..			120				
4	..			128	Significance			
5	..			133				

## KARJAT FARM II.

To ascertain the best distribution of manures with sulphate of ammonia  
60 lbs. of N.

Rice—Kolamba variety.

Plots—1/100 acre.

Lay-out—Duplicated with 4 replications in 1929.

Treatments—(1) No manure.

(2) 60 lbs. of N all at once.

(3) 30 lbs. and 30 lbs.—two doses.

(4) 30 lbs. 15 lbs. and 15 lbs.—three doses.

(5) 20 lbs. 20 lbs. and 20 lbs.—three doses.

## Method—I.

Treat- ment.	Grain yields in Lbs. per plot.				Aver- age.	Percent- age.	Percent- age error.	Signi- ficance.	Net profit in Rs.	
(1925)										
1	..	29	28	..	..	28.5	100	1.62	..	0.95
2	..	42	36	..	..	39.0	137	7.3	..	1.68
3	..	44	43	..	..	43.5	152	1.10	9.75	1.93
4	..	..	..	..	..	..	..	..	..	..
5	..	45	48	..	..	46.5	163	3.00	..	2.08
(1926)										
1	..	26	24	..	..	25.0	100	3.8	..	0.77
2	..	34	37	..	..	35.5	142	4.0	..	1.45
3	..	36	38	..	..	37.0	148	2.5	9.18	1.53
4	..	36	38	..	..	37.0	148	2.5	..	1.99
5	..	37	39	..	..	38.0	152	2.5	..	1.78
(1927)										
1	..	29	30	..	..	29.5	100	1.6	..	0.99
2	..	38	39	..	..	38.5	131	1.22	..	1.60
3	..	41	37	..	..	39.0	132	6.36	10.0	1.60
4	..	39	38	..	..	38.5	131	1.22	..	1.56
5	..	41	37	..	..	39.0	132	6.36	..	1.60
(1928)										
1	..	25	22	..	..	23.5	100	6.0	..	0.60
2	..	32	27	..	..	29.5	126	7.8	..	0.94
3	..	35	33	..	..	34.0	145	2.3	11.4	1.23
4	..	32	33	..	..	32.5	138	1.5	..	1.12
5	..	34	33	..	..	33.5	143	1.4	..	1.65
(1929)										
1	..	27	29	26	28	27.5	100	3.12	..	0.92
2	..	42	39	36	40	39.0	143	4.33	..	1.64
3	..	38	38	40	38	38.5	140	1.71	6.1	1.49
4	..	41	38	40	41	40.0	145	2.30	..	1.56

N.B.—The figures of the year 1929 were tried by Fisher's method of Analysis of Variance and except for a definite positive significance of the last three treatments over the first, nothing else is found between the treatments.

## KARJAT FARM III.

To ascertain the effect of increasing doses of Sulphate of Ammonia  
(1) 30 lbs. N (2) 40 lbs. N (3) 60 lbs. N. per acre on varying numbers  
of seedlings per bunch (culms.)

Rice—Kolamba variety.

Plots—1/100 acre.

Lay-out—Duplicated.

Method—I.

Treatment.			Grain yield in lbs. per plot.		Average.		Percent- age.	Percent- age error.	Net profit.
1928.									
4 Seedlings per bunch.									
1	..	..	25	..	28	26.5	100	5.3	0.90
2	..	..	31	..	29	30.0	113	3.0	1.02
3	..	..	33	..	32	32.5	123	1.5	1.12
8 Seedlings per bunch.									
1	..	..	29	..	31	30.0	113	3.0	1.07
2	..	..	31	..	33	32.0	121	2.8	1.16
3	..	..	34	..	35	34.5	130	1.4	1.28
12 Seedlings per bunch.									
1	..	..	32	..	31	31.5	119	1.5	1.17
2	..	..	27	..	35	31.0	117	12.2	1.21
3	..	..	29	..	37	33.0	125	11.4	1.19
Significance 14.0									
Lay-out—3 replications.									
1929.									
4 Seedlings per bunch.									
1	..	..	32	31	32	32.0	100	1.2	1.19
2	..	..	37	39	..	38.0	119	2.4	1.48
3	..	..	37	42	38	39.0	123	4.5	1.48
8 Seedlings per bunch.									
1	..	..	35	29	29	31.0	97	7.5	1.18
2	..	..	35	34	37	35.0	112	2.9	1.35
3	..	..	39	35	37	37.0	117	3.6	1.42
12 Seedlings per bunch.									
1	..	..	33	36	35	35.0	109	2.9	1.38
2	..	..	35	33	34	34.0	107	3.9	1.30
3	..	..	31	32	39	34.0	107	8.6	1.30
Significance 10.2									

Treat- ments.	Grain Yields in lbs. per plot.						Aver- age.	Percent- age.	Percent- age error.	Net profit Rs. per plot.
	1	2	3	4	5	6				
1930.										
<i>Lay-out</i> —6 replication s.										
4 Seedlings per bunch.										
1	37	38	34	38	38	35	37	100	3.16	0.77
2	37	35	41	44	42	40	40	109	5.5	0.86
3	43	45	44	47	45	46	45	123	2.0	1.00
8 Seedlings per bunch.										
1	39	38	37	35	36	39	37	102	2.8	0.83
2	40	39	39	38	40	37	39	106	2.0	0.83
3	38	39	42	40	47	39	41	111	5.4	0.88
12 Seedlings per bunch.										
1	34	35	35	36	38	36	36	97	3.8	0.76
2	38	39	37	37	35	39	37.5	102	2.7	0.80
3	39	35	40	38	39	41	39	105	3.5	0.82
							Significance 5.9			

The best treatment in this year is 4 culms with 60 lbs. N followed by 8 culms with 60 lbs. N.

All the years taken together show that 12 seedlings per bunch has no advantage over 8 or 4 culms. Singly 60 lbs. N give only slightly higher net profits over 40 lbs. N 30 lbs. N is the lowest nearly in all cases.

#### KARJAT FARM IV.

*To ascertain the effect of Green manuring 60 lbs. N ploughed into the land before transplanting.*

*Rice—Kolamba variety.*

*Plots*  $\frac{1}{100}$  acre.

*Lay-out*—Duplicated.

*Treatments*—(1) No manure.

(2) Rui leaves.

(3) Ipomia Carnia leaves.

*Method*—I.

Treatment.	Grain yields in lbs.		Aver- age.	Percent- age.	Percent- age error.	Signi- ficance.	Net profit.
			(1925)				
1 .. ..	28	29	28.5	100	1.7	....	1.27
2 .. ..	37	36	36.5	128	1.3	13.2	1.65
3 .. ..	41	33	37.0	130	10.2	....	1.72



Treatment.			Grain yields in lbs.		Aver- age.	Percent- age.	Percent- age error.	Signi- ficance.	Net profit.
					(1927)				
1	..	..	29	28	28.5	100	1.7	....	1.24
2	..	..	40	40	40.0	140	....	3.1	1.82
3	..	..	34	33	33.5	117	1.4	....	1.50
					(1928)				
1	..	..	23	22	22.5	100	2.1	....	0.77
2	..	..	34	33	33.5	141	1.4	11.5	1.27
3	..	..	27	32	29.5	131	8.0	....	1.12

*Remarks.*—Combining the three years' results the percentage yields can be put down as :

100 }  
136 } for the three treatments.  
126 }

The average significance figure is 9.3 and it is seen that the treatment with *Rui* leaves stands best. The other treatment is the next. Both the treatments have a distinctly positive advantage over the no-manure treatment.

Putting the above as six replications and treating by Fisher's method of "Analysis of Variance" also yields exactly the same result.

*Statement showing the Fortnightly Rainfall at the Rice Research Station, Karjat.*

Months.	Fortnight.	June.		July.		August.	
		1st.	2nd.	1st.	2nd.	1st.	2nd.
Year.							
1919	..	21.22	7.06	24.97	27.46	13.12	37.22
1920	..	2.45	16.12	27.47	13.32	15.11	3.08
1921	..	5.41	3.53	4.89	44.71	15.89	7.56
1922	..	1.84	20.11	22.50	28.20	5.57	10.83
1923	..	3.08	1.08	29.52	69.81	22.58	5.96
1924	..	0.57	12.48	14.17	15.49	9.06	35.31
1925	..	6.34	17.26	13.80	16.36	23.55	10.16
1926	..	0.44	3.41	42.27	21.80	36.80	22.95
1927	..	6.83	19.29	22.68	36.20	10.10	13.03
1928	..	5.01	2.81	16.71	36.68	11.41	31.49
1929	..	11.49	6.28	23.95	7.47	9.37	18.16
1930	..	4.66	23.49	16.20	26.66	20.81	3.90
1931	..	2.91	2.18	44.57	31.58	25.83	26.46

Year.	Months.		September.		October.		November.		December.		Total.
	Fortnight.		1st.	2nd.	1st.	2nd.	1st.	2nd.	1st.	2nd.	
1919	..		4.19	8.06	3.57	..	..	..	..	..	146.87
1920	..		9.19	2.62	0.60	1.14	..	..	..	..	91.10
1921	..		5.83	11.71	..	..	..	..	..	..	99.53
1922	..		7.00	10.48	1.06	..	2.17	..	..	..	109.76
1923	..		1.32	4.61	..	..	..	..	..	..	137.96
1924	..		7.33	5.17	0.06	..	..	..	..	..	99.64
1925	..		5.01	2.87	1.86	0.16	0.80	..	..	..	107.13
1926	..		13.88	12.74	0.08	..	..	..	..	..	154.37
1927	..		2.85	4.35	5.65	0.29	1.61	..	..	..	122.88
1928	..		1.27	10.68	1.19	1.39	0.01	..	..	..	118.65
1929	..		2.05	11.94	0.53	..	0.16	..	..	..	91.40
1930	..		31.53	2.60	3.13	1.81	..	..	..	..	136.79
1931	..		7.73	17.19	25.25	1.14	0.53	..	0.49	..	185.86

## KARJAT FARM.

Prices for manures—Prices for outturns.

		Sulphate of Ammonia lbs. per Re.	Grain. lbs. per Rs.	Straw lbs. per Rs.
1922-23	..	6	18.0	150
1923-24	..	6	18.0	150
1924-25	..	.....	18.0	105
1925-26	..	10	19.2	115
1926-27	..	10	19.2	100
1927-28	..	9	18.0	150
1928-29	..	13	20.5	160
1929-30	..	13	20.5	160
1930-31	..	16	30.0	200

## KOPERGAON FARM I.

To ascertain the comparative effects of the following manures on Nilwa Jowar :—

- (1) Sulphate of ammonia .. 100 lbs. per acre.
- \* (2) Castor cake .. 480 lbs. per acre.
- (3) Farm Yard Manure .. 12,000 lbs. per acre.
- (4) No-manure.

\*In the second year Safflower cake 286 lbs. was substituted for castor cake.

Plots—1 acre each.

Lay-out—Duplicated.

Method—III.

## Yields in lbs. per plot.

Treatment.	Grain.		Average.	Fodder.		Average.	Average net profits p/p in Rs.
	I	II		I	II		
			Year 1919-20.				
1 ..	209	216	213	5,193	4,981	5,087	57.1
2 ..	266	238	252	4,943	4,942	4,943	59.9
3 ...	242	246	244	4,612	4,710	4,661	56.3
4 ..	138	162	150	3,111	3,081	3,096	37.3
Significance	23.0			137.2			
			Year 1921-22.				
1 ..	649	495	572	3,837	3,710	3,774	27.40
2 ..	495	440	468	3,197	2,901	3,049	6.16
3 ...	484	374	429	2,878	2,508	2,693	(13.50)
4 ..	319	286	303	2,734	2,070	2,402	1.22
Significance	58.0			234			

In this experiment the fodder being the primary product significance was found in each year for that also.

So far as the fodder-yielding capacity is concerned, in both the years the treatments stand in the order as they are written above, for both the years. In yielding grains, treatments 2 and 3 are better than 1 for the first year and for the second year they stand in the same order as for the fodder. In the first year the net profits for the treatments 1, 2 and 3 do not differ much, thereby showing that they are more or less equally advantageous. But in the second year Sulphate of ammonia has given the best yield and highest net profits. F. Y. M. has given a high loss which remains to be accounted for. As the results are not consistent we cannot say anything more than that the Sulphate of ammonia may prove to be the best.

## KOPERGAON FARM II.

To compare the effects of the following manurings on Jowar :—

- (1) Sulphate of ammonia 100 lbs. per acre.
- \* (2) Groundnut cake 300 lbs. per acre.
- (3) F. Y. M. 12,000 lbs. per acre.
- (4) No-manure.

\*In 1919-20 castor cake was substituted for groundnut cake, the quantity used being 480 lbs. per acre.

Plots—16 to 20 gunthas each. But yields are given per acre.

Lay-out—Duplicated.

Method—VII.

## Yields in lbs. per acre.

Treatments.	1918-19			1919-20			Average net profits per acre in Rs.
	Grains.		Average.	Grains.		Average.	
	I	II		I	II		
1 ..	1,500	1,050	1,275	1,266	1,173	1,220	113·76
2 ..	1,110	945	1,020	1,158	1,069	1,114	86·36
3 ..	1,020	990	1,005	1,058	874	966	74·82
4 ..	1,110	720	915	980	897	939	84·16
Significance ..	201·7			51·1			

Sulphate of ammonia and cake give higher yields than F. Y. M. and no-manure in both the years. F. Y. M. gives only equal yields with no-manure. Only Sulphate of ammonia gives good net profits over no-manure. Cake gives equal net profits with no-manure whereas F. Y. M. gives a lower profit.

## KOPERGAON FARM III.

To compare the effects of the following treatments on Sugarcane  
(1) Planted, (2) Ratoon :—

- (1) Sulphate of ammonia and Safflower cake 75 lbs. N each.
- (2) Nitrate of Soda and Safflower cake 75 lbs. N each
- (3) Sulphate of ammonia and Groundnut cake 75 lbs. N each.
- (4) Castor cake and Safflower cake 75 lbs. N each.

These top-dressings were given in three doses of (i) 37·5 lbs. N of the first manure, (ii) 37·5 lbs. N plus 25 lbs. N. of the two manures respectively, (iii) 50 lbs. of N of the second manure—the cake.

Plots—10 gunthas each.

Lay-out—Unreplicated.

Treatment.	I PLANTED.				II RATOON.		Average net profits per plot.
	Gul yields in lbs.		Average.	Average net profits.	Gul yields in lbs. per plot.		
	1920	1922			1921	1923	
1 ..	2,476	2,704	2,590	668·9	crop.	1,322	175·0
2 ..	2,899	2,781	2,840	773·3	extremely	1,593	240·6
3 ..	2,835	2,455	2,645	730·6	poor.	1,232	140·8
4 ..	3,156	2,599	2,878	782·6	..	1,401	297·6

For both canes, treatments 2 and 4, i.e., Nitrate of Soda and Safflower cake, and Castor cake plus Safflower cake show higher yields and higher net profits than the other two treatments.

## KOPERGAON FARM IV.

To ascertain the effects of increasing the doses of nitrogenous top-dressings given in the form of a mixture of Sulphate of ammonia and Safflower cake in equal proportions of nitrogen crop. Sugarcane; (i) Planted, (ii) Ratoon.

Plots—5 gunthas each.

Lay-out—Duplicated.

Rotation—San cane ratoon, bajri groundnut. (5 years.)

Manuring per acre—Basic manure San green with a top-dressing given in three doses:—

- |                 |                 |
|-----------------|-----------------|
| (1) 100 lbs. N. | (4) 250 lbs. N. |
| (2) 150 lbs. N. | (5) 300 lbs. N. |
| (3) 200 lbs. N. | (6) 350 lbs. N. |

Yields of Gul in lbs. per plot.

I PLANTED.										Average net profit per plot in Rs.
Treatments	1926-27			1927-28			1928-29			
	I	II	Average.	I	II	Average.	I	II	Average.	
3	1,639	1,518	1,579	1,413	1,450	1,432	1,351	1,174	1,263	35.44
4	1,496	1,587	1,542	1,431	1,451	1,391	1,289	1,244	1,267	29.22
5	1,542	1,445	1,494	1,407	1,473	1,440	1,344	1,489	1,470	30.80
6	1,551	1,600	1,576	1,501	1,433	1,467	1,374	1,315	1,345	26.50
Significance	111.8			78.0			144.0			
II RATOON.										
1929-30										
1930-31										
1	1,604	1,642	1,623	1,698	1,518	1,608	..	..	..	54.5
2	1,730	1,729	1,730	1,567	1,568	1,568	..	..	..	53.8
3	1,868	1,745	1,807	1,654	1,688	1,661	..	..	..	62.5
Significance	94.8			95.4						
1926-27										
1927-28										
1928-29										
3	1,484	1,336	1,410	1,161	1,259	1,210	1,007	1,151	1,079	63.47
4	1,335	1,220	1,278	1,173	1,167	1,170	1,011	1,037	1,024	50.63
5	1,298	1,276	1,287	1,117	1,096	1,107	984	1,038	1,011	46.54
6	1,210	1,294	1,252	1,131	1,103	1,117	1,153	1,193	1,173	43.21
Significance	.. 107.4			63.2			53.0			

Figures were treated by method III.

So far as increasing the nitrogen up to 200 lbs. is concerned, the net profits are not much affected as seen from 1929-30 and 1930-31.

Further increase in the nitrogenous top-dressings do not give any appreciable increase in yields and hence the net profits go down much lower in the case of planted and ratoon canes. 150 lbs. nitrogen may be taken to be the best top-dressing.

*Statement showing the Fortnightly Rainfall on Kopergaon Farm from 1915 to 1923.*

Months.	1915		1916		1917		1918	
	Fortnight.		Fortnight.		Fortnight.		Fortnight.	
	1st.	2nd.	1st.	2nd.	1st.	2nd.	1st.	2nd.
January .. ..	..	..	..	0.06	..	..	..	..
February .. ..	..	..	..	..	0.69	..	..	..
March .. ..	..	..	..	..	..	..	..	..
April .. ..	..	..	..	..	..	..	..	..
May .. ..	..	..	..	3.41	0.13	0.03	0.13	1.58
June .. ..	..	4.13	7.54	0.47	6.31	0.44	..	1.16
July .. ..	0.14	6.55	3.59	7.83	0.05	0.12	1.00	0.45
August .. ..	0.30	0.22	2.62	0.46	0.31	3.80	0.84	1.12½
September .. ..	1.44	5.27	4.02	0.80	1.32	3.54	1.11	0.14
October .. ..	1.84	0.14	2.41	3.89	1.25	1.15	..	..
November .. ..	0.06	0.07	..	1.09	0.0	1.50	..	..
December .. ..	..	0.22	..	..	..	..	..	..
Total .. ..	20.38		38.19		20.69		7.53½	

Months.	1919		1920		1921		1922		1923	
	Fortnight.		Fortnight.		Fortnight.		Fortnight.		Fortnight.	
	1st.	2nd.	1st.	2nd.	1st.	2nd.	1st.	2nd.	1st.	2nd.
January .. ..	0.53	..	0.77	..	..	0.02	0.69	..	..	..
February .. ..	..	..	..	..	..	..	..	0.09	..	..
March .. ..	..	..	..	..	..	..	..	..	1.69½	..
April .. ..	..	..	..	..	0.40	..	..	0.08	..	..
May .. ..	0.87	0.43	..	0.14	..	..	..	0.47	..	..
June .. ..	2.74	0.22	0.42½	1.33	1.94	0.87	2.21	5.37½	0.45	..
July .. ..	0.11½	2.69	0.13	1.04	2.66	2.25	2.32	0.23	1.80½	0.67
August .. ..	0.30	1.06	0.80	0.21	0.82	0.22	0.17½	0.68	..	0.11
September .. ..	..	14.75	0.31	1.97	0.17	4.62	1.71	0.19	2.88	4.95
October .. ..	0.53	..	..	0.53½	0.04	0.14	0.11	..	..	..
November .. ..	0.88	..	..	..	..	..	5.18	0.15	..	0.01
December .. ..	..	..	..	..	..	..	0.08	..	..	..
Total .. ..	25.11½		7.66		14.15		19.74		12.57	

*Statement showing the Fortnightly Rainfall on Kopergaon Farm, from the year 1924-31.*

Months.	1924		1925		1926		1927	
	Fortnight.		Fortnight.		Fortnight.		Fortnight.	
	1st.	2nd.	1st.	2nd.	1st.	2nd.	1st.	2nd.
January .. ..	..	..	..	..	0·89	1·47	..	..
February .. ..	..	..	..	..	0·05	..	..	..
March .. ..	..	..	0·02	..	..	..	0·06	..
April .. ..	..	..	..	..	..	..	..	0·11
May .. ..	..	..	0·11	0·33	0·13	0·58	..	..
June .. ..	0·23	0·82	2·18	0·66	0·74	1·74	2·18	4·54½
July .. ..	0·19	0·84	0·54	0·50½	2·05	0·63	6·72	1·10
August .. ..	..	6·50	1·29	0·18	1·67	1·49	1·21	0·29
September ..	0·59	11·46	0·51	1·84	1·43	0·45	2·37	1·58
October .. ..	0·08	1·11	0·16	..	0·11	0·21	5·94	..
November ..	..	..	1·56	0·21	..	..	3·24	..
December ..	..	..	..	..	..	0·18	..	0·01
<b>Total ..</b>	21·82		10·09½		13·72		29·35½	

Months.	1928		1929		1930		1931	
	Fortnight.		Fortnight.		Fortnight.		Fortnight.	
	1st.	2nd.	1st.	2nd.	1st.	2nd.	1st.	2nd.
January .. ..	..	..	0·08	..	..	..	..	..
February .. ..	0·15½	..	0·16	0·08	..	..	..	..
March .. ..	..	..	..	..	..	..	..	..
April .. ..	..	..	0·83	0·61	..	0·34	0·0½	..
May .. ..	..	..	..	..	..	0·65	..	..
June .. ..	4·11	0·32	0·75	4·34	3·67	4·12	0·34½	2·09
July .. ..	2·05	0·37	1·79	..	2·05½	1·19½	2·58½	2·45½
August .. ..	0·14	2·23	0·16	0·06	0·79	0·17½	0·50	0·55
September ..	..	5·54	0·39	4·94	6·63½	1·62	0·43	3·44
October .. ..	0·50	1·30	0·89	..	1·10	1·99	5·79	0·77
November ..	..	..	..	..	5·03	..	1·29½	..
December ..	1·06	..	..	0·02	0·04	..	0·39	0·01
<b>Total ..</b>	17·77½		15·10		29·41		20·65½	

## KOPERGAON FARM.

Statement showing the rates of various manures and "Gul"  
in lbs. per rupee.

Year.	Safflower cake.	Castor cake.	Ground- nut cake.	Sulphate Ammo- nia.	Nitrate of Soda.	F.Y.M.	Gul.
1919-20	16.0	28.2	26.6	8.4	9.5	250	..
1920-21	13.7	18.1	24.7	5.6	9.5	250	6.0
1921-22	18.4	26.5	28.2	7.0	9.5	250	7.0
1922-23	17.7	25.2	20.0	8.0	9.5	250	8.0
1923-24	16.0	17.7	19.2	10.2	..	266	10.0
1924-25	15.7	17.7	..	10.2	..	266	8.0
1925-26	16.5	..	..	10.6	..	266	9.5
1926-27	16.5	..	..	11.2	..	285	12.3
1927-28	16.2	..	..	11.7	..	285	13.0
1928-29	19.2	..	..	13.8	..	285	10.0
1929-30	20.8	26.5	28.2	13.1	..	285	10.6
1930-31	37.0	43.6	40.0	14.4	..	500	16.4

## KUMTA FARM I.

To ascertain the effect of Bone-meal with and without F.Y.M. as a manure  
for rice crop.

Land—Low-lying non-springy.

Plot—1 guntha each in 1924 and 1925 and 0.5 guntha in 1929  
and 1930.

Rice—"Halga" variety.

Treatments—(1) F.Y.M. 5 carts per acre.

(2) Bone-meal 224 lbs per acre.

(3) Bone-meal 224 lbs per acre.

Lay-out—Duplicated.

Treatments.		Grain yields.		Average.	Percent- age.	Signi- ficance.
1924.						
1	..	19	13	16.0	100	} 36.5
2	..	24	29	26.5	166	
3	..	30	37	33.5	209	
1925.						
1	..	23	24	23.5	100	} 17.94
2	..	31	39	35.0	149	
3	..	41	46	43.5	185	



## Lay-out—Three replications.

Plot.	Treatments.			Average.	Plot.	Treatments.			Average.
	1	2	3			1	2	3	
		1929				1930			
1	15	31	34	27	1	15	27	33	25
2	17	25	30	24	2	18	24	27	23
3	29	36	41	35	3	17	27	31	25
4	32	39	40	37	4	22	30	32	28
Average	23.25	32.75	36.25	30.75	Average.	18	27	30.75	..

The results of 1924 and 1925 were treated by method I as there were only duplicates. The results of 1929 and 1930 were treated by method III and the significances for differences in means of treatments were found to be 3.6 and 2.8 respectively. In all the years treatment 3 gives the best yield, though in 1929 the difference between this and treatment 2 is not significant.

Comparing the average net profits as follows:—

				Years.			
				1924	1925	1929	1930
1	..	..	..	—(.15)	—(.03)	0.495	0.043
2	..	..	..	0.907	0.484	1.012	0.223
3	..	..	..	0.630	0.784	0.756	0.274
				1 guntha a plot.		0.5 guntha plot.	

We may say that treatment 3 is more or less equal to 2 economically.

## KUMTA FARM II.

To ascertain the effects of the following manurial treatments on rice crop.

Land—Low-lying non-springy.

Plots— $\frac{1}{2}$  Guntha each.

Rice—"Halga" variety.

Lay-out—4 replications.

Treatments—

- (1) 5 carts F. Y. M. per acre.
- (2) Bone-meal 224 lbs. per acre plus green leaves of Terminalia paniculata.
- (3) Bone-meal 224 lbs. per acre plus green leaves of Strychnos nux-vomica.
- (4) Green leaves—Terminalia paniculata.
- (5) Green leaves—Strychnos nux vomica.

## Grain yields in lbs. per plot.

1929.

Plot.	Treatment.					
	1	2	3	4	5	Average.
1	15	32	39	31	34	30.2
2	17	33	46	23	34	30.6
3	29	45	48	26	34	36.4
4	32	46	51	33	43	41.0
Average treatment per	23.25	39.00	46.00	28.25	36.25	34.55

Working out these figures by method III we have standard error for comparing the means = 2.428. Hence significance =  $2.43 \times 2.1 = 5.103$ .

1930.

Plot.	Treatment.					
	1	2	3	4	5	Average.
1	15	23	31	14	18	20.2
2	18	24	25	12	17	19.2
3	17	29	29	16	20	22.2
4	22	23	31	18	24	23.6
Average treatment per	18	25	29	15	20	21.3

By the same process, we obtained significance =  $1.424 \times 2.1 = 2.99$ .

Comparing the treatment means in the light of the above significance figures we see that in both years treatment 3 stands first and treatment 2 comes next. Treatment 5 can be taken to be the third. As for treatments 1 and 4, their differences are contradictory and in both years the difference is just equal to the significance.

Hence we may arrange the treatments as follows in their order of importance so far as yields are concerned:—3, 2 and 5, 1 and 4.

Considering the net profits which are as follows:—

Treatment.	Average net profit in Rupees per plot			
	1929			
1	..	..	..	.613
2	..	..	..	.997
3	..	..	..	1.481
4	..	..	..	.684
5	..	..	..	1.102

The same order of importance is maintained.

## KUMTA FARM III.

To ascertain the effects of F.Y.M. sulphate of ammonia and their combination on rice crop.

Land—Low-lying non-springy.

Plots—1 guntha each.

Rice—“Halga” variety.

Layout—4 replications.

Treatments—

(1) F.Y.M. 5 carts per acre.

(2) F.Y.M. 5 carts plus sulphate of ammonia = 40 lbs. N per acre.

(3) Sulphate of ammonia 40 lbs. N per acre.

Grain yield per plot in lbs.

Year.	Treatment.			Average	—
	1	2	3		
1924					
(4 plots).	57 55 40 35	79 60 48 46	63 49 35 34	66 55 41 38	These figures were treated by method III as there was a distinct consistent gradation between the replications.
Average ..	46.75	58.25	45.25	50.08	

Standard error for comparison of means = 4.93 and hence the significance = 10.85.

1925					
(2 plots).	53 39	60 47	51 40	54.67 42.0	Treated by the same method. Significance = 1.69.
Average ..	46	53.5	45.5	..	

1926					
(2 plots).	51 50	75 61	57 59	61 56.66	Treated by the same method. Significance = 9.01.
Average ..	50.5	68	58		

From the above we can say that treatment 2 is significantly better than the other two treatments which are more or less equal in yielding capacity.

Year.	Treatments.			
	1	2	3	
1924 .. ..	1.864	2.041	1.153	From the table of net profits it is seen that except in one year treatment 2 has maintained a high net profit.
1925 .. ..	1.377	0.785	0.562	
1926 .. ..	1.652	1.968	1.462	

## KUMTA FARM IV.

To ascertain the effect of F.Y.M. rock phosphate and their combination as manures for rice crop.

Land—Low-lying non-springy.

Plot— $\frac{1}{2}$  guntha each.

Rice—“Halga” variety.

Treatments—

(1) F.Y.M. 5 carts per acre.

(2) Rock phosphate 112 lbs. per cre.

(3) F.Y.M. 5 carts plus rock phosphate per acre.

Treatments.	Grain yields in lbs. per plot.		Average	Net profit in Rs.
	1923	1924		
1 .. ..	31	20	25.5	0.351
2 .. ..	31	22	26.5	0.523
3 .. ..	31	21	26.0	0.237

So far as their yields are concerned there is practically no difference between the treatments. But the net profits show that treatment 2 is the most economical. But it cannot be asserted on such a slender basis. Hence nothing can be confirmed without further trials in this matter.

## KUMTA FARM V.

To ascertain the effects of rock phosphate with and without leaves as manure for rice crop.

Land—Low-lying non-springy.

Plots—4 guntha each.

Rice—“Halga” variety.

Treatments—

(1) 5 Carts F.Y.M. per acre.

(2) Rock phosphate 112 lbs. per acre.

(3) Green leaves 3750 lbs. (=20 lbs. of N) + rock phosphate 112 lbs.

(4) Dry leaves 2225 lbs. (=20 lbs. of N) + rock phosphate 112 lbs.

Treatments.	Grain yields in lbs. per plot.			Average.	Average net profit per plot in Rs.
	1918	1919	1920		
1 .. ..	80	175	154	136.3	4.2
2 .. ..	94	210	179	161.0	5.63
3 .. ..	120	232	207	186.3	6.61
4 .. ..	108	215	212	178.3	5.63

From the above it is seen that the average yields as well as net profit for treatment 3 stands highest. Though the net profits may be equal in the case of treatments 2 and 4 their yields differ considerably. Hence 4 must be preferable to 2.

### KUMTA FARM VI.

To ascertain the effects of the following manurial treatments on rice crop.

Land—Low-lying non-springy.

Plots— $\frac{1}{2}$  guntha each.

Rice—"Halga" variety.

Lay-out—4 replications.

Treatments—

(1) Ammonium phosphate 224 lbs. per acre.

(2) Ammonium phosphate 224 lbs. + 5 carts F.Y.M. per acre.

(3) 5 carts F.Y.M. per acre.

### Grain yields.

Plot.	Treatments.			Average.
	1	2	3	
1 .. ..	43	49	17	36.3
2 .. ..	34	43	27	34.6
3 .. ..	37	40	31	36.0
4 .. ..	35	37	26	32.6
Average ..	37.25	42.25	25.25	34.92

Treated by method III.

7.18.

Therefore standard error—3.59—Ed.

Hence any difference above ( $3.59 \times 2.1 = 7.54$ ) between means can be taken to be significant.

Hence it is seen that the treatments 1 and 2 are significantly better than treatment 3. As there is only a difference of 5 between the means of 1 and 2, we cannot say which of the two is better. But we can say that treatment 2 may tend to prove better than 1.

## KUMTA FARM VII.

To ascertain the best yielding manurial treatment for Rice crop, by laying out plots in latin square of seven replications.

Land—Low-lying, non-springy.

Plots— $\frac{1}{2}$  guntha each.

Rice—"Halga" variety.

Treatments—

- (1) Phosphate of ammonia 224 lbs. per acre.
- (2) Phosphate of ammonia 224 lbs. per acre plus 5 carts F. Y. M.
- (3) Calcium cyanamide 224 lbs. per acre.
- (4) Calcium cyanamide 224 lbs. per acre plus 5 carts F. Y. M.
- (5) Bone-meal 224 lbs. per acre.
- (6) Bone-meal 224 lbs. per acre plus 5 carts F. Y. M.
- (7) F. Y. M. alone 5 carts per acre.

*Lay-out of Rice manuring experiments for 1930-31 by Latin square method on Kumta Farm VII.*

Plot No. 99.		Plot No. 100.		Plot No. 101.		Plot No. 102.
1	2	3	4	5	6	7
2	3	4	5	6	7	1
3	4	5	6	7	1	2
4	5	6	7	1	2	3

—+ Main road +—

Plot No. 84.		Plot No. 85.		Plot No. 86.		Plot No 87.
5	6	7	1	2	3	4
6	7	1	2	3	4	5
7	1	2	3	4	5	6

*Plan of the lay-out with yields of grain in the plots.*

Y = Yields.

T = Treatments.

	T. Y.	T. Y.	T. Y.	T. Y.	T. Y.	T. Y.	T. Y.	T. Y.	Average R.
	1 18	2 20	3 22	4 23	5 19	6 24	7 25		21.6
	2 18	3 22	4 21	5 14	6 21	7 23	1 28		21.0
	3 21	4 28	5 12	6 17	7 16	1 25	2 32		21.7
	4 27	5 14	6 18	7 13	1 24	2 29	3 32		22.4
	5 19	6 22	7 14	1 20	2 32	3 22	4 26		21.1
	6 20	7 17	1 18	2 19	3 23	4 23	5 21		20.1
	7 18	1 24	2 20	3 18	4 24	5 18	6 19		19.0
Average columns.	19.9	21	18	17.7	22.7	23.4	26.1		..
Treatments Average	..	1 22.4	2 24.3	3 22.9	4 24.6	5 16.9	6 20.1	7 17.7	

Treating the above by the method of Fisher's analysis of variance, we get the following results:—

Nature of Variation.				Degrees of freedom.	Sum of Squares.	Mean of Squares.	$\frac{1}{2} \log_e$ (mean squares).
Rows	..	..	..	6	31.07	5.18	0.821
Columns	..	..	..	6	382.21	63.70	2.0746
Treatments	..	..	..	6	391.64	65.25	2.087
Error	..	..	..	30	287.58	9.59	1.129

Now for  $n_1 = 6$  and  $n_2 = 30$ , the 5 per cent. point for the value of  $Z$  is found from the table to be  $= 0.4420$ . Now since the difference between the figures in the last column above, for treatment and error is  $0.958$  which is more than the above value for  $Z$ , the variations between treatments are considerably significant.

Now the standard error for the total of 7 plots  $= \sqrt{9.59 \times 7} = 8.193$ .

The totals for each treatment are given below :—

	Treatments.							Mean.	Standard error.
	1	2	3	4	5	6	7		
Totals	115	128	118	130	76	99	82	105	8.19

Since the standard error is 8.19, any difference between the totals higher than  $2 \times 8.19$  i.e. 16.38 may be taken to be significant. We are able to see from this point of view that the first four treatments are all distinctly better than the last three. Among the first four themselves nothing can be said.

*Note.*—The variance for the columns is as high as that for the treatments which shows that there is soil variation between the columns.

It must be noted that in the lay-out of the experiment the columns were not randomised which fact might have affected certain treatments alone due to soil variations in columns and along the diagonals.

### KUMTA FARM VIII.

To ascertain the effect of the following treatments on Rice Crop.

*Land*—Low-lying, non-springy and ill-drained.

*Plots*—1 guntha each.

*Rice*—Halga variety.

*Treatments*—

- (1) F.Y.M. 5 carts per acre.
- (2) F.Y.M. 5 carts plus bone-meal 224 lbs. per acre.
- (3) Bone-meal 224 lbs. per acre.

Treatment.	1925		Aver- age.	Per cent.	1926		Aver- age.	Per cent.
	Grain yields per plot.				Grain yields per plot.			
1	42	42	42	100	28	27	27.5	100
2	40	40	40	95	25	24	24.5	89
3	38	41	39.5	94	21	21	21.0	76
Significance.	3.6				3.6			

Figures were treated by Method I.

From the above it is seen that the addition to the F.Y.M. or treating with bone meal alone gives significantly lower yields than when F.Y.M. alone is used, and hence the F.Y.M. alone proves better than the other two treatments.



## KUMTA FARM IX.

To find the effect of bone meal with and without F.Y.M. on Rice Crop.

Rice—Halga variety.

Land—Low-lying "springy".

Plot—1 guntha each.

Lay-out—Duplicated.

Treatments—

(1) F.Y.M. 5 carts.

(2) Bone-meal 224 lbs.

(3) Bone-meal 224 lbs. plus 5 carts F.Y.M.

Treatments.	Grain yields per plot.			Average.	Grain yields per plot.			Average.
	1924				1925			
1 .. ..	34	30	32	24	22	23		
2 .. ..	48	46	47	59	52	55.5		
3 .. ..	49	41	45	58	57	57.5		
Significance	3.3			3.4				
	1926			1927	1928			
1 .. ..	75	63	69	44	63	53.5		
2 .. ..	69	79	74	48	83	65.5		
3 .. ..	81	75	78	72	81	76.5		
Significance	12.1			Single plot experiments.				

The figures were treated by Method III and the significances for differences between treatment means are given except for the last two years when there were single plot experiments. In the first two years there is distinct significance of treatments two and three over one. But in 1926 the error runs high and hence the result is not satisfactory. The net profits per plot compare as follows:—

Treatments.	1924	1925	1926	1927	1928	Average.
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
1 .. ..	1.0	0.1	2.2	1.0	1.8	1.2
2 .. ..	2.7	2.4	3.1	1.2	2.8	2.5
3 .. ..	2.2	2.2	2.9	1.6	2.5	2.3

This decides in favour of treatment 2.

## KUMTA FARM X.

To compare the effects of the following manures on Rice.

Land—Low-lying "springy".

Plot—4 gunthas each.

Rice—Halga variety.

Treatments—

- (1) F.Y.M. 5 carts per acre.
- (2) Bone-meal 224 lbs. per acre.
- (3) Bone-meal 224 lbs. plus green leaves 3,750 lbs. per acre.

Treatments.				Grain yields in lbs. per plot.			Average.	Average net profits per plot in rupees.
				1918	1919	1920		
1	..	..	..	120	175	154	150	4·88
2	..	..	..	190	255	220	222	12·08
3	..	..	..	181	260	210	217	10·35

Though this has been a set of single plot experiments the results are fairly consistent and we can say that the treatments 2 and 3 are distinctly better than the first. This is also true economically, since the net profits for 2 and 3 are more than twice that of treatment 1.

## KUMTA FARM XI.

To ascertain the effects of the following treatments on Rice Crop.

Land—Low-lying "springy".

Plot—1 guntha each.

Rice—Halga variety.

Treatments—

- (1) F.Y.M. 5 carts per acre.
- (2) F.Y.M. 5 carts plus sulphate of ammonia equal to 40 lbs. N per acre.
- (3) Sulphate of ammonia equal to 40 lbs. of N per acre.

Treatments.				Grain yields in lbs. per plot.			Average.	Average net profits in rupees. per plot.
				1924	1925	1926		
1	..	..	..	47	37	52	45·3	1·35
2	..	..	..	56	37	54	49·0	0·53
3	..	..	..	46	25	36	35·6	0·26

As the above is a single plot experiment we cannot find the experimental error. On comparing the averages we can say that the application of sulphate of ammonia alone gives a lower yield than the other two treatments. But comparing the average net profits for each treatment we see that the F.Y.M. alone gives the highest profits.

## KUMTA FARM XII.

To ascertain the effect of sulphate of ammonia with and without F.Y.M. on Rice crop.

Rice—"Muskati" variety.

Land—High-lying.

Plot—1 guntha each.

Treatments—

- (1) F.Y.M. 5 carts per acre.
- (2) F.Y.M. 5 carts plus sulphate of ammonia equal to 40 lbs. of N per acre.
- (3) Sulphate of ammonia equal to 40 lbs. N per acre.

Treatments.	Plot yields in lbs. per plot.			Average.	Per cent.	Significance.	Net profits.
	1	2	3				
1925							
1 .. ..	25	35		30	100	..	Rs. 0.35
2 .. ..	30	50		40	133	41.6	0.01
3 .. ..	40	41		40.5	135	..	0.18
(This year the experiment shows very high error.)							
1926							
1 .. ..	59	45		52	100	..	1.81
2 .. ..	74	71		72.5	140	22.2	2.36
3 .. ..	..	61		61	117	..	1.24
(This year one plot in treatment 3 was affected by pest.)							
1927							
1 .. ..	48	40	50	46	100	..	1.23
2 .. ..	63	66	70	66.3	144	15.4	1.23
3 .. ..	44	51	55	50	109	..	0.68

The figures were treated by Method I and the results are not quite consistent but on the whole may tend towards the conclusion that the combination treatment is more yielding and not less profitable than the others.

## KUMTA FARM XIII.

To ascertain the effects of (1) F.Y.M. 5 carts per acre "the local system" over (2) the no manure treatment; for Rice crop on various kinds of land.

Plot— $\frac{1}{2}$  guntha each.

(i) Land—High-lying.

Rice—"Muskati" variety.

Year.	Treatments.	Grain yields in lbs.				Average.	Per cent.	Significance.
1925	1 ..	21	22	18	24	21	131	19.8
	2 ..	13	17	15	19	16	100	

Treatments.	1926				1927			
	Yields.		Average.	Per cent.	Yields.		Average.	Per cent.
1 ..	25	33	29	138	20	24	22	210
2 ..	21	21	21	100	12	9	10.5	100
Significance ..	19.5				33.0			

(ii) Land—Low-lying "springy". Rice—Halga variety.

Treatments.	1924				1925					
	Yields in lbs. per plot.		Average.	Per cent.	Grain yields in lbs. per plot.		Average.	Per cent.		
1 ..	24	21	22.5	150	27	24	18	20	22.0	163
2 ..	14	16	15.0	100	11	21	10	12	13.5	100
Significance ..	18.5				39.5					

Treatments.	1926				1927				1929			
	Yields.		Average.	Per cent.	Yields.		Average.	Per cent.	Yields.		Average.	Per cent.
1 ..	37	31	34.0	174	22	26	24.0	171	26	27	27	147
2 ..	20	19	19.5	100	15	13	14.0	100	19	17	18	100
Significance ..	15.9				21.6				10.2			

## (iii) Land—Low-lying “Non-springy”. Rice—Halga.

Treatments.				1924				1925					
				Yields in lbs. per plot.		Average.	Per cent.	Yields in lbs. per plot.		Average.	Per cent.		
1	..	..	..	13	11	12.0	133	15	16	11	22	16.0	110
2	..	..	..	11	7	9.0	100	9	11	22	16	14.5	100
Significance ..				42.8				40.0					

Treatments.				1926				1927				1929			
				Yields in lbs. per plot.		Average.	Per cent.	Yields in lbs. per plot.		Average.	Per cent.	Yields in lbs. per plot.		Average.	Per cent.
1	..	..	..	35	29	32	133	22	20	21	210	15	17	16	133
2	..	..	..	24	24	24	100	9	11	10	100	12	12	12	100
Significance ..				13.3				20.2				8.5			

## (iv) Land—Ill-drained, low-lying. Rice—Halga.

Treatments.				1925				1926					
				Yields in lbs. per plot.		Average.	Per cent.	Yields in lbs. per plot.		Average.	Per cent.		
1	..	..	..	31	30	20	26	27	169	25	25	25	139
2	..	..	..	13	20	12	18	16	100	22	14	18	100
Significance ..				29.9				31.4					

The figures for each year have been treated by Method I and it is found that there is a definite significance in the higher yields due to the application of F.Y.M. in all kinds of lands. Of course, there is an exception to this in the two cases 1924 and 1925 for the low-lying “non-springy” lands. The error runs so high that the difference becomes insignificant.

## KUMTA FARM XIV.

To ascertain the effects of various manures with a basal dressing of F.Y.M. 15,000 lbs. per acre, on the two varieties of Sugarcane: (1) Red Mauritius, (2) Daskabbu.

PLOTS—2 gunthas each.

*Treatments* : In addition to the basal dressing of F.Y.M.—

- (1) Nil.
- (2) Fish manure 1,250 lbs. per acre.
- (3) *Undi* cake 2,500 lbs. per acre.
- (4) Sulphate of ammonia 375 lbs. per acre.

	Treatments.	Yields of <i>Gul</i> in lbs. per plot.				Average.	Average net profits per plot.
		1919	1920	1921	1922		
	<i>I. Red Mauritius.</i>						Rs.
1	.. ..	342	400	342	376	365	8.36
2	.. ..	323	464	437	427	413	10.38
3	.. ..	431	410	423	382	412	9.73
4	.. ..	450	432	408	355	411	8.69
	<i>II. Daskabbu.</i>						
1	.. ..	436	485	298	277	374	9.44
2	.. ..	462	452	360	274	387	9.55
3	.. ..	400	401	345	377	398	8.49
4	.. ..	494	473	304	342	403	8.88

As the experimental results are for single plots only no error could be found out.

In the first variety the yields for treatments 2, 3 and 4 are more or less equal, which shows that the yielding capacities of all top dressings are the same. Even with the 2nd variety the differences in the yields lie within five per cent. and hence the above conclusions may be taken as very probable. Comparing the net profits, however, it is seen that treatment 2 stands out the best for both varieties.

#### KUMTA FARM XV.

To ascertain the effects of various manures with a basal dressing of F.Y.M. 15,000 lbs. per acre on two varieties of Sugarcane: (1) *Red Mauritius*, (2) *Daskabbu*.

Plot—2 gunthas each.

*Treatments*—

- (1) No top-dressing.
- (2) Top-dressing with *Undi* cake 2,500 lbs. plus bone-meal 200 lbs. per acre.
- (3) Bone-meal 200 lbs. per acre.
- (4) *Undi* cake 2,500 lbs. per acre.
- (5) Sulphate of ammonia 375 lbs. per acre.
- (6) Bone-meal 200 lbs. plus sulphate of ammonia 375 lbs. per acre.

Treatment.	Yields of <i>Gul</i> in lbs. per plot.			Average.	Average net profits per plot.
	1927	1928	1929		
<i>I. Red Mauritius.</i>					Rs.
1	470	441	364	425	9.79
2	664	516	502	561	17.30
3	640	501	405	515	16.73
4	670	437	488	532	15.14
5	580	487	335	467	11.76
6	630	506	388	475	11.45
<i>II. Daskabtu.</i>					
1	397	..	367	382	8.90
2	516	..	586	551	18.94
3	543	..	434	489	17.26
4	582	..	494	538	18.82
5	342	..	195	269	1.5
6	346	..	288	317	0.82

The second variety was affected by Red Rot in 1928. From the above it is seen that for the first variety treatment 2 gives highest yield and net profits; and treatment 3 though giving a lower yield gives nearly the same net profit. For the other variety treatments 2 and 4 can be considered equally efficient both in yields and profits. Treatments 5 and 6 are of absolutely no use for this variety.

#### KUMTA FARM.

*Statement showing the cost of cultivation per acre in the above farm for various years for the two crops, Rice and Sugarcane.*

Year.	Rice.			Sugarcane.
	Rs.	a.	p.	Rs.
1918	52	0	0	373
1919	52	0	0	395
1920	57	0	0	405
1921	56	7	0	410
1922	52	13	0	412
1923	53	8	0	418
1924	55	0	0	425
1925	59	0	0	420
1926	53	12	0	430
1927	56	0	0	438
1928	52	0	0	448
1929	57	0	0	452
1930	59	0	0	458

## KUMTA FARM.

Table showing the rates of various manures etc.

	1917	1918	1919	1920	1921	1922	1923	1924
<i>Gul</i> .. ..	..	..	11	14	11	18	12	11
Paddy ( <i>Halga</i> ) ..	23	20	18	24	22	25	20	22
Straw .. ..	70	80	90	60	60	70	60	70
Dry leaves ..	960	800	800	800	800	800	800	800
Farm Yard Manure..	640	600	560	420	320	320	320	320
Sulphate of ammonia..	..	..	5	4.5	4.5	4.5	7.0	7
Lime .. ..	100	100	90	100	90	80	80	80
Sulphate of potash ..	..	..	..	..	..	..	..	..
Nitrate of soda .. ..	..	..	5	4.5	4.5	4.5	4.5	4.5
Nitrate of potash ..	..	..	..	..	..	..	..	..
Calcium cyanamide..	..	..	..	..	..	..	..	..
Superphosphate .. ..	..	..	..	4	4	4	11	11
Rock phosphate .. ..	..	..	16	16	16	16	16	16
Ammophos .. ..	..	..	..	..	..	..	..	..
<i>Undi</i> cake .. ..	..	56	56	..	38	74	74	74
Bone meal .. ..	..	10	17	..	17	17	22	14

	1925	1926	1927	1928	1929	1930	1931
<i>Gul</i> .. ..	10	11	12	16	14	16	..
Paddy ( <i>Halga</i> ) ..	24	25	25	25	25	36	..
Straw .. ..	70	60	100	120	114	100	..
Dry leaves .. ..	600	800	750	800	800	650	..
Farm Yard Manure..	320	320	320	320	320	320	..
Sulphate of ammonia..	4.5	5	7	10	11	13	..
Lime .. ..	80	106	106	70	70	80	..
Sulphate of potash ..	..	..	10	11	12	12	..
Nitrate of Soda .. ..	4.5	4.5	9	11	11	11	..
Nitrate of potash ..	..	..	7	7	7	7	..
Calcium cyanamide..	..	..	..	6	6	6	..
Superphosphate .. ..	11	11	17	12	12	22	..
Rock phosphate .. ..	32	32	32	32	32	32	..
Ammophos .. ..	..	..	..	7	14	3	..
<i>Undi</i> cake .. ..	60	56	66	56	45	35	..
Bone meal .. ..	16	16	13	16	17	16	..



## Fortnightly Rainfall Record of the Kumta Farm, district Kanara.

Month.	January		February		March		April		May		June	
Fortnight.	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
<i>Years.</i>												
1919	..	..	..	..	..	..	..	..	..	0.72	12.25	18.29
1920	..	..	..	..	..	..	..	0.27	..	0.50	15.79	17.28
1921	..	..	..	..	..	..	0.53	0.11	..	..	20.60	10.90
1922	..	1.57	..	..	..	..	..	0.65	2.98	6.47	17.36	19.72
1923	..	..	..	..	..	..	..	0.60	0.60	0.19	10.37	14.16
1924	..	..	..	..	..	..	0.67	..	0.12	1.84	17.87	38.47
1925	..	..	..	..	1.65	..	..	..	0.70	5.47	16.61	39.50
1926	..	0.58	..	..	..	..	..	..	..	..	9.97	25.69
1927	..	..	..	..	..	..	..	0.15	..	3.50	12.24	11.19
1928	..	..	1.65	..	..	..	..	..	..	..	26.42	13.28
1929	..	..	..	..	..	..	0.31	3.60	0.94	1.36	33.59	33.64
1930	..	0.40	..	..	..	..	..	..	0.93	0.32	8.68	40.63
1931	..	..	..	..	..	..	..	0.46	0.10	1.44	5.10	24.52

Month	July		August		September		October		November		December		Total
Fortnight.	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	
<i>Years.</i>													
1919..	16.10	25.98	10.95	13.26	2.61	2.67	11.60	0.42	7.80	..	..	..	122.70
1920..	23.65	7.54	7.13	12.50	4.76	1.30	2.93	2.84	..	..	..	..	96.59
1921..	16.24	16.41	16.44	12.44	7.87	3.12	4.80	..	..	..	..	3.74	113.20
1922..	30.99	20.13	8.59	14.31	7.67	4.70	..	0.39	3.84	1.00	..	..	140.37
1923..	42.83	21.16	35.46	9.18	4.43	12.59	0.14	0.18	..	..	..	..	151.89
1924..	31.47	20.43	7.64	8.49	1.98	7.72	1.55	..	0.26	..	..	..	138.51
1925..	7.56	25.67	18.97	14.93	2.23	0.40	6.50	..	0.87	..	0.50	..	141.56
1926..	16.89	28.33	23.56	10.40	9.41	8.39	1.50	..	..	..	..	..	134.72
1927..	38.76	12.98	6.91	14.25	2.33	11.66	7.15	..	4.14	..	..	..	125.26
1928..	27.84	30.00	17.85	14.64	1.49	5.69	2.52	8.41	0.32	..	0.28	..	150.39
1929..	26.36	9.62	9.55	11.48	2.17	6.13	6.72	0.54	2.74	..	..	..	148.77
1930..	9.62	16.32	13.13	31.81	8.63	6.00	3.96	0.90	..	..	..	0.37	140.33
1931..	34.97	37.81	26.90	16.60	5.23	7.14	7.25	1.50	2.38	..	3.85	..	175.25

## MANJRI FARM I.

To study the possibility of reducing the basic dose of F.Y.M. (30,000 lbs.) for Sugarcane crop.

Sugarcane—"Pundya" variety.

Rotation—Sugarcane, Nilva, and Cotton.

Manuring—Top-dressing with 75 lbs. N. as groundnut cake and 75 lbs. of N. as sulphate of ammonia per acre.

Plots—5 gunthas each.

Lay-out—4 replications.

Quantity of F.Y.M. used per acre.			Gul yields in lbs. per plot.				Average.	Average net profits per plot in rupees.
Year 1929-30								
30,000 lbs.	..	..	1,314	1,432	1,272	1,470	1,372	50.1
20,000 lbs.	...	..	1,546	1,341	1,342	1,414	1,411	56.1
10,000 lbs.	..	..	1,080	1,372	1,200	1,446	1,277	45.2
Average			1,313	1,382	1,274	1,448	1,353	..
Year 1930-31								
30,000 lbs.	..	..	1,500	1,449	1,537	1,378	1,466	23.6
20,000 lbs.	..	..	1,476	1,454	1,438	1,477	1,461	25.3
10,000 lbs.	..	..	1,350	1,410	1,470	1,421	1,415	24.5

The above results were treated by method IV, to find out whether there is any significance in the differences between the means of the treatments. In both the years it is observed that the variance due to the treatments shows no definite significance over the random variance. A difference of about 206 lbs. in 1929-30 and 94 lbs. in 1930-31 is required to show any significance between any two treatments, but we see that the means do not differ by the required amounts in both the years. Hence the conclusion is that statistically there is no significance in the treatments. But comparing the net profits 20,000 lbs. of F.Y.M. seems to give favourable results in both the years.

## MANJRI FARM II.

To compare the effects of F.Y.M., san-green, trash and stable manure as basic manures for sugarcane crop.

Variety—"Pundya".

Rotation—Cane, Ratoon, Gram and Nilwa.

Manuring (Basic) per acre—

- (1) 10,000 lbs. dry matter F.Y.M.,
- (2) San-green,
- (3) 10,000 lbs. dry matter of trash,
- (4) 10,000 lbs. dry matter of stable manure,

with a top-dressing of 150 lbs. of N. as a mixture of safflower cake and sulphate of ammonia, half and half.

Plots—10 gunthas each.

Lay-out—Unreplicated.

Treatments.	Gul yields in lbs. per plot.				Average.	Average net profits per plot in rupees.
	1914	1915	1916	1917		
1 .. ..	2,755	3,209	2,916	3,172	3,013	134.4
2 .. ..	3,060	3,340	2,870	3,093	3,091	145.9
3 .. ..	2,482	3,061	2,867	2,845	2,814	128.8
4 .. ..	..	3,153	3,188	2,782	3,041	133.4

The net profits have been given only for three years 1915, 1916 and 1917; and hence the figures given as net profits above are the averages for these three years only. These averages show that all the manures except trash are more or less of equal yielding capacities. Considering the net profits *san-green* gives favourable results, in comparison with others.

## MANJRI FARM III.

To ascertain the effect of supplementing basic *san-green* manure by F.Y.M. or oil cake to make up 200 lbs. of N. per acre for sugarcane.

Variety—"Pundya".

Rotation—San, Cane and Nilwa.

Manuring per acre (Basic)—

- (1) San alone,
- (2) San plus safflower cake 100 lbs. N.,
- (3) San plus F.Y.M. 100 lbs. N.,

with a top-dressing of 150 lbs. N. as a mixture of oil-cake and sulphate of ammonia, in equal proportion of nitrogen.

Plots—5 gunthas each.

Lay-out—Unreplicated.

Treatments.	Gul yields in lbs. per plot.				Average.	Average net profits per plot in rupees.
	1924	1925	1926	1927		
1 .. ..	1,229	1,183	1,167	1,239	1,209	53·87
2 .. ..	1,335	1,178	1,214	1,113	1,210	45·37
3 .. ..	1,232	1,210	1,212	1,147	1,200	47·28

These being single plot experiments no significance could be found. The average yields per plot for the various treatments show that there is no great difference between the yielding capacities of the various treatments. As such, the first treatment gives the highest net profit and hence the results tend to prove that there is no necessity for *San green* being supplemented by any other manure.

#### MANJRI FARM IV.

To ascertain the most economical and efficient substitute for F.Y.M. as basic manure for Sugarcane.

Variety—“Pundya”.

Rotation—No particular rotation.

Manuring per acre (Basic)—

(1) F.Y.M. 200 lbs. N.

(2) F.Y.M. 100 lbs. N. plus Safflower cake 100 lbs. N.,

(3) 200 lbs. N. as Safflower cake,

with a top-dressing of 150 lbs. N. as a mixture of oil-cake and sulphate of ammonia in equal proportion of nitrogen.

Plots—5 gunthas each.

Lay-out—Unreplicated, in first two years and duplicated in 1925–26.

Years 1923 and 1924.

Treatments.	Gul yields in lbs. per plot.		Average.	Average net profits per plot in rupees.
	1923–24	1924–25		
1 .. ..	692	1,067	890	3·53
2 .. ..	854	871	863	17·59
3 .. ..	899	1,108	1,003	18·88

## Year 1925-26.

Treatments.	Gul yields in lbs. per plot.		Average.	Percentage.	Average net profits in rupees.
	1	2			
1 .. ..	1,361	1,504	1,433	100	74.56
2 .. ..	1,289	1,449	1,369	96	59.59
3 .. ..	1,363	1,457	1,410	98	60.07
Significance ..			13.4		

The yield figures for the first two years are shown separately. The results of the last year were treated by method I and the significance is found to be 13.4. Hence there seems to be no difference in the yielding capacities of the various treatments. Considering the net profits the treatments are in the ascending order of importance in the first two years, whereas the order becomes quite the reverse in the last year except that treatments 2 and 3 are almost equal.

## MANJRI FARM V.

To compare the effects of F.Y.M. 30,000 lbs. dry matter per acre, with and without San green on Sugarcane.

Variety—"Pundya".

Rotation—Cane, Ratoon, Gram, and Nilwa.

Manuring per acre (Basic)—as mentioned above, with a top-dressing of 150 lbs. of N. as a mixture of Safflower cake and Sulphate of Ammonia in equal proportion of N.

Plots—10 gunthas each.

Lay-out—Unreplicated.

Treatments.	Gul yields in lbs. per plot.			Average.
	1908	1909	1910	
San with F.Y.M. .. ..	2,664	2,383	1,759	2,269
F.Y.M. alone .. ..	2,693	2,725	1,744	2,387

The above figures seem to show that the addition of San Green has a detrimental effect on the yielding capacity of F.Y.M. But it is too flimsy a ground to base our conclusions upon.

## MANJRI FARM VI.

To ascertain the effects of varying quantities of nitrogen used for top-dressing for Sugarcane.

Variety—"Pundya".

Rotation—San, Sugarcane, Nilwa.

Manuring per acre (Basic)—San green, with top-dressings—

- (1) 75 lbs. of N. as a mixture of cake and sulphate of ammonia, equal parts of N.
- (2) 100 lbs. of N. as a mixture of cake and sulphate of ammonia, equal parts of N.
- (3) 125 lbs. of N. as a mixture of cake and sulphate of ammonia, equal parts of N.
- (4) 150 lbs. of N. as a mixture of cake and sulphate of ammonia, equal parts of N.

Plots—About 10 gunthas each; yields are calculated for 10 gunthas.

Lay-out—Unreplicated.

Treatments.	Gul yields in lbs. per plot.			Average.	Average net profits per plot in rupees
	1920	1921	1922		
1 .. .. .	1,170	1,771	2,590	1,843	75·17
2 .. .. .	992	1,510	2,245	1,582	39·40
3 .. .. .	1,043	1,594	2,755	1,797	61·32
4 .. .. .	980	1,457	2,612	1,683	43·97

It would seem from the above that treatment no. 1 yields the highest quantity of Gul and also gives the highest net profit. We cannot usefully make any real conclusions out of this experiment.

## MANJRI FARM VII.

To ascertain the effects of varying doses of nitrogenous top-dressing to find out which of them is the most economic for Sugarcane.

Variety—"Pundya".

Rotation—Sugarcane, Nilwa, and Cotton.

Manuring per acre (Basic)—F.Y.M. 30,000 lbs. with a top-dressing of—

- (1) 75 lbs. of N. as a mixture of groundnut cake and sulphate of ammonia, in equal parts of N.
- (2) 112·5 lbs. N. as a mixture of groundnut cake and sulphate of ammonia, in equal parts of N.
- (3) 150 lbs. N. as a mixture of groundnut cake and sulphate of ammonia, in equal parts of N.

Plot—5 gunthas each.

Lay-out—4 replications randomised.

Year.	Treatment.	Gul yields in lbs. per plot.				Average.	Significance.	Average net profits per plot in rupees.
		1	2	3	4			
1928-29 ..	1	1,358	1,188	1,464	1,505	1,379	182	74·1
	2	1,309	1,478	1,611	1,425	1,456		78·7
	3	1,600	1,503	1,506	1,548	1,539		84·0
1929-30 ..	1	1,549	1,479	1,768	1,544	1,585	181	76·6
	2	1,488	1,654	1,719	1,655	1,629		75·9
	3	1,578	1,575	1,538	1,604	1,574		68·4
1930-31 ..	1	874	1,206	1,087	1,230	1,099	214	5·8
	2	1,092	1,135	1,211	1,294	1,183		6·6
	3	1,347	1,330	1,122	1,624	1,356		15·8

The plot yield figures were dealt with by method IV, and in no year was there any significance of the variance due to the treatments. But comparing the net profits, in two years out of three, treatment 3 gives the highest net profit. Nothing more can be said.

#### MANJRI FARM VIII.

To ascertain the effect of increasing doses of Nitrogen (top-dressing) as a combination of equal quantities of N of sulphate of ammonia and oil cake for sugarcane.

Variety—"Pundya".

Rotation—San, Cane, Nilwa.

Manuring per acre—Basic san green with a top-dressing of—

- (1) 75·0 lbs. of N as a mixture of safflower cake\* and sulphate of ammonia in equal proportions of N.
- (2) 150 lbs. of N as a mixture of safflower cake and sulphate of ammonia in equal proportions of N.
- (3) 225 lbs. of N as a mixture of safflower cake and sulphate of ammonia in equal proportions of N.
- (4) 300 lbs. of N as a mixture of safflower cake and sulphate of ammonia in equal proportions of N.

Plots—About 10 gunthas each, but yields are calculated for 10 gunthas.

Lay-out—Unreplicated except in the last year.

Treatment.	Gul yields in lbs. per plot.					Average.	Average net profits per plot in rupees.
	1923	1924	1925	1926	1927		
1 ..	1,297	2,409	2,007	2,106	2,177	1,999	58·51
2 ..	1,591	2,592	2,245	2,523	2,294	2,249	48·30
3 ..	1,476	2,248	2,317	2,485	2,978	2,301	59·12
4 ..	2,799	2,355	2,302	2,730	2,774	2,594	74·69

\* In 1928-29 Ground-nut cake was used instead of safflower cake.

Treatment.	Year 1928-29		Average.	Average net profit per plot in rupees.
	i	ii		
1 .. ..	1,352	1,283	1,318	(14·18)
2 .. ..	2,259	1,989	2,124	52·60
3 .. ..	2,403	2,046	2,225	51·39
4 .. ..	2,207	2,137	2,172	35·57

The results of the last year were manipulated by Method III, and 154 lbs. was the significance obtained. From this it is seen that so far as this year was concerned treatments 2, 3 and 4 are equal and better than 1, which is confirmed by average results of the previous year. The average net-profits do not show any definite conclusions reliable enough.

### MANJRI FARM IX.

To compare the effects of Nitrogen in various forms as top-dressing with 75 lbs. of N per acre for sugarcane.

Variety—"Pundya".

Rotation—Cane, Nilwa, San.

Manuring per acre—Basic manure—San green, with a top-dressing of 75 lbs. N as—

- |                       |                          |
|-----------------------|--------------------------|
| (1) Castor cake.      | (5) Fish manure.         |
| (2) Safflower cake.   | (6) Sulphate of Ammonia. |
| (3) Ground-nut cake.  | (7) Nitrate of Soda.     |
| (4) Cotton seed cake. |                          |

Plots—10 gunthas each.

Lay-out—Unreplicated except in 1917-18.

Note.—In this experiment only the weight of cane was given for each plot and it has been reduced to *Gul* weight with the help of the *Gul* to cane ratio for each year.

Treatments.	<i>Gul</i> yields in lbs. per plot.					Average.
	1917-18	1918-19	1920-21	1921-22	1922-23	
1 .. {	2,932	3,829	1,614	1,397	1,853	2,240
	2,477					
2 .. {	2,878	3,876	1,352	1,314	1,923	2,235
	2,943					
3 .. {	2,799	3,524	1,696	1,138	2,296	2,267
	2,561					
4 .. {	3,020	3,220	1,646	1,441	1,852	2,201
	2,876					



Treatments.	Gul yields in lbs. per plot.					Average.
	1917-18	1918-19	1920-21	1921-22	1922-23	
5 .. {	3,366	3,596	1,504	1,371	1,987	2,326
	2,982					
6 .. {	3,186	3,306	1,805	1,425	2,212	2,394
	3,261					
7 ..	..	3,151	1,835	1,390	1,856	2,058

Treating the figures for the year 1917-18 alone by Method III no significant result was obtained except that treatments 5 and 6 showed significantly better yields than the rest. This may be probable because the general averages also tend to show higher values of yield for these two treatments than for others. Nothing more can be said from the results available.

#### MANJRI FARM X.

To compare the effects of Sulphate of ammonia and Nitrate of Soda in top-dressing for sugarcane.

Variety—"Pundya".

Rotation—Cane, Nilwa, Ground-nut.

Manuring per acre (Basic)—F.Y.M. 10,000 lbs. dry or 20,000 lbs. wet matter.

Top-dressing—

(1) 75 lbs. N Safflower cake with 75 lbs. N Sulphate of Ammonia.

(2) 75 lbs. N Safflower cake with 75 lbs. N Nitrate of Soda.

Plots—10 Gunthas each.

Lay-out—Unreplicated.

Treatments.	Gul yields in lbs. per plot.			Average.	Average net profit per plot in rupees.
	1915	1916	1917		
1 .. ..	2,868	3,247	3,548	3,221	149.43
2 .. ..	2,689	2,914	2,929	2,844	113.93

Though there are no replications wherefrom we can deduce the statistical significance, the consistent better yields of treatment 1 in each year and also in all the years combined tends to show that treatment 1 may be preferable to 2. The difference between the averages of the yields of the two treatments, and also the difference between their net profits are considerable enough that we can safely conclude that so far as we can see from this experiment Sulphate of Ammonia proves to be better than Nitrate of Soda, to be used in the above combination for top-dressing.

## MANJRI FARM XI.

To ascertain the number of doses of top-dressing with N which is most beneficial for sugarcane, as a mixture of sulphate of ammonia and oil-cake in equal quantities of nitrogen.

Variety—"Pundya".

Rotation—San, Sugarcane, Nilwa.

Manuring per acre (Basic manure)—San, with a top-dressing of 150 lbs. N in—

- (1) three equal doses of  $\frac{1}{3}$  N each, at planting, at three weeks, and at eight weeks from planting.
- (2) three equal doses of  $\frac{1}{3}$  N each, at planting, at three weeks, and at earthing.
- (3) three equal doses of  $\frac{1}{3}$  N each, at planting, at eight weeks, and at earthing.
- (4) three equal doses of  $\frac{1}{3}$  N each, at three weeks, at eight weeks, and at earthing.
- (5) four equal doses of  $\frac{1}{4}$  N each, at planting, at three weeks, at eight weeks, and at earthing.
- (6)  $\frac{1}{2}$  N at three weeks, and  $\frac{1}{2}$  N at earthing.
- (7)  $\frac{1}{2}$  N at three weeks, and  $\frac{1}{2}$  N at eight weeks.

Plots—5 gunthas each.

Lay-out—Unreplicated.

Treatments.	Gul yields in lbs. per plot.			Average.	Average net profits per plot in rupees.
	1923-24	1924-25	1925-26		
1 .. ..	745	958	956	886	18·97
2 .. ..	822	852	1,270	981	27·42
3 .. ..	914	875	1,353	1,047	34·01
4 .. ..	696	861	1,200	919	21·87
5 .. ..	843	935	1,254	1,011	31·00
6 .. ..	..	643	1,067	855	14·05
7 .. ..	..	1,047	1,242	1,158	41·20

Treatment 7, though tried only for 2 years has given the highest yield and the highest net profits. The next will be treatment 3. The rest can be arranged in the following descending order of merit so far as their efficiency and profit are concerned :—5, 2, 4, 1 and 6.

## MANJRI FARM XII.

To ascertain the best combination of watering cum manure top-dressing for sugarcane.

Variety—"Pundya".

Rotation—San, Sugarcane, Nihwa.

Manuring and watering per acre—San green as Basic manure

Water :—

70 acre inches.		100 acre inches.	
1.	75 lbs. N.	4.	75 lbs. N.
2.	150 lbs. N.	5.	150 lbs. N.
3.	300 lbs. N.	6.	300 lbs. N.

as a mixture of oil-cake and sulphate of ammonia in equal proportion of nitrogen.

Plots—5 gunthas each.

Lay-out—Duplicated.

Treat-ments.	1929-30			Aver- age net profit in rupees.	1930-31			Aver- age net profit per plot in rupees.
	Gul yields in lbs.		Aver- age.		Gul yields in lbs.		Aver- age.	
	1	2			1	2		
1	1,182	901	1,042	24.74	1,058	1,129	1,094	7.9
2	1,209	1,151	1,180	32.65	1,295	1,317	1,306	12.4
3	1,241	1,303	1,272	36.35	1,568	1,306	1,437	16.5
4	1,078	1,099	1,089	29.00	1,163	1,290	1,227	12.3
5	1,171	1,377	1,274	41.20	1,341	1,193	1,267	9.8
6	1,480	1,666	1,573	63.70	1,336	1,381	1,359	11.2
Significance	188.				156.			

The figures were treated by Method III in both the years. It is seen that comparing the means in the light of the significance figures, that in the first year the use of 70 acre/ inches or 100 acre/ inches of water has no different effects except when the manure of 300 lbs. N is used (because only the difference between 3 and 6 is significant). Whatever may be the quantity of water used there is no significance between the uses of 75 lbs. N and 150 lbs. N.

In the second year the results for 100 acre/ inches water is more or less the same as their differences fall within the significance figure. In the first year treatment 6 and in the second 3 have given the highest net profits.

## MANJRI FARM XIII A AND B.

To ascertain the effect of *Gurhal* ashes containing 100 lbs. of Potash and 40 lbs. of  $P_2O_5$  on sugarcane.

Variety—"Pundya".

Rotation—Cane, Nilwa, Ground-nut.

Manuring per acre.—Basic manure 10,000 lbs. of dry matter F.Y.M. with a top-dressing of 150 lbs. N as a mixture of oil-cake and nitrate of soda in equal proportions of nitrogen.

(1) One of the plots was given *Gurhal* ashes in addition to the above and the other. (2) Only the above treatment.

Plots—10 gunthas each.

Lay-out—Unreplicated.

## XIIIa

Treatment.	Gul yields in lbs. per plot.			Average.	Average net profits per plot in rupees.
	1915-16	1916-17	1917-18		
<i>Gurhal</i> ashes .. ..	2,644	2,808	2,948	2,800	107.9
Nil .. ..	2,689	2,914	2,929	2,844	114.9

## XIIIb

Manuring the same as above except that *san* green was substituted for F.Y.M. and sulphate of ammonia for the mixture of oil-cake and nitrate of soda.

Treatment.	Gul yields in lbs. per plot.		Average.	Average net profits per plot in rupees.
	1920-21	1921-22		
<i>Gurhal</i> ashes .. ..	1,632	2,464	2,048	172.2
Nil .. ..	1,377	1,792	1,588	104.4

The above figures seem to show that the addition of *Gurhal* ashes to the basic F.Y.M. top-dressed with oil-cake and nitrate of soda has practically no effect if not detrimental. From the second part of the experiment it may be possible to conclude that *Gurhal* ashes added to *san* green top-dressed with sulphate of ammonia produces good effects. But further investigations must be carried out in this matter before anything is confirmed.

## MANJRI FARM XIV.

To ascertain the effects of addition of  $K_2O$  and  $P_2O_5$  in top-dressing of sugarcane.

Variety—"Pundya".

Rotation—Cane, *Nihwa*, Ground-nut.

Manuring per acre.—Basic F.Y.M. 10,000 lbs. dry matter with a top-dressing of 150 lbs. of N as a mixture of cake and nitrate of soda in equal proportions of nitrogen, with the additions of—

- (1) Nil.
- (2) 100 lbs. of  $K_2O$  as sulphate of potash.
- (3) 100 lbs. of  $P_2O_5$  as super-phosphate.
- (4) 100 lbs. of  $K_2O$  as sulphate of potash plus 100 lbs. of  $P_2O_5$  as super-phosphate.

Plots—10 gunthas each.

Lay-out—Unreplicated.

Treatment.	Gul yields in lbs. per plot.				Average.
	1917	1920	1921	1922	
1 .. ..	2,929	1,930	1,231	2,928	2,255
2 .. ..	3,111	1,949	1,531	2,866	2,364
3 .. ..	2,985	1,839	1,335	2,373	2,133
4 .. ..	3,158	2,130	1,192	2,297	2,194

According to the above figures only the addition of  $K_2O$  alone gives the best yield.

## MANJRI FARM.

Statement showing the cost of cultivation per acre and the rate of gul sold.

Year.	Cost of Cultivation.		Lbs. of Gul per rupee.
	Rs.	a. p.	
1916-17 ..	469	8 0	12·5
1917-18 ..	475	10 0	12·5
1918-19 ..	475	8 0	12·5
1919-20 ..	....		..
1920-21 ..	492	11 0	7·0
1921-22 ..	671	14 0	7·0
1922-23 ..	620	13 0	9·4
1923-24 ..	604	4 0	10·7
1924-25 ..	660	10 0	8·0
1925-26 ..	635	9 0	10·0
1926-27 ..	623	13 6	11·0
1927-28 ..	626	8 0	12·0
1928-29 ..	593	3 0	10·5
1929-30 ..	596	4 4	11·2

MANJRI FARM.

Statement showing the rates of various sugarcane manures from year to year.

(Lbs. per rupee.)

Year.	Sulphate of ammonia.	Fish manure.	Castor- cake.	Ground- nut cake.	Safflower cake.	F.Y.M.
1913-14	8.3	60.0	29.1	..	22.8	666
1914-15	7.7	32.0	33.0	34.3	22.8	500
1915-16	8.8	19.8	33.1	..	24.0	485
1916-17	6.6	19.8	28.2	..	24.0	535
1917-18	6.7	..	29.5	33.1	25.3	485
1918-19	5.9	29.1	24.6	28.0	25.3	500
1919-20	4.3	22.8	26.6	12.6	21.8	500
1920-21	5.0	20.9	16.0	13.3	17.0	400
1921-22	6.0	19.2	19.2	17.1	14.4	400
1922-23	5.8	18.4	22.2	11.4	19.5	400
1923-24	7.8	17.1	19.2	19.2	19.5	400
1924-25	9.8	16.5	17.9	10.2	18.8	349
1925-26	10.2	..	..	..	19.4	400
1926-27	10.0	..	16.0	..	22.6	400
1927-28	10.0	..	..	..	22.6	400
1928-29	12.9	..	28.2	20.5	20.3	500
1929-30	14.4	..	30.0	20.0	27.4	500

*Statement showing the Fortnightly Rainfall on Mangri Farm  
from 1903-30.*

Months.	January.		February.		March.		April.		May.		June.	
	1st.	2nd.	1st.	2nd.	1st.	2nd.	1st.	2nd.	1st.	2nd.	1st.	2nd.
Years.												
1903	..	..	..	..	..	..	..	..	..	1.89	3.45	..
1904	..	..	..	0.14	..	..	0.22	..	..	..	0.49	0.67
1905	..	..	..	..	..	..	..	..	3.43	1.00	0.70	0.06
1906	..	1.03	..	..	..	..	..	..	..	..	5.23	2.35
1907	..	..	..	..	..	0.05	1.33	1.92	..	..	2.10	1.18
1908	..	..	..	..	..	..	0.14	0.00	..	..	2.77	0.02
1909	0.01	..	..	..	..	0.01	..	..	1.90	1.36	2.53	0.69
1910	..	..	..	..	..	..	..	..	0.25	..	0.92	3.10
1911	..	..	..	..	..	..	..	..	1.79	6.19	0.14	..
1912	..	..	..	..	..	..	..	..	0.07	0.76	4.67	..
1913	..	..	..	..	..	..	..	2.81	..	3.54	5.98	5.84
1914	..	..	..	..	..	0.33	..	..	0.03	0.16	4.22	1.99
1915	..	0.01	0.01	..	..	..	0.14	0.91	..	..	..	10.98
1916	..	..	..	..	..	..	0.43	..	..	4.72	2.18	0.41
1917	..	..	1.07	..	..	..	..	..	0.13	..	1.20	0.58
1918	..	..	..	..	0.06	..	..	..	3.47	2.60	..	0.68
1919	..	0.04	..	..	..	..	..	..	0.18	1.34	1.19	0.20
1920	0.45	..	..	..	..	..	..	0.92	..	..	1.98	0.32
1921	..	..	..	..	..	..	1.35	..	..	..	1.22	0.09
1922	..	..	..	..	..	..	..	1.36	..	0.35	2.25	3.01
1923	..	..	..	..	1.39	..	0.93	..	..	..	0.35	..
1924	..	..	..	..	..	0.10	0.42	1.52	..	1.86	1.90	0.73
1925	..	0.03	..	..	..	..	..	..	2.04	0.60	6.59	1.80
1926	0.14	0.55	..	..	..	..	..	..	..	0.63	1.16	0.50
1927	..	..	..	..	0.73	..	..	0.07	..	0.72	4.19	2.57
1928	..	..	0.38	..	..	..	0.90	0.59	..	..	2.32	2.52
1929	0.02	..	0.28	0.04	..	..	0.36	0.26	..	..	0.68	4.98
1930	..	..	..	..	..	..	0.09	0.24	..	0.88	0.46	1.38

*Statement showing the Fortnightly Rainfall on Manjri Farm  
from 1903-30—contd.*

Months.	July.		August.		September.		October.		November.		December.		Total.	
	Fortnight.	1st.	2nd.	1st.	2nd.	1st.	2nd.	1st.	2nd.	1st.	2nd.	1st.		2nd.
Years.														
1903	..	4.04	2.24	0.81	1.39	..	2.65	3.09	0.32	..	..	..	..	19.88
1904	..	1.89	0.52	0.38	0.18	1.99	0.94	3.45	2.08	..	..	..	..	12.35
1905	..	2.20	3.17	0.92	0.81	0.16	0.47	0.83	1.12	..	0.34	..	..	15.21
1906	..	0.45	2.09	0.02	2.45	0.21	1.68	0.08	..	0.83	0.03	..	0.38	16.83
1907	..	5.31	7.04	4.47	0.58	0.16	7.96	0.80	..	..	0.08	..	..	32.99
1908	..	2.49	1.38	3.24	0.45	0.71	4.73	..	0.48	0.08	..	..	..	16.58
1909	..	1.52	1.88	0.94	0.13	1.57	1.32	3.83	0.02	0.03	..	..	..	17.74
1910	..	1.39	0.64	3.12	3.81	4.38	3.47	1.40	2.06	3.01	..	..	0.04	29.59
1911	..	2.03	0.06	2.67	0.93	0.25	..	..	0.22	..	3.05	..	..	17.33
1912	..	0.05	6.64	0.87	0.21	..	1.26	3.62	0.53	0.15	2.58	..	..	21.61
1913	..	0.64	1.45	0.65	0.28	0.16	3.34	3.03	..	..	..	..	..	27.22
1914	..	1.28	6.16	4.12	0.89	0.45	4.49	0.51	..	0.46	..	0.63	..	25.12
1915	..	2.68	6.86	1.68	0.06	2.20	4.95	1.46	0.45	0.60	..	..	..	32.99
1916	..	2.05	2.93	0.70	0.62	6.28	1.92	0.26	4.33	0.19	0.32	..	..	27.34
1917	..	0.01	0.50	0.98	1.56	0.29	4.53	3.28	3.21	0.15	1.91	..	..	19.35
1918	..	..	..	..	0.82	0.02	0.23	1.82	..	0.53	2.28	0.16	..	12.67
1919	..	1.35	2.52	0.34	1.45	0.35	10.10	0.50	..	2.31	0.53	..	..	22.40
1920	..	1.55	0.89	0.64	..	..	4.18	0.90	3.27	..	..	..	..	15.10
1921	..	1.31	4.36	0.42	..	..	0.74	1.99	0.38	..	..	..	..	11.86
1922	..	1.07	1.31	0.59	0.91	0.18	0.72	3.90	0.11	8.98	0.31	..	..	25.05
1923	..	0.90	2.13	1.08	0.04	0.70	6.58	0.23	..	0.03	..	..	..	14.36
1924	..	0.50	1.32	0.23	5.94	0.08	7.15	0.11	3.71	..	0.41	..	..	25.98
1925	..	1.04	1.18	1.83	0.45	0.14	3.38	0.68	..	0.82	..	..	..	14.38
1926	..	3.63	1.80	1.69	1.87	1.66	4.85	0.69	0.26	0.20	..	..	..	19.63
1927	..	1.43	3.00	0.33	0.46	1.14	6.73	0.16	0.77	2.99	..	..	..	24.57
1928	..	1.38	2.30	0.65	2.63	0.80	8.46	0.06	0.66	..	..	..	..	23.65
1929	..	1.70	0.34	0.23	0.54	0.05	7.52	4.17	..	0.12	..	..	0.01	21.25
1930	..	2.40	1.13	0.84	1.04	4.32	0.81	3.69	1.40	2.85	..	0.1	0.05	21.67



## MANJRI DRY FARM I.

To ascertain the effects of:—(1) No-manure, (2) F.Y.M. 6 carts., (3) San Green, (4) Green manure—Chawali, (5) Sulphate of Ammonia, (6) Nitrate of soda.

Crop—Jowar (Rabi crop).

Variety—Kalbondi.

Plots—Varies for each year.

Lay-out—3 replications for 1926 to 1929 and varying in the year 1930.

Manipulated by methods II and III.

Treatments.					1926-27			Size of plot 590 square feet excluding ring.
					Yields in lbs. per plot.			
					1	2	3	Average.
1	..	..	..	..	13	15	12	13·3
2	..	..	..	..	16	10	14	13·3
3	..	..	..	..	11	14	14	13·0
4	..	..	..	..	15	12	14	13·7
5	..	..	..	..	13	13	11	12·3

The significance as found from method III is 3·9. Judging from this we see that all the treatments including no-manure show equal results.

Treatments.					1927-28			Size of plot 590 square feet excluding ring.
					Yields in lbs. per plot.			
					1	2	3	Average.
1	..	..	..	..	22	19	19	20·0
2	..	..	..	..	16	22	21	19·7
3	..	..	..	..	23	20	22	21·7
4	..	..	..	..	21	21	21	21·0
5	..	..	..	..	18·25	..	..	18·0
6	..	..	..	..	25·0	..	..	25·0

Significances by method III is 3·96. There seems to be no difference between treatments except 6 which shows a high yield. But it is single plot result and hence not reliable.

Treatments.					1928-29			Size of plot 576 square feet excluding ring.
					Yields in lbs. per plot.			
					1	2	3	Average.
1	..	..	..	..	17	18	20	18.3
2	..	..	..	..	20	17	..	18.5
3	..	..	..	..	16	25	24	21.7
4	..	..	..	..	21	17	21	19.7
5	..	..	..	..	20	..	..	20.0
6	..	..	..	..	23	..	..	23.0

Significance was calculated on basis of results of treatments 1, 3 and 4 alone and it is = 5.1. No significance among treatments. Here also 6 shows high yields.

Treatments.					1929-30			Size of plot 576 square feet excluding ring.
					Yields in lbs. per plot.			
					1	2	3	Average.
1	..	..	..	..	16	13	21	16.7
2	..	..	..	..	17	20	20	19.0
3	..	..	..	..	17	21	15	17.7
4	..	..	..	..	16	17	18	17.0
5	..	..	..	..	14	..	..	14.0
6	..	..	..	..	16	..	..	16.0

Significance = 4.6. All the treatments show equal results.

Treatments.	1930-31							Size of plots 270 sq. feet.			
	Yields in lbs. per plot.							Average of first 2 plots.	Average of first 4 plots.	Average of first 7 plots.	
	1	2	3	4	5	6	7				
1	..	5.6	7.4	3.2	7.0	6.0	7.1	4.9	6.5	5.8	5.9
2	..	8.0	10.5	8.3	9.3	8.5	7.6	7.6	9.3	9.0	8.5
3	..	4.3	5.9	3.5	2.8	..	..	..	5.1	4.1	..
4	..	3.6	2.8	5.3	7.5	..	..	..	3.2	4.8	..
5	..	7.5	7.1	..	..	..	..	..	7.3	..	..
6	..	6.4	6.5	..	..	..	..	..	6.5	..	..
Significance								1.6	2.8	1.0	

In this year the replications vary with treatments. The first two treatments have 7 replications, the next two have 4 replications and the last two have 2 replications.

For comparisons treatments which have equal number of replications were taken and compared.

Thus the first two treatments with 7 replications were treated with Method II and the significance obtained was 1.0 which shows by their averages that F.Y.M. has a distinct effect over no-manure.

Then the first four replications of the first two treatments were taken with four replications of 3 and 4 and by Method III significance obtained was 2.8. This shows again that F.Y.M. is the best and neither of the green manures has any advantage over no-manure.

Then the first two replications of all treatments were combined and Method III gave a significance of 1.6 which again shows that F.Y.M. is the best. *Chawali* green manure is inferior to *san* and artificials. Sulphate of ammonia plus nitrate of soda have no distinct advantage over no-manure.

## MODIBAG GARDENS I.

### *Bananas.*

To ascertain the comparative effects of:—(1) F.Y.M. 80 lbs. per plant, (2) Poudrette 125 lbs. per plant, (3) Castor cake 11 lbs. per plant, (4) Bone-meal 10 lbs.

Five plants were taken for each treatment.

The manures are added on the basis of 0.5 lbs. N per plant.

Manure applied in March 1925.

Manipulated by Method IV.

Treatments.	1924-25					Average.
	Yields in lbs. per plant.					
	1	2	3	4	5	
1 .. .. .	28	29	26	21	16	24
2 .. .. .	21	25	29	10	28	22.6
3 .. .. .	25	29	28	34	23	27.8
4 .. .. .	26	27	29	25	15	24.11

## Analysis of Variance.

Kind of variance.				Degrees of freedom.	Sum of variance.	Variance $\frac{1}{2} \log_e V$
Treatments	..	..	..	3	75	25.0
Plant Blocks	..	..	..	4	206.5	51.6
Error	..	..	..	12	338.7	28.23

There is no significant effect due to treatment.

All the treatments seem to give equal results.

## POONA MODIBAG GARDENS II.

## Figs.

To compare the effects of:—(1) *F.Y.M.* 80 lbs. per tree, (2) Bone-meal 3 lbs. plus nitrate of soda 1.5 lbs. plus 20 lbs. *F.Y.M.* per tree, (3) 20 lbs. *F.Y.M.* plus nitrate of soda 2 lbs., (4) the above plus 10 lbs. bone-meal.

There were 18 trees per treatment. They were divided into two blocks of 36 trees each. Each treatment consisted of a row of 9 trees in each block.

In the second block one tree in each treatment has been omitted due to discrepancies in results.

The yields in lbs. per tree were treated by Method III.

Treatments.		Yields in lbs. per tree.									Average.	Significance.
1	..	42	36	34	25	25	24	36	22	11	28.3	} 10.2
2	..	36	36	17	23	34	20	33	31	15	27.6	
3	..	45	33	40	13	30	18	32	20	13	27.1	
4	..	51	40	34	25	39	32	20	29	73	38.2	

In this block the first three treatments give equal results and treatment 4 alone is significantly better than the other.

Treatment.	Yields in lbs. per tree.									Average.	Significance.	Net profit for 17 trees in rupees.	
	1	2	3	4	5	6	7	8	9				
1	..	33	34	16	36	39	26	22	28	..	29.3	} 9.6	66.8
2	..	43	20	12	15	4	18	10	7	..	16.1		43.2
3	..	41	39	21	25	10	5	12	14	..	20.9		51.8
4	..	38	35	39	14	20	45	18	27	..	29.5		77.9

In this block both treatment 1 and treatment 4 have given significantly better yields than treatment 2. Treatment 3 is nearer to treatment 2

and the differences between it and 1 and 4 are on the margin of the significance. Hence we may say that treatments 1 and 4 are better than 2 and 3.

Considering the net profits also for 17 trees together, we see that treatment 4 stands best followed by 1. Treatment 3 gives a net profit slightly more than treatment 2 and both these are much below the other treatments.

### MODIBAG GARDENS III.

#### *Pomegranate.*

To compare the effects of:—(1) *F.Y.M.* 80 lbs. per tree, (2) *Bone-meal* 3 lbs. plus *Nitrate of Soda* 1·5 lbs. plus per *F.Y.M.* 20 lbs. per tree, (3) 20 lbs. *F.Y.M.* plus *Nitrate of Soda* 2 lbs. per tree, (4) 20 lbs. *F.Y.M.* plus *Bone-meal* 10 lbs. per tree.

There were 22 trees for each treatment. They were in two blocks of 44 trees; each row consisting of 11 trees of one treatment in each block.

The yields are given in number of fruits per tree. But it is quite evident that due to the variations of the size of the fruits and hence of their weight this is not the proper unit for considering the yields. There is a very high variation in the yields which could have been lessened a little by taking the weights of the yields of each tree.

Yet an attempt has been made to find the significance which results in a very high percentage of error. It amounts to more than 60 per cent. of the yield of a block. The results are by no means satisfactory, and more so because of the difference in the yields of the two blocks as pointed out below:—

Treatments.	Year 1928-29											Average.
	Number of fruits per tree.											
	1	2	3	4	5	6	7	8	9	10	11	
1 .. ..	63	45	19	71	24	62	89	63	48	90	79	59·4
2 .. ..	19	81	58	48	98	40	18	13	31	32	41	50
3 .. ..	56	76	42	31	13	16	8	18	47	44	34	35
4 .. ..	56	59	75	44	66	63	16	55	68	34	69	55
Significance ..	20·7											

This shows that treatment 3 alone is significantly lower than 1 and 4, and slightly lower than 2.

## Block 2.

Treatment.	Number of fruits per tree.											Average.
	1	2	3	4	5	6	7	8	9	10	11	
1 .. ..	60	33	52	58	36	55	21	10	64	24	32	40.5
2 .. ..	30	27	20	58	6	80	72	48	47	42	43	43.0
3 .. ..	127	38	53	64	36	54	9	14	64	58	9	47.8
4 .. ..	40	13	61	15	37	34	49	37	57	53	35	40.1

As the difference between yields for each treatment is small and the variation between the trees is very high it was thought not worth while to calculate the significance in this case, which will evidently be very high. But it may be noted that, here though not significant treatment 3 which stood lowest in the other block stands highest in this, and treatments 1 and 4 which stood highest in the other block come down in this block. Hence the results seem to be very unreliable.

The net profits per treatment for both the blocks are as follows :—

	Treatments.			
	1	2	3	4
	Rs.	Rs.	Rs.	Rs.
Total net profits .. ..	43.9	37.3	32.0	33.3

Judging from this we can say that treatment 1 may prove more beneficial than others.

## POONA MODIBAG GARDENS IV.

*Santra—Oranges.*

To compare the effects of :—(1) *F.Y.M.* 80 lbs. per tree, (2) *Bone-meal* 3 lbs. plus *nitrate of soda* 1.5 lbs. plus *F.Y.M.* 20 lbs., (3) *F.Y.M.* 20 lbs. plus *nitrate of soda* 2 lbs., (4) *F.Y.M.* 20 lbs. plus 10 lbs. *bone-meal*.

There were 40 trees at 10 trees for each treatment. They were arranged in blocks of 20 trees each block containing a row of 5 trees for each treatment.

Yields of the number of fruits per tree is given. But it may be noted that there is a very great divergence in the yields and hence

since the error will be very high no attempt was made at finding the error.

Treatment.	Number of fruits per tree.					Average.
	1	2	3	4	5	
<i>Block 1.</i>						
1 .. ..	328	67	58	45	18	103
2 .. ..	153	70	51	78	147	100
3 .. ..	114	42	11	48	378	117
4 .. ..	68	14	27	32	1	28.4
<i>Block 2.</i>						
1 .. ..	..	47	45	157	187	87
2 .. ..	8	3	20	93	18	28.4
3 .. ..	246	51	135	11	52	99
4 .. ..	5	5	24	59	377	94
Treatment.						
	1	2	3	4		
Net profit for 10 trees ..	24.7	10.5	29.9	7.1		

In the first block the first three treatments show equality and 4 has given a very low result. In 2nd block treatment 2 has fallen down and 3 has risen up high thereby showing that treatments 1, 3 and 4 are equal. But it may be noted that treatments 1 and 3 have maintained equality in high yields in both years and hence they may be said to be more beneficial than the other two. This is also confirmed by the net profits.

### POONA MODIBAG GARDEN.

*Rates, 1928-29.*

F.Y.M.—Rs. 2 per cart of 800 lbs.

Bone-meal—Rs. 110 per ton.

Sodium Nitrate—Rs. 185 per ton.

Figs—5.3 lbs. per rupee.

Pomegranates—16 per rupee.

Santra—24 per rupee.

Cost of cultivation for 17 trees of figs—Rs. 22.1

Do. do. for 22 trees of Pomegranate—Rs. 20.3

Do. do. for 10 trees of oranges—Rs. 13.

## NADIAD FARM I.

To compare (1) *San green ordinary* with (2) *F.Y.M.* 15 tons per acre for tobacco and kodra rotation.

Crop—Tobacco and Kodra rotation.

Plots—

Lay-out—Unreplicated.

Treatments.	Yields in lbs. per acre of cured leaves.		Average.	Average net profit.
	1906-07	1907-08		
<i>Shallow tillage.</i>				Rs.
<i>San green</i> .. .. .	2,092	813	1,453	52·06
<i>F.Y.M.</i> .. .. .	1,512	1,261	1,387	28·88
<i>Deep tillage.</i>				
<i>San green</i> .. .. .	1,948	1,112	1,530	59·12
<i>F.Y.M.</i> .. .. .	1,780	1,344	1,562	49·7

For shallow tillage the yield of plots for *san green* will be higher had it not been that it was spoiled by wilt in 1907-08. Even with this small difference of yield between this and *F.Y.M.* treatment, the net profit given by *san green* is appreciably better.

For deep tillage though both the manures seem to give equal yields the net profit is higher for *san green* treatment.

Hence *san* may be preferable.

## NADIAD FARM II.

To ascertain the effects of: (1) *F.Y.M.* (20,000 lbs. basic manure); (2) *F.Y.M.* plus castor-cake 1,000 lbs.; (3) *F.Y.M.* plus cotton seed cake 1,000 lbs.; (4) *F.Y.M.* plus safflower cake 1,000 lbs.; (5) *F.Y.M.* plus Ground-nut cake 1,000 lbs. for tobacco, irrigated.

Crop—Tobacco, irrigated.

Plots— $\frac{1}{8}$ th acre each.

Lay-out—Unreplicated.



Treatment.	Yields of tobacco leaves per plot in lbs.						Average.	Average net profits per plot.
	1909-10	1910-11	1911-12	1912-13	1913-14	1914-15		
1 ..	254	185	..	196	130	215	198	Rs. 3.69
2 ..	268	228	..	337	197	293	269	6.82
3 ..	308	209	..	254	182	250	241	3.69
4 ..	296	223	..	..	..	..	260	5.95
5 ..	..	..	..	282	200	259	251	3.82

*Note.*—Treatment 4 was tried in 1909-10 and 1910-11 and then 5 was substituted for it. Yields for 1911-12 are omitted as it was a bad year.

The addition of castor cake has given the best yield accompanied by the highest net profit. Safflower seems to stand next, but it was tried only for two years and hence is not conclusive. Though the other cake give higher yields, they give equal net profits with the first treatment where no cake is added and hence are not profitable.

### NADIAD FARM III.

To ascertain the effects of the following treatments per acre on the above crop under ordinary and deep tillage separately: (1) F.Y.M. 15 tons; (2) Castor cake 2,000 lbs.; (3) F.Y.M. 10 tons plus castor cake 600 lbs.; (4) F.Y.M. 10 tons plus Nitre 112 lbs.; (5) F.Y.M. 10 tons plus Nitrate of soda 112 lbs.; (6) F.Y.M. 10 tons plus Sulphate of ammonia 112 lbs.; (7) San green.

*Crop*—Tobacco, irrigated, unrotated.

*Plots*—10 gunthas each.

*Lay-out*—Unreplicated.

#### Yields of cured leaves in lbs. per plot.

Treatment.	Ordinary tillage.					Deep tillage.					Net profit ordinary tillage.	Deep tillage.	
	1906	1907	1908	1910	Average.	1906	1907	1908	1910	Average.			
1 ..	445	228	433	524	408	440	323	479	549	448	12.3	15.1	F.Y.M. plus castor cake is the only treatment showing a high yield and a good net profit. All other treatments are more or less equal among themselves and inferior to the above treatment.
2 ..	376	323	436	472	402	357	418	459	497	433	8.5	12.1	
3 ..	498	373	561	569	500	496	463	555	595	527	18.5	21.2	
4 ..	310	336	479	502	407	391	434	494	534	463	11.5	15.9	
5 ..	306	332	463	520	405	402	391	481	547	455	10.6	14.6	
6 ..	373	329	530	..	410	..	..	413	..	413	12.5	20.2	
7 ..	456	..	413	385	418	543	222	433	453	413	17.1	14.3	

*Note.*—The yields are not available for 1908-09 as it was year of excessive rains. In 1911-12 the crop was not grown as it was a famine year.

## NADIAD FARM IV.

To ascertain the comparative effects of the following treatments on tobacco, irrigated.

Crop—Tobacco, irrigated.

Plots—Yields per acre were given. They have been reduced to yields for 4 gunthas for calculation.

Lay-out—Duplicated in 1911-12 and 1914-15.

Treatments—

- (1) Superphosphate 300 lbs. plus (a) 100 lbs.  $K_2O$  as  $K_2SO_4$ .  
 (b) 100 lbs.  $K_2O$  as wood-ashes.  
 (c) 50 lbs.  $K_2O$  as  $K_2SO_4$ .  
 (d) 50 lbs.  $K_2O$  as wood-ashes.  
 (e) No potash.
- (2) Superphosphate 300 lbs. plus Nitrate of Soda 200 lbs. plus. (a) 100 lbs.  $K_2O$  as  $K_2SO_4$ .  
 (b) 100 lbs.  $K_2O$  as wood-ashes.  
 (c) 50 lbs.  $K_2O$  as  $K_2SO_4$ .  
 (d) 50 lbs.  $K_2O$  as wood-ashes.  
 (e) No potash.
- (3) Nil, plus .. (a) 100 lbs.  $K_2O$  as  $K_2SO_4$ .  
 (b) 100 lbs.  $K_2O$  as wood-ashes.  
 (c) 50 lbs.  $K_2O$  as  $K_2SO_4$ .  
 (d) 50 lbs.  $K_2O$  as wood-ashes.  
 (e) No potash.

Yields in lbs. of Tobacco leaves per plot of 4 gunthas.

Treatment.	1911-12		Average.	1912-13	1914-15		Average.	
	i	ii		Single plot yield.	i	ii		
1 ..	(a) ..	151	170	161	110	109	130	120
	(b) ..	144	120	132	113	122	130	126
	(c) ..	151	137	144	173	173	143	158
	(d) ..	130	144	139	194	160	135	148
	(e) ..	128	165	147	155	117	137	127
2 ..	(a) ..	146	151	149	130	162	122	142
	(b) ..	149	156	153	79	144	139	142
	(c) ..	163	125	144	154	148	151	150
	(d) ..	168	161	165	214	166	148	157
	(e) ..	104	125	115	142	133	150	142
3 ..	(a) ..	139	103	121	160	167	108	133
	(b) ..	132	115	124	86	188	144	166
	(c) ..	130	118	124	250	142	90	116
	(d) ..	127	166	147	204	188	103	146
	(e) ..	124	131	128	117	110	124	117

Significance ..

17.2

19.4

There seems to be no consistency in the results above. This is perhaps one of the drawbacks of trying too many treatments more or less of the same value at a time.

In general it may be said that the yields under treatment 2 are better than those under 1 or 3. It is suggested that 50 lbs.  $K_2O$  may prove more advantageous than 100 lbs., when applied with Superphosphate.

#### NADIAD FARM V.

To compare—(1) *F.Y.M.* 7.5 tons plus nitre 80 lbs., (2) *No-manure*,  
(3) *F.Y.M.* 7.5 tons alone, for rice, non-irrigated.

Crop—Rice—non-irrigated.

Plots—6 gunthas each.

Year.	Yields in lbs. per acre.		
	Treatments.		
	1	2	3
1906-07	1,266	1,200	1,127
1907-08	893	860	407
1908-09	600	..	467
1909-10	1,713	..	1,286
1910-11	1,866	..	1,600
Average yield	1,268	1,030	977
Average net profit	Rs. 8.25	7.05	-10.85

Though the treatment 1 has given a slightly higher yield, it gives a loss and hence is not profitable. Treatment does not show any advantage.

#### NADIAD FARM VI.

To compare—(1) *F.Y.M.* 7.5 tons plus nitre 80 lbs., (2) *F.Y.M.* 7.5 tons alone, for rice, irrigated.

Crop—Rice—Irrigated.

Plots—6 gunthas each.

Year.	Yields of grain in lbs. per acre.	
	Treatment.	Treatment.
	1	2
1906-07	1,933	1,529
1907-08	1,633	711
1908-09	1,600	758
1909-10	1,900	1,040
1910-11	2,893	2,120
Average	1,992	1,232
Average net profits	Rs. 6.79	-6.22

Addition of nitre has given better yields and net profits, whereas *F.Y.M.* alone has given a net loss.

## NADIAD FARM VII.

To compare the effects of—(1) Urine earth 15,000 lbs. per acre, (2) Cattle dung 15,000 lbs. per acre, for "Sundhia" Jowar.

Crop—"Sundhia" Jowar.

Plots— $\frac{1}{4}$ th acre each.

Lay-out—Unreplicated.

Note—The fodder is to be considered in this experiment.

Year.				Yields in lbs. per acre.			
				Urine earth.		Cattle dung.	
				Grain.	Fodder.	Grain.	Fodder.
1911-12	..	..	..	752	5,612	992	5,460
1912-13	..	..	..	88	2,336	104	3,208
1913-14	..	..	..	344	3,000	288	2,478
1914-15	..	..	..	484	2,228	512	2,416
1914-15	..	..	..	226	1,008	301	1,525
Average ..				379	2,837	430	3,017

Cattle dung seems to give more yields than urine earth, both for grains and fodder.

## POONA COLLEGE FARM I.

To compare the effects of various combinations of the manures with no-manure treatment.

Crop—"Nilwa" Jowar (Kharif).

Plot— $\frac{1}{12}$ th of an acre each.

Lay-out—Duplicated.

Rotation—Jowar, Cotton, Groundnut.

Manures used per acre—

(1)  $\frac{1}{2}$  F.Y.M. plus K.

(2)  $\frac{1}{2}$  F.Y.M.

(3) Nil.

(4)  $\frac{1}{2}$  F.Y.M. plus K plus P plus N.

(5) F.Y.M.

(6)  $\frac{1}{2}$  F.Y.M. plus K plus P plus N. plus Ca.

(7)  $\frac{1}{2}$  F.Y.M. plus K plus P.

Where—

F. Y. M. = 10 carts and 1/2 F. Y. M. = 5 carts.

P = Superphosphate 640 lbs. per acre.

N = Sulphate of Ammonia 160 lbs. per acre.

K = Potash sulphate 200 lbs. per acre.

Ca = Lime 672 lbs. per acre.

Plot.		1912-13							
		Grain yields in lbs. per plot.							
		Treatments.							
		1	2	3	4	5	6	7	
1	..	12	35	24	39	56	59	46	Manipulation by method III. $\sigma_d^2 = \frac{2 \times 7}{6} (522 \cdot 3 - 400 \cdot 1)$ $= 285 \cdot 13.$ therefore $\sigma_d = 16 \cdot 884$ Ed. = 16 \cdot 884 $\sqrt{2}$
2	..	89	85	77	89	76	78	57	
Average	..	50 \cdot 5	60	50 \cdot 5	64	66	68 \cdot 5	51 \cdot 5	

Therefore Significance in difference of means is equal to  $\frac{16 \cdot 884}{\sqrt{2}} \times 2 \cdot 1$   
 equal to 25 \cdot 33.

		1914-15							
		1	2	3	4	5	6	7	
1	..	37	37	34	42	33	24	20	$\sigma_d^2 = 41 \cdot 93$ therefore $\sigma_d = 6 \cdot 475$ therefore significance in difference of means equal to $\frac{6 \cdot 475 \times 2 \cdot 1}{\sqrt{2}}$ $= 9 \cdot 713.$
2	..	47	43	31	36	40	32	17	
Average	..	42	40	32 \cdot 5	39	36 \cdot 5	28	18 \cdot 5	

In the first year no two means differ by more than the significance. In the 2nd year the treatments 6 and 7 show significantly lower results than 1, 2 and 4 and 1, 2, 3, 4, 5, 6 respectively. The differences among the other treatments are not significant.

## POONA COLLEGE FARM II.

To compare basic F.Y.M. (= 5 lbs. N per acre) with additions 10 lbs. of N in various forms.

Crop—"Shalu" Jowar (Rabi).

Plot—1 guntha each.

Lay-out—4 replications, Randomised.

Treatments per acre—

- (1) F.Y.M. (5 lbs. N).
- (2) F.Y.M. plus sulphate of ammonia (= 10 lbs. N).
- (3) F.Y.M. plus Nitrate of soda (= 10 lbs. N).
- (4) F.Y.M. plus Calcium cyanamide (= 10 lbs. N).
- (5) F.Y.M. plus Leunaphos (= 10 lbs. N).
- (6) F.Y.M. plus Nitrophoska (= 10 lbs. N).

Method used—IV.

Treatments.				1929-30				Average per plot.
				Yield of grain in lbs. per plot.				
				1	2	3	4	
1	..	..	..	46	46	58	65	53.75
2	..	..	..	69	34	45	46	48.5
3	..	..	..	27	44	59	53	45.75
4	..	..	..	51	49	49	44	48.25
5	..	..	..	51	42	55	51	49.75
6	..	..	..	37	52	50	56	48.75
Average ..				46.83	44.5	52.61	52.5	49.125

*Analysis of variance.*

Kind of variance.				Degrees of freedom.	Sum of squares.	Mean square.	1/2 log <sub>e</sub> mean square.
Treatments..	..	..	..	5	137.85	27.57	1.6565
Blocks ..	..	..	..	3	303.31	101.10	2.3054
Errors ..	..	..	..	15	1510.44	100.70	2.3030

It is seen that the variance due to treatment is much less than that due to error. Hence there is no significance due to treatments.

Even comparing the individual treatment means we have the standard error for such comparison =  $\sqrt{\frac{100.7 \times 2}{4}} = 7.0958$ . This multiplied by 2.131 gives 15.13 for significance in differences in the treatment means. But no two means differ by more than this. Hence there is no difference in the effects of treatments.

## POONA COLLEGE FARM III.

To compare the basic F.Y.M. (5 lbs. N. per acre) with additions 10 lbs. of N. in different forms.

Crop—"Shalu" Jowar (Rabi).

Plot—1 guntha each.

Lay-out—Randomised with four replications.

Method used—IV (Fisher's).

Treatments per acre—

- (1) F.Y.M. alone = 5 lbs. N.
- (2) F.Y.M. plus Niciphos = 10 lbs. N.
- (3) F.Y.M. plus Complete fertiliser = 10 lbs. N.
- (4) F.Y.M. plus Calcium cyanamide = 10 lbs. N.
- (5) F.Y.M. plus Nitrate of soda = 10 lbs. N.
- (6) F.Y.M. plus Sulphate of ammonia = 10 lbs. N.

Year 1930-31.

Treatments.				Grain yields per plot in lbs.				Average per plot.
1	..	..	..	58	53	85	57	63.25
2	..	..	..	58	65	64	67	63.50
3	..	..	..	52	63	63	63	60.25
4	..	..	..	59	61	65	58	60.75
5	..	..	..	61	61	51	73	61.50
6	..	..	..	58	60	55	58	57.75
Average per plot ..				57.6	60.5	63.83	62.6	61.16

*Analysis of variance.*

Kind of variance.				Degrees of freedom.	Sum of squares.	Mean square.	$1/2 \log_e$ of mean square.
Treatments	..	..	..	5	90.414	18.08	1.4458
Blocks	..	..	..	3	132.0	44.20	1.8922
Error	..	..	..	15	932.4	62.16	2.0625

The 5 per cent. point of  $z$  for  $n_1 = 5$  and  $n_2 = 15$  is 0.5326. But it is seen that the variance due to errors exceeds those due to Treatments and Blocks and hence there is no significance due to treatments.

Standard error for comparison of two treatment means is

$$\sqrt{\frac{62.16 \times 2}{4}} = 5.582. \text{ The 5 per cent. value of } t \text{ for } n_2 = 15 \text{ is } 2.131.$$

Hence the significance in the difference between two means is  $2.131 \times 5.582 = 11.722$ . But the highest difference between treatment means is 5.75 and hence there is absolutely no significance and difference between the treatments. It may be noted that check plot gives a higher yield than the 4 treated plots.

## POONA COLLEGE FARM IV.

To ascertain the comparative effects of chemical fertilisers over the Jowar (Shalu) crop.

Crop—Jowar (Shalu).

Plots—15' × 15'. But a ring of 2·5' around was left off resulting in the net plot of 10' × 10'.

Lay-out—Each treated plot had its check plot by its side and thus there were as many check plots as there were treated plots. Each fertiliser was tried on three plots.

Manuring—As the plots were heavily manured in the previous years, the foundation dose of F.Y.M. of 5 lbs. N. per acre was not given.

Treatments per acre—The following fertilisers were used at the rate of 10 lbs. N. per acre each :—

- (1) Sulphate of ammonia.
- (2) Nitrate of soda.
- (3) Calcium cyanamide.
- (4) Leunaphos.
- (5) Ammophos.
- (6) Nitrophoska.
- (7) Farm Yard Manure.

Data manipulated by Method IV.

The following table shows the arrangement of the plots, and gives the yields of each plot in lbs. The figures in the upper left corner of each plot indicate the treatment used in that plot. Check is indicated by the letter C :—

c	3	2	c	c	1
8·38	8·63	6·5	7·38	7·63	8·06
c	7	4	c	c	5
7·88	7·75	7·19	5·44	7·00	7·69
c	1	3	c	c	2
6·31	7·19	6·81	6·38	6·88	8·88
c	5	7	c	c	4
5·25	5·38	5·81	7·38	6·88	8·75
c	2	1	c	c	3
5·63	5·75	7·00	6·75	6·88	7·13
c	4	5	c	c	7
6·13	6·31	7·44	7·13	6·13	7·69
c	6	6	c	c	6
7·13	8·06	7·19	7·81	7·00	7·75



## Analysis of variance.

Kind of variation.			D	Sum of squares.	Mean square or Variance.	$\frac{1}{2} \text{Log}_e V.$
Treatments	..	..	7	4.16	0.5943	
Blocks	..	..	2	7.92	3.9600	
Error	..	..	32	22.05	0.6891	
Total	..	..	41	34.13	0.8324	

## Mean yields.

Check	Treatments.							
	1	2	3	4	5	6	7	
Mean yields	6.83	7.42	7.04	7.52	7.42	6.84	7.67	7.08

As the variance due to treatments is less than that due to error there seems to be no significance due to treatments on the whole. The standard error of the difference between the mean of check plots and the mean of any other treatment is equal to—

$$\sqrt{\frac{0.6891}{3} \text{ plus } \frac{0.6891}{21}} = \sqrt{0.2625} = 0.5123.$$

Therefore the significance figure for this comparison is less than  $0.5123 \times 2.045$  i.e., less than 1.05. Now, no treatment mean differs from the check mean by 1.05 and hence there is no significant difference between various treatments.

## POONA COLLEGE FARM V.

To compare F.Y.M. (5 lbs. N.) with additions of 10 lbs. N. in various forms.

Crop—"Akola" Bajri.

Plots—1 guntha each. 16' × 68'.

Lay-out—Randomised blocks with 4 replications.

Method—IV.

Treatments—

- (1) F.Y.M. 5 carts.
- (2) F.Y.M. plus 10 lbs. N. as sulphate of ammonia.
- (3) F.Y.M. plus 10 lbs. N. as nitrate of soda.
- (4) F.Y.M. plus 10 lbs. N. as calcium cyanamide.
- (5) F.Y.M. plus 10 lbs. N. as Leunaphos.
- (6) F.Y.M. plus 10 lbs. N. as Nitrophoska.

Year 1929-30.  
Grain yields in lbs. per plot.

Treatments.				Blocks.				Net profits.
				1	2	3	4	
1	..	..	..	30	26	27	20	Rs. 0·3
2	..	..	..	39	27	31	24	0·8
3	..	..	..	49	21	23	21	0·2
4	..	..	..	45	26	37	21	0·9
5	..	..	..	37	32	38	18	0·7
6	..	..	..	43	25	38	15	0·7

*Analysis of variance.*

Kind of variation.				D.	Sum of squares.	Mean square or Variance.	$\frac{1}{2} \text{Log}_{10} V.$
Treatments..	..	..	..	5	106·21	21·242	
Blocks ..	..	..	..	3	1400·46	466·820	
Error ..	..	..	..	15	430·29	28·686	
Total ..				23	1936·96	84·216	

$$S. D. = \sqrt{28 \cdot 686} = 5 \cdot 356.$$

*Mean yields.*

			Treatments.					
			1	2	3	4	5	6
Mean yields	..	..	25·75	30·25	28·50	32·25	31·25	30·25

$$\text{Mean S. E.} = \sqrt{\frac{28 \cdot 686}{4}} = 2 \cdot 678.$$

Since the variance due to treatments is less than that due to error, there seems to be no significant effect due to the treatments on the whole.

The same fact may be established by comparing the treatment means. The standard error for comparing the means is 3·79 and hence the significance in the difference of treatment means is  $3 \cdot 79 \times 2 \cdot 31 = 8 \cdot 08$ . Now, no two treatment means differ even by this much number and hence we conclude that the treatments show no significant effect on the whole. It may be noted that the treatments 2 to 6 give better yield—though not significantly—than the F.Y.M. treatment.

## POONA COLLEGE FARM VI.

To compare the effects of the following treatments on Bajri.

Crop—"Akola".

Variety—Bajri.

Plots—1 guntha each.

Lay-out—8 replications, randomised.

Treatments per acre—

- (1) F.Y.M.
- (2) F.Y.M. plus sulphate of ammonia.
- (3) F.Y.M. plus nitrate of soda.
- (4) F.Y.M. plus calcium cyanamide.
- (5) F.Y.M. plus niciphos.
- (6) F.Y.M. plus complete manure.

Quantity of manure applied is equivalent to 10 lbs. of N per acre except with F.Y.M. which is 5 lbs. of N.

Treatment.	Grain yields in lbs. per plot.								Average.	Net profits.
	1	2	3	4	5	6	7	8		
										Rs.
1 ..	24	23	21	25	16	27	26	23	23.125	—(0.75)
2 ..	17	26	23	25	18	32	30	24	24.375	—(0.8)
3 ..	20	30	30	27	20	24	31	25	25.875	—(0.8)
4 ..	22	23	25	24	23	21	30	24	24.00	—(0.8)
5 ..	24	22	23	22	17	27	28	26	23.625	—(0.9)
6 ..	26	24	23	25	18	24	29	22	23.875	—(0.9)
Average ..	22.16	24.6	24.16	24.6	18.6	25.83	29	24	..	....

*Analysis of variance.*

Kind of variance.	Degrees of freedom.	Sum of squares.	Mean squares.	$\frac{1}{2} \log_e$ mean square.
Treatments ..	5	35.52	7.10	1.022
Blocks ..	7	364.26	52.04	1.9737
Random error ..	35	252.12	7.20	0.9859

5 per cent. point of  $z$  for  $n_1=5$  and  $n^2=35$  is not less than 0.4311. Hence no significance in treatments.

The standard error for comparison between means =  $\sqrt{\frac{7.20 \times 2}{8}} = 1.34$ .

Hence any significance in means would be indicated by a difference of  $1.34 \times 2.02 = 2.707$ . From this we see that except treatment 3, no treatment is significantly better than check treatment 1.

## POONA COLLEGE FARM VII (A, B, C AND D).

(a) To compare the effects of green manuring, *san* with 10 carts of Poudrette per acre.

Crop—"Bakshi" wheat (irrigated).

Plots—5 gunthas each.

Lay-out—Duplicated.

Years—1912-13 and 1913-14.

Green manure is grown on plot during rains and ploughed in.

Year.				Poudrette.	Green manuring.	Significance.
1912-13	..	..	..	{ 170	146	
				{ 159	159	
			Average ..	164.5	152.5	10.7
1913-14	..	..	..	{ 150	121	
				{ 193	168	
			Average ..	174	144.5	0.75

In both the years the Poudrette treatment gives significantly better results than the other treatment.

(b) To compare 10 carts of F.Y.M. with *san* green manuring.

Plots—5 gunthas each.

Year.				F.Y.M.	Green manure.	Significance.
1914-15	..	..	..	{ 112.5	94	
				{ 100.0	75	
			Average ..	106.5	84.5	4.5

This shows that F.Y.M. is better than green manuring.

(c) To compare 20 lbs. of N as sulphate of ammonia with 20 lbs. of N as Nitrate of soda, in addition 5 carts Poudrette.

Year.				5 carts Poudrette plus sulphate of ammonia.	5 carts Poudrette plus nitrate of soda.	Significance.
1912-13	..	..	..	{ 84	93	
				{ 83	86	
			Average ..	83.5	89.5	4.5

This shows that nitrate of soda gives a better yield than sulphate of ammonia in the above combinations.

(d) To compare the effects of 5 carts F.Y.M. plus 20 lbs. N as sulphate of ammonia with 5 carts of F.Y.M. plus 20 lbs. N as nitrate of soda.

(N as nitrate of soda.)

Year.				F.Y.M. plus sulphate of ammonia.	F.Y.M. plus Nitrate of soda.	Signi- ficance.
1914-15	..	..	..	{ 188 156	156 141	
Average ..				172	148.5	12.25

This shows that sulphate of ammonia is better than nitrate of soda when combined with F.Y.M.

N.B.—The above results were manipulated by Method III.

#### POONA COLLEGE FARM VIII.

To compare the effects of the following manuring treatments on wheat crop.

Crop—"Pusa 4" wheat (rotated with cotton).

Plots—1.32 gunthas each.

Lay-out—11 replications randomised.

Manuring per acre—

(1) No manure.

(2) F.Y.M. 2½ carts.

(3) F.Y.M. plus sulphate of ammonia (= 10 lbs. N).

(4) Sulphate of ammonia (= 10 lbs. N).

Manipulated by Method IV.

Treatment.	1930-31											Average per plot.
	Grain yields in lbs. per plot.											
	1	2	3	4	5	6	7	8	9	10	11	
1 ..	12	18	19	19	23	23	28	24	20	17	15	19.82
2 ..	13	13	19	17	23	26	30	24	16	19	14	19.45
3 ..	13	13	17	20	24	27	26	26	23	19	14	20.18
4 ..	16	9	18	16	25	24	25	26	19	17	15	19.09

#### Analysis of variance.

Kind of variance.	Degrees of freedom.	Sum of squares.	Mean squares.	1/2 log <sub>e</sub> mean square
Treatments .. ..	3	7.2886	2.4295	
Blocks .. ..	10	984.00	98.4000	
Random error .. ..	30	111.4	3.713	

From the above it is clearly seen that there is no effect due to treatments as the variance due to treatments does not exceed that for errors ; hence no necessity to investigate further.

But taking the standard error of comparison for two means, we have  $\sqrt{\frac{3.713 \times 2}{11}} = 0.822$ . This multiplied by 2.042 which is the value of "t" for 30 degrees of freedom, we get 1.679 as significance for the difference between two treatment means. Judging from this it may be said that no treatment is significantly better over the other. Hence the treatments afford no advantage.

### POONA COLLEGE FARM IX

To compare the effects of F.Y.M. superphosphate, sulphate of ammonia, lime and sulphate of potash on cotton in the following combinations.

Crop—Cotton "Varadi" (Khandesh).

Plots—1/12 acre each.

Rotation—Jowar, cotton, groundnut.

Manuring per acre—

F.Y.M.=10 carts F.Y.M.

K=Sulphate of potash 320 lbs.

P=Superphosphate 640 lbs.

N=Sulphate of ammonia 128 lbs.

Ca=Lime 672 lbs.

Manipulated by Method III.

Year.	Yields in lbs. per plot.						
	1/2 F.Y.M. + K.	1/2 F.Y.M.	Nil.	1/2 F.Y.M. K + P + N.	F.Y.M.	1/2 F.Y.M. + K + P + N + Ca.	1/2 F.Y.M. + K + P.
	1	2	3	4	5	6	7
1912-13	{ 41 44	{ 38 39	{ 34 39	{ 38 40	{ 40 48	{ 40 43	{ 32 38
Average	42.5	38.5	36.5	39	44	41.5	35
1913-14	{ 61 70	{ 60 64	{ 30 43	{ 36 74	{ 41 60	{ 66 71	{ 43 60
Average	65.5	62	36.5	55	50.5	68.5	51.5
1914-15	{ 28 41	{ 38 49	{ 29 32	{ 32 29	{ 37 38	{ 29 31	{ 28 25
Average	34.5	43.5	30.5	30.5	37.5	30	26.5

The significances for the differences in the means as calculated by the above method are, 2·6, 12·3 and 8·2 respectively. In the first year treatments 1, 5 and 6 stand better than the others. In the second year treatments 1, 2 and 6 are better than 4, 5 and 7 which again are better than the no-manure treatment. In the third year treatment 2 is the only one that stands above the other treatments which may be considered all equal statistically except for the difference between 5 and 7. Hence it may be summed up that treatments 1, 2, 5 and 6 may prove more promising than the others, but treatment 6 economically goes down, and hence it may be said that treatments 1, 2 and 5 are the most promising.

### POONA COLLEGE FARM X.

#### Cotton.

To ascertain the effect of adding to 8 carts F.Y.M. per acre (basic), the following combinations of manures—

Ammophos 30·5 lbs.

+Superphosphate 25 lbs.

+Sulphate of Potash 5·25 lbs.

Manures applied 6 weeks after sowing.

Plots—2½ gunthas each.

Lay-out—Four replications.

Manipulated by Method II.

*Yields in lbs. of seed of cotton per plot.*

1926-27.

Plots.	Treatment.	
	Farm Yard Manure.	F.Y.M. plus combinations.
1 .. .. .	73	74
2 .. .. .	84	97
3 .. .. .	80	76
4 .. .. .	76	55
Average ..	78·25	75·5

The significance for difference in means was obtained to be 13·44 lbs. But as the means differ only by 2·75 lbs. we can say that there is no significant difference between the two treatments.

## POONA COLLEGE FARM XI.

To compare the following combinations of F.Y.M. and Sulphate of Ammonia for cotton.

Crop—Cotton "N. R." rotated with wheat.

Plots—1.32 gunthas.

Lay-out—Four replications randomised.

Treatments per acre—

(1) No-manure.

(2) F.Y.M. (=10 lbs. N).

(3) F.Y.M. (=10 lbs. N) plus Sulphate of Ammonia (=10 lbs. N).

(4) Sulphate of Ammonia (=10 lbs. N).

Manipulated by Method IV.

1929-30.

Treatment.	Cotton yield in lbs. per plot.					Average per plot.
	1	2	3	4	5	
1 .. ..	7	13	13	15	..	12
2 .. ..	8	12	19	17	..	14
3 .. ..	13	20	13	18	..	16
4 .. ..	15	10	19	14	..	14.5
Average ..	10.75	13.75	16	16	..	..

*Analysis of Variance.*

Kind of variance.	Degrees of freedom.	Sum of squares.	Mean square.	1/2 log <sub>10</sub> (mean square).
Treatments .. ..	3	32.75	10.92	..
Blocks .. ..	3	74.25	24.75	..
Random error .. ..	9	114.75	12.75	..

The variance due to treatments is less than that due to error showing thereby that there is no significance in treatments.

For comparing two means the standard error is  $\sqrt{\frac{12.75 \times 2}{4}} = 2.52$ .

This multiplied by 2.262, the 5 per cent. value of t, for n=9, we have 5.7 for significance in means. But no two individual means differ by more than this. Hence there is no significant difference between the means.



## POONA COLLEGE FARM XII (A AND B).

(a) To ascertain the effects of Sulphate of Ammonia when added to Poudrette, Potash Sulphate and Superphosphate.

Crop—Groundnut, "Big Japan" variety.

Plots—5 gunthas each.

Lay-out—Duplicated.

Treatments per acre—

1912-13.

(1) Poudrette 5 carts plus Potash Sulphate 106 lbs. plus Superphosphate 328 lbs.

(2) The above plus Sulphate of Ammonia 152 lbs.

1913-14 and 1914-15.

(1) Poudrette 5 carts plus Potash Sulphate 120 lbs. plus Superphosphate 240 lbs.

(2) The above plus Sulphate of Ammonia 120 lbs.

Manipulated by method I.

Treatment.			Pod yields.		Average.	Per-centage.	Signi-ficance.
			1	2			
(1912-13)							
1	..	..	235	220	227.5	100	} 36.4
2	..	..	237	374	305.5	134	
(1913-14)							
1	..	..	386	333	360	100	} 21.2
2	..	..	350	300	325	90	
(1914-15)							
1	..	..	331	288	310	100	} 12.8
2	..	..	341	325	333	108	

The results are not consistent and the error runs very high and hence no conclusion can be drawn from these experiments.

(b) To ascertain the effects of adding Sulphate of Potash to Poudrette as manure for groundnut.

Treatment per acre—

1912-13.

(1) Poudrette 10 carts.

(2) The above plus 103 lbs. of Sulphate of Potash.

1913-14 and 1914-15.

(1) Poudrette 10 carts.

(2) The above plus 120 lbs. of Sulphate of Potash.

Treatment.	Pod yields.		Average.	Percent- age.	Signi- ficance.		
	1	2					
(1912-13)							
1	..	..	332	313	323	100	} 6.8
2	..	..	303	315	309	96	
(1913-14)							
1	..	..	309	360	335	100	} 20.7
2	..	..	298	346	322	96	
(1914-15)							
1	..	..	304	334	319	100	} 8.82
2	..	..	326	338	332	104	

The same remarks as for Experiment (a) holds good here also though the errors do not run so high.

#### POONA COLLEGE FARM XIII.

To compare the effects of the following combinations of F.Y.M. K, N and Ca for groundnut.

Crop—"Big Japan" groundnut.

Plots—1/12 acre each.

Lay-out—Duplicated.

Method—III.

Treatments per acre—

(1) F.Y.M. 5 carts plus Sulphate of Potash 320 lbs.

(2) F.Y.M. 5 carts.

(3) Nil.

(4) F.Y.M. 5 carts plus Sulphate of Potash 320 lbs. plus Superphosphate 640 lbs. plus Sulphate of Ammonia 128 lbs.

(5) F.Y.M. 10 carts.

(6) F.Y.M. 5 carts plus Sulphate of Potash 320 lbs. plus Superphosphate 640 lbs. plus Sulphate of Ammonia 128 lbs. plus lime 1 000 lbs.

(7) F.Y.M. 5 carts plus Sulphate of Potash 320 lbs. plus Superphosphate 640 lbs.

Year.	Pod yields in lbs. per plot.							Signi- ficance.
	1	2	3	4	5	6	7	
Average ..	69 114 91.5	81 93 87	78 87 82.5	63 75 69	108 117 112.5	126 111 118.5	60 63 61.5	} 4

Year.	Pod yields in lbs. per plot.							Significance.
	1	2	3	4	5	6	7	
1913-14.	128	104	98	159	141	129	84	} 26·5
	189	168	114	164	147	165	117	
Average ..	158·5	136	106	161·5	144	147	100·5	
1914-15.	100	138	88	148	149	136	101	} 27·0
	184	141	141	181	184	165	157	
Average ..	142	139·5	114·5	164·5	166·5	150·5	129	

In the first year the order of treatments in point of yielding capacity is as follows : 6, 5, 1, 2, 3, 4 and 7. In the second year the order of groups of treatments stands : (4, 1), (6, 5, 2) and (3, 7). In the last year the order stands : (4, 5, 6), (1, 2) and (3, 7). From this it may be inferred that the most successful treatments will be 6, 5, 4 and 1. The rest are inferior.

#### POONA COLLEGE FARM XIV.

To ascertain the comparative effects of (1) Nil. (2) Sulphate of ammonia 20 lbs. N., (3) Nitrate of soda 20 lbs. of N., (4) Calcium cyanamide 20 lbs. N., (5) Niciphos 20 lbs. N., (6) Complete fertiliser i.e., 12·9 lbs. N., 13·3 lbs.  $P_2O_5$  and 11·3 lbs.  $K_2O$ . All these per acre applied addition to the basic  $2\frac{1}{2}$  carts of F.Y.M. after germination between row.

Crop—Groundnut "Spanish peanut" early variety.

Plots—1 guntha each.

Lay-out—8 replications—randomised.

Lay-out plan for the groundnut crop for 1930-31.

#### North

12c		13c		14c		15c	
1		7		13		19	
	2		4		5		1
2		8		14		20	
	3		6		4		5
3		9		15		21	
	4		1		1		3
4		10		16		22	
	5		5		2		2
5		11		17		23	
	6		2		3		4
6		12		18		24	
	1		3		6		6

*Lay-out plan for the groundnut crop for 1930-31—contd.*

West

East

12B		13B		14B		15B	
43	6	37	2	31	2	25	5
44	4	38	5	32	1	26	3
45	2	39	6	33	5	27	1
46	3	40	1	34	6	28	4
47	5	41	4	35	4	29	2
48	1	42	3	36	3	30	6

## South

- 1 Nil.
- 2 Sulphate of ammonia.
- 3 Nitrate of soda.
- 4 Calcium cyanamide.
- 5 Nicifos.
- 6 Complete fertiliser.

*Year 1930-31.*

Treatments.	Pods yields in lbs. per plot.								Average.
	1	2	3	4	5	6	7	8	
1 ..	10	13	15	13	11	13	16	15	13·3
2 ..	11	12	16	18	13	15	16	14	14·4
3 ..	11	14	21	24	16	13	23	15	17·1
4 ..	12	14	14	16	12	13	15	11	13·4
5 ..	11	14	15	19	18	13	15	18	15·4
6 ..	11	14	15	17	13	12	13	12	13·4

*Method—IV.*

## Analysis of variance.

Kind of variation.	D	Sum of squares.	Variance.	$\frac{1}{2} \text{Log}_e V.$
Treatment .. ..	5	94.1448	18.8289	1.4659
Blocks .. ..	7	193.1544	27.5935	1.6569
Errors .. ..	35	140.7216	4.0206	0.6949

The plot yields were treated by method IV, and the result of the analysis of variance are given above. The 5 per cent. point of  $z$  for  $n_1 = 5$  and  $n_2 = 30$  is 0.4,648.

Obviously its value for  $n_2 = 35$  will be smaller. But here the value of  $z$  for comparing treatments with errors is 0.7710 which is evidently greater than the 5 per cent. value. Hence the treatments are significantly effective.

The standard error of difference in two means is  $\sqrt{(4.021 \times 2 \div 8)} = 1.0025$ . This multiplied by 2.02 (value of  $t$ ) = 2.025, which is the significant figure.

Judging from this we can say that treatment 3 stands best, followed by 5. The others do not show any significant differences.

## POONA COLLEGE FARM XV.

To compare (1) Poudrette 12 carts plus  $\text{Na NO}_3$  160 lbs. plus Thomas-slag 200 lbs. per acre and (2) the above plus 224 lbs. of sulphate of ammonia.

Plot—5 gunthas each.

Lay-out—Duplicated.

Crop—Chillies (red, dry.)

Treatment.	1914-15				
	Yields in lbs. per plot.		Average.	Percent-age.	Signifi-cance.
	1	2			
1 .. ..	179	173	176	100	} 13.59
2 .. ..	134	157	146	83	

Method I was used and the significance in percentage difference evaluated.

From this it is seen that the addition of sulphate of ammonia diminishes the yielding capacity of the combination of manures, because the difference in percentage is significant.

## POONA COLLEGE FARM XVI.

To ascertain the effects of addition of 20 lbs. of N in various forms, to 20 lbs. N as F.Y.M. (Basic dressing), for chillies :—

Crop—Chillies.

Plots—1 guntha each.

Lay-out—4 replications randomised.

Treatments per acre—

- (1) F.Y.M. (20 lbs. N)
- (2) Do. plus sulphate of ammonia (20 lbs. N)
- (3) Do. plus nitrate of soda (20 lbs. N)
- (4) Do. plus calcium cyanamide ( do. )
- (5) Do. plus leunaphos ( do. )
- (6) Do. plus nitrophoska ( do. )

Manipulated by method IV.

1929-30.

Treatments.			Yields in lbs. per plot.				Average.
1	..	..	37	26	38	33	33.5
2	..	..	31	39	40	39	37.25
3	..	..	33	42	42	32	37.25
4	..	..	36	31	45	33	36.25
5	..	..	35	41	42	31	37.25
6	..	..	40	42	44	46	43.00
Average ..			35.3	36.8	41.8	35.6	

*Analysis of variance.*

Kind of variance.			Degrees of freedom.	Sum of squares.	Mean square.	$\frac{1}{2} \log_e V$ mean square.
Treatments	..	..	5	191.6,664	38.333	1.8210
Blocks	..	..	3	163.35	54.45	1.9964
Random error	..	..	15	285.647	19.0,431	1.4677

Five per cent. value of  $z$  for  $n_1=5$  and  $n_2=15$  is 0.5326. Hence there seems to be no significance due to the treatments.

Standard error of comparison of two means is  $\sqrt{\frac{19.04 \times 2}{4}} = 3.084$ .

This multiplied by  $2.131 = 6.57$  for significance in difference of means.

No two means of treatments differ by more than this except of treatments 1 and 6. Hence 6 is the only treatment that gives a distinctly better yield than the check.

### POONA COLLEGE FARM XVII.

To ascertain the effects of (1) Nil, (2) Sulphate of ammonia 20 lbs. of N, (3) Nitrate of soda 20 lbs. N, (4) Calcium cyanamide 20 lbs. N, (5) Niciphos 20 lbs. N, (6) Complete fertiliser 20 lbs. N. All these per acre applied in addition to the basic dose of F.Y.M. 20 lbs. N.

(N.B.—Complete Fertiliser is 12.9 lbs. N, 13.3 lbs.  $P_2O_5$ , and 11.3 lbs. of  $K_2O$ .)

Crop—Chillies—local, long, red.

Plots—1 guntha, (68' × 16").

Lay-out—7 replications, randomised.

Method—IV.

#### Lay-out Plan for Chillies Crop for the year 1930-31.

North

9A      10A      11A      12A      13A      14A      15A

1	7	13	19	25	31	37	1. Nil.  2. Sulphate of ammonia. 3. Nitrate of soda. 4. Calcium cyanamide. 5. Niciphos. 6. Complete fertiliser.
5	3	6	5	3	6	4	
2	8	14	20	26	32	38	
2	1	4	3	4	2	2	
3	9	15	21	27	33	39	
4	2	5	6	6	3	1	
4	10	16	22	28	34	40	
3	6	2	1	5	5	3	
5	11	17	23	29	35	41	
6	4	1	2	1	4	6	
6	12	18	24	30	36	42	
1	5	3	4	2	1	5	

Year 1930-31.

Pod yields in lbs. per plot.

Treatments.	Blocks.						
	1	2	3	4	5	6	7
1 .. ..	13	14	14	13	16	12	24
2 .. ..	19	21	20	21	18	30	25
3 .. ..	20	25	25	22	38	28	34
4 .. ..	19	18	23	25	32	28	41
5 .. ..	23	19	24	28	23	29	32
6 .. ..	20	20	26	22	26	29	33

*Analysis of variance.*

Kind of variation.	D	Sum of squares.	Mean square or variance.	$\frac{1}{2} \text{Log}_e V.$
Treatments .. ..	5	723.05	144.61	2.4845
Blocks .. ..	6	692.58	115.43	2.3745
Error .. ..	30	448.28	14.94	1.3240
Total ..	41	1,863.91	45.46	....

$$S. D. = \sqrt{14.94}.$$

*Mean yields.*

—	Treatments.					
	1	2	3	4	5	6
Mean yields ..	15.14	22.00	27.43	26.57	25.43	25.13

$$\text{Mean S. E.} = \sqrt{\frac{14.94}{7}} = 1.461.$$

The 5 per cent. point of 'Z' for  $n_1=5$  and  $n_2=30$  is 0.4648. In the present case, it is found to be 1.1605 showing thereby that there is significance due to treatments. The standard error for comparing the means is 2.066 and hence the significance in the difference of treatment means is 4.22. Judging from this figure, we see that the last four



treatments are significantly better than the first treatment. Treatment second though significantly better than first, is not as good as the last four treatments. The last four treatments, among themselves show absolutely no difference.

POONA COLLEGE FARM XVIII. (A, B, C, D AND E.)

To compare the effects of the following manurial treatments :—

Crop—Potato (Rabi-irrigated).

Plots—5 gunthas each.

Lay-out—Duplicated.

Treatments per acre—

1912-13 : (1) Poudrette 10 carts *plus* sulphate of potash 200 lbs.  
A *plus* superphosphate 616 lbs.

(2) The above *plus* sulphate of ammonia 304 lbs.

1912-13 : (1) Poudrette 10 carts.

B (2) The above *plus* sulphate of potash 206 lbs.

1913-14 : (1) Green manuring with Niger.

C (2) Green manuring *plus* sulphate of potash 168 lbs.

1914-15 : (1) Poudrette 10 carts *plus* sulphate of potash 75 lbs.  $K_2O$ ,  
D *plus* superphosphate 20 lbs.  $P_2O_5$ ,

(2) The above *plus* safflower cake 30 lbs. N.

1914-15 : (1) Poudrette 10 carts *plus* superphosphate 20 lbs.  
E  $P_2O_5$ ,

(2) The above *plus* sulphate of potash 75 lbs.  $K_2O$ ,

Manipulated by Method I.

Year.	Treatment.	Yields in lbs. per plot.		Average.	Percentage.	Significance.
		1	2			
1912-13	1	951	1,311	1,131	100	34.0
A	2	1,364	1,606	1,485	131	
1912-13	1	1,378	875	1,126.5	100	40.8
B	2	1,055	935	995.0	88	
1913-14	1	281	224	252.5	100	No.
C	2	289	220	254.5	101	
1914-15	1	994	1,014	1,004	100	3.8
D	2	1,101	1,064	1,082.5	108	
1914-15	1	929	733	831	100	38.4
E	2	846	621	734	88	

Except in cases A and D there is no significant differences between the treatments compared. In A, though the difference is just below the significance, we can say that the difference is not negligible. In case D the difference between treatments is quite significant.

#### POONA COLLEGE FARM XIX.

To compare the effects of the following combinations of manure :—

*Crop*—Onions (Red).

*Plots*—5 gunthas each.

*Lay-out*—Duplicated.

*Treatments per acre*—

1912-13: (1) Poudrette 10 carts *plus* sulphate of ammonia 300 lbs.

(2) Poudrette 10 carts *plus* nitrate of soda 400 lbs.

1914-15: (1) Poudrette 24 carts *plus* sulphate of ammonia (=75 lbs. N).

(2) Nitrate of soda (=75 lbs. N).

1913-14: (1) F.Y.M. 24 carts *plus* sulphate of ammonia 500 lbs.

(2) F.Y.M. 24 carts *plus* nitrate of soda 600 lbs.

Manipulated by Method I.

Year.	Treat- ment.	Yields in lbs. per plot.		Average.	Percen- tage.	Signifi- cance.
		1	2			
1912-13 ..	{ 1	1,132	1,423	1,277·5	100	31·4
	{ 2	1,297	1,612	1,454·5	114	
1914-15 ..	{ 1	4,705	4,805	4,755	103	3·57
	{ 2	4,558	4,693	4,625·5	100	
1913-14 ..	{ 1	1,384	1,844	1,614	100	52·8
	{ 2	1,894	3,041	2,467·5	153	

In the first case there is no significance in difference between treatments. In the second case the difference is just below the significance. There may be a positive effect between the treatments. In the last case there is a definite significance between the two treatments.

#### POONA COLLEGE FARM XX.

To ascertain the comparative effects of addition of (20 lbs. N per acre) in various forms to a basic dressing of 20 lbs. N as F.Y.M. 5 carts.

*Crop*—Onions (Red).

*Plots*—5 gunthas each.

*Lay-out*—4 replications, randomised.

*Treatments per acre*—

(1) F.Y.M. 5 carts.

(2) F.Y.M. 5 carts *plus* sulphate of ammonia (=20 lbs. N).

- (3) F.Y.M. 5 carts *plus* nitrate of soda (=20 lbs. N).  
 (4) F.Y.M. 5 carts *plus* calcium cyanamide (=20 lbs. N).  
 (5) F.Y.M. 5 carts *plus* leunaphos (=20 lbs. N).  
 (6) F.Y.M. 5 carts *plus* nitrophoska (=20 lbs. N).

Manipulated by Method IV.

1929-30.

Treatments.			Yields in lbs. per plot.				Average.
1	..	..	270	324	280	288	290.5
2	..	..	346	318	371	274	327.25
3	..	..	306	245	235	335	280.25
4	..	..	391	323	286	317	329.25
5	..	..	317	323	342	298	320.0
6	..	..	277	274	371	272	298.50

*Analysis of variance.*

Kind of variance.			Degrees of freedom.	Sum of squares.	Variance.	$\frac{1}{2} \log_e V$
Treatments	..	..	5	8,527.37	1,705.47	3.7164
Blocks	..	..	3	1,843.29	614.43	3.2068
Errors	..	..	15	25,832.96	1,722.198	3.7214

The variance due to treatments is less than that due to errors and hence there is no significant effect due to treatments.

Even in comparing individual treatments the significance is 66.398 lbs. and no two treatments differ by so much.

POONA COLLEGE FARM XXI.

*To ascertain the comparative effects of chemical fertilisers for the Onions (irrigated) :—*

*Crop—Onions (irrigated).*

*Plots—15' × 15'. But a ring of 2.5' around was left off resulting in the net plot 10' × 10'.*

*Lay-out—Each treated plot had its check plot by its side. Three replications for each treatment and its check plot.*

*Treatments per acre—The following fertilisers were used at the rate of 10 lbs. N per acre each :—*

- (1) Sulphate of ammonia.
- (2) Nitrate of soda.
- (3) Calcium cyanamide.

- (4) Leunaphos.  
 (5) Ammophos.  
 (6) Nitrophoska.  
 (7) Farm Yard Manure.

*Manuring etc.*—Irrigation was given every tenth day.

The following table shows the arrangement of plots, and gives the yields of plots in lbs. of the bulb onions. The figure in the upper left corner of each plot indicates the treatment used in it, when C indicates check :—

*Yields of onions bulbs in lbs. per plot.*

C 49·0	3 53·5	2 44·1	C 42·0	C 58·8	1 65·6
C 44·4	7 46·9	4 54·8	C 41·5	C 46·4	5 57·8
C 46·8	1 62·5	3 43·6	C 43·4	C 50·5	2 56·1
C 52·5	5 58·0	7 47·3	C 53·3	C 41·5	4 54·8
C 56·7	2 44·5	1 57·3	C 40·4	C 46·4	3 53·5
C 53·0	4 56·9	5 57·8	C 46·4	C 53·3	7 47·3
C 52·1	6 45·1	6 41·0	C 42·8	C 42·8	6 41·0

The average yield in lbs. for each treatment stands as given below :

Treatment.	Yield.
Check.	47·8 (mean of 21 plots).
1	61·8 (mean of 3 plots).
2	48·2 ( do. )
3	50·2 ( do. )
4	55·5 ( do. )
5	57·5 ( do. )
6	42·4 ( do. )
7	47·2 ( do. )

The experiment was considered in three blocks, each block containing two columns. Each block consisted of 7 check plots and 7 treated

plots. The variance due to blocks alone was eliminated and the variance due to treatments was also determined giving due weight to the fact that the check treatment contained seven times the number of plots for each of the other treatments.

*Analysis of variance.*

Kind of variation.			D	Sum of squares.	Mean square or variance.	$\frac{1}{2} \text{Log}_e V$
Treatments	..	..	7	1,001·9630	143·138	2·4819
Blocks	..	..	2	191·2300	95·615	2·2802
Error	..	..	32	609·3699	19·043	1·4736
Total			41	1,802·5629	43·965	

The 5 per cent. point of 'Z' for  $n_1=7$  and  $n_2=32$  is less than 0·4420. While in the present case, it is found to be 1·0083, hence the treatments are seen to have significant effect. The standard error of the difference between the mean of check plots and the mean of any other treatment is equal to  $\sqrt{\frac{19\cdot043}{3} + \frac{19\cdot043}{21}} = 7\cdot2544$ . The significance figure for these comparisons =  $2\cdot7 \times 2 = 5\cdot4$ .

Treatments 1 (sulphate of ammonia), 4 (leunaphos) and 5 (ammophos) are the only treatments that give significantly better yields than the check treatment. Of these three sulphate of ammonia stands first and the others are lower. But the difference between sulphate of ammonia and leunaphos is significant, whereas ammophos comes midway between the two and hence the difference between this and either of the above is not significant.

Nitrate of soda (2), Calcium cyanamide (3), and F.Y.M. (7) are all equally effective with the check. Hence they are not advantageous.

The remaining one treatment, nitrophoska has given a significantly lower yield than the check itself. This is interesting and may be noted.

The standard error of the difference between any two treatment means other than the check is  $\sqrt{\frac{19\cdot043 \times 2}{3}} = 3\cdot56$ . The significance of this difference is 7·12. From this figure it will be seen that treatment 1 (sulphate of ammonia), 4 (leunaphos) and 5 (ammophos) are significantly better than the rest of the treatments, except that there is not a significant difference between leunaphos and calcium cyanamide (3). Treatment 6 nitrophoska is significantly lower than all the treatments.

## POONA COLLEGE FARM XXII (A TO D).

To compare the effects of the various combinations of manures for Turmeric :

Crop—Turmeric (irrigated).

Plots—5 gunthas each.

Lay-out—Duplicated.

Treatments per acre—

1912-13 : (1) Poudrette 15 carts *plus* safflower cake 1,184 lbs.

A

(2) Poudrette 15 carts *plus* safflower cake 592 lbs. *plus* sulphate of ammonia 124 lbs.

1914-15 : (1) Poudrette 15 carts *plus* safflower cake 1,528 lbs.

B

(2) Poudrette 15 carts *plus* safflower cake 764 lbs. *plus* sulphate of ammonia 178 lbs.

1912-13 : (1) Poudrette 30 carts.

C

(2) Poudrette 15 carts *plus* safflower cake 1,800 lbs.

1914-15 : (1) Poudrette 30 carts.

D

(2) Poudrette 15 carts *plus* safflower cake 1,528 lbs.

Manipulated by Method I.

Year.	Treat-ment.	Yields in lbs. per plot.		Average.	Percent- age.	Signifi- cance.
		1	2			
1912-13 A	1	335	241	288	100	} 48
	2	361	259	310	108	
1914-15 B	1	214	205	209.5	100	} 3.96
	2	218	221	219.5	105	
1912-13 C	1	436	298	367	100	} 47
	2	246	179	212.5	58	
1914-15 D	1	229	209	219	100	} 14.9
	2	246	219	232.5	107	

In cases A and D there is no significant difference compared. In B there is a definite significance in the difference and in case C due to

high error the difference has just fallen below the significance and we may take that there is some difference between the treatments showing that safflower cake does not prove to be a good substitute for poudrette 15 carts, in addition to poudrette 15 carts.

POONA COLLEGE FARM XXIII.

To compare the following manurial treatments.

Crop—Cabbage and Khol Khol.

Plots—5 gunthas each.

Lay-out—Triplicated in 1913-14 and duplicated in 1914-15.

Yields of vegetable cabbage in lbs. per plot.

(1913-14.)

Plots.					F.Y.M. 48 carts per acre.	F. Y. M. 24 carts plus nitrate of soda 330 lbs. per acre.	Significance for difference of means.
1	..	..	..	..	66	80	} 21.0
2	..	..	..	..	68	64	
3	..	..	..	..	59	41	
Average ..					64.3	64.6	....

(1914-15.)

Plots.					Poudrette 48 carts per acre.	Poudrette 24 carts plus 660 lbs. of Na NO <sub>3</sub>	Signifi- cance.
1	..	..	..	..	446	628	} 17.9
2	..	..	..	..	427	582	
Average ..					436.5	605	

From the above it is seen that when F.Y.M. is used there is no difference to be seen by substituting 1/2 F.Y.M. by nitrate of soda, whereas if poudrette is used there is a significant positive effect in substituting nitrate of soda for 1/2 of poudrette.

## POONA COLLEGE FARM XXIV.

To compare local manure (groundnut cake), with complete manure and sulphate of ammonia.

Crop—*Suran* (irrigated).

Plots—1 guntha each.

Lay-out—6 replications randomised.

Basic manure—20 carts of F.Y.M. per acre when the land is prepared.

Treatments per acre—

- (1) 88 lbs. of groundnut cake applied in two equal doses, the first being after 2 months from planting and the second three weeks later.
- (2) Complete manure—115 lbs. of N as sulphate of ammonia plus 170 lbs. of  $K_2O$  as sulphate of potash plus 84 lbs. of  $P_2O_5$  as superphosphate (as found in 16 tons of *suran*) of this N is given in two equal doses at times mentioned in (1), and K and P as a single dose along with the first dose of N.
- (3) 115 lbs. of N as sulphate of ammonia, applied in two equal doses at 2 months after planting and three weeks later.

Manipulated by Method IV.

Treatments.	Yields in lbs. per plot.						Average.	Net profits in.
	Rs.							
1 ..	762	744	634	1,085	1,046	777	841·3	25·8
2 ..	762	759	684	1,116	1,084	973	896·3	26·4
3 ..	804	877	607	1,111	1,024	1,021	907·3	28·4

*Analysis of variance.*

Kind of treatment.			Degrees of freedom.	Sum of squares.	Variance.	$\frac{1}{2} \log_e V.$
Treatments	..	..	2	15,004·08	7,502·04	4·4565
Blocks	..	..	5	469,574·49	234,787·25	6·1763
Random error	..	..	10	35,731·55	3,573·16	4·08007

The 5 per cent. point of  $z$  for  $n_1=2$  and  $n_2=10$  is 0·7058 and since the difference between the figures in the last column for treatments and error do not differ by so much there is no significant effect due to treatments.

Now comparing the treatment means individually, the standard error or such a comparison is 33·511 and the significance for the difference between two means is  $33·511 \times 2·228 = 74·66$ . But the means do not



differ by so much. But anyhow the differences between 1 and 2 and 1 and 3 which are 55 lbs. and 66 lbs. cannot be neglected altogether. This indicates that treatments 2 and 3 may prove better than 1, but we cannot press this point from these results alone.

POONA COLLEGE FARM XXV.

To compare the effects of groundnut cake, complete manure and sulphate of ammonia for the ginger (irrigated).

Crop—Ginger (irrigated).

Plots—1 guntha each.

Lay-out—6 replications randomised.

Manuring—20 carts F.Y.M. per acre as basic manure.

Treatments applied 2 months after planting.

Treatments per acre—

- (1) 800 lbs. of groundnut cake.
- (2) Complete manure i.e., 45 lbs. N as sulphate of ammonia *plus* 52 lbs. of  $K_2O$  as sulphate of potash *plus* 22 lbs.  $P_2O_5$  as superphosphate (as found in 10,000 lbs. of green ginger).
- (3) 45 lbs. of N as sulphate of ammonia.

Treatment.		Grain yields in lbs. per plot.						Average.
1	.. ..	225	231	124	260	181	185	201
2	.. ..	235	195	209	173	181	155	191.3
3	.. ..	227	232	127	196	170	133	180.83

Analysis of variance method IV.

Kind of variance.		Degrees of freedom.	Sum of squares.	Variance.	$\frac{1}{2} \log_e V.$
Treatments	.. ..	2	1,220.52	610.26	....
Blocks	.. ..	5	15,944.55	3,188.91	....
Random error	.. ..	10	9,875.62	987.562	....

The variance due to treatments being less than that due to random error it is easily seen that there is no significant effect due to treatments as a whole.

Even in comparing individual treatment means the standard error for comparison =  $\sqrt{\frac{987.56 \times 2}{6}} = 18.143.$

Multiplying this by 2.228 (value of 5 per cent. of  $t$  for  $n_2=10$ ). We get 40.419 for significance between means. But the means in the experiment do not differ by so much and hence we must say that the treatments do not differ significantly.

## POONA COLLEGE FARM XXVI.

To compare the following treatments for linseed.

Crop—Linseed (*Rabi*-dry).

Plots—5 gunthas each.

Lay-out—Duplicated.

Treatments per acre—

(1) F.Y.M. 10 carts *plus* nitrate of soda 133 lbs. *plus* sulphate of potash 64 lbs. *plus* lime 600 lbs.

(2) The above *plus* superphosphate 320 lbs.

Manipulated by Method I.

Treatment.	Plot yield in lbs.		Average.	Percentage.	Significance.
	1	2			
1	38	49	43.5	100	} 40.8
2	31	43	37	85	

There is absolutely no significant difference between the treatments.

## POONA COLLEGE FARM XXVII.

To ascertain the effects of addition of 300 lbs. of superphosphate to be applied in December (once in a year), to 60 cart loads of F.Y.M. which is applied in 3 doses at four months intervals.

Crop—Lucerne.

Plots—5 gunthas each.

Lay-out—4 replications.

Manipulated by Method II.

	1927-28.		1928-2		1929-30.		1930-31.	
	Grain yields in lbs. per plot.							
	Treatment.		Treatment.		Treatment.		Treatment.	
	1	2	1	2	1	2	1	2
1	1,237	1,217	8,616	8,397	6,002	6,639	5,794	6,820
2	1,359	776	8,649	7,844	6,545	6,718	6,494	6,440
3	983	1,226	8,622	7,567	6,444	6,919	5,490	5,417
4	920	915	7,534	8,861	6,967	7,826	5,499	5,928
Average	1,125	1,033.5	8,355	8,167	6,490	7,026	5,819	6,151
Significance for each year.	332.7		1,018.4		285.5		788.8	

Except in 1929-30, where the difference between the treatment means is nearly double the significance figure, in all the years the means differ

by an amount less than the significance. It is possible that the addition of superphosphate is not effective.

FORTNIGHTLY RAINFALL RECORD OF THE AGRICULTURAL COLLEGE FARM, POONA.

Month.	January.		February.		March.		April.		May.		June.		
[Fortnight	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	
Years.													
1910	..	..	..	..	..	..	..	..	..	..	0·92	7·07	
1911	..	..	..	..	..	..	..	..	0·37	0·02	3·66	0·34	
1912	..	..	..	..	..	..	..	..	0·32	0·11	1·05	0·62	
1913	..	..	..	..	..	..	0·02	0·55	..	1·50	5·47	8·21	
1914	..	..	..	..	..	..	..	..	0·02	..	2·17	4·12	
1915	..	..	..	..	0·02	..	0·14	0·73	..	..	..	13·94	
1916	..	..	..	..	..	..	0·11	..	..	2·85	1·50	0·62	
1917	..	..	..	1·18	..	..	0·04	..	0·12	..	0·12	2·90	2·19
1918	..	0·15	..	..	..	0·12	..	..	..	1·00	3·10	0·13	0·18
1919	..	..	..	..	..	..	0·32	..	..	0·97	2·92	1·60	0·30
1920	..	0·28	0·03	..	..	..	..	..	0·97	0·08	..	4·07	0·59
1921	..	0·25	0·02	..	..	..	..	1·13	..	..	..	0·91	0·35
1922	..	..	..	..	0·38	..	..	..	2·58	..	1·06	1·32	5·70
1923	..	..	..	..	0·01	1·38	0·16	0·35	..	..	0·66	0·34	0·00
1924	..	0·01	..	..	..	..	..	1·17	..	..	..	1·01	1·32
1925	..	..	..	..	..	0·06	0·39	..	..	0·09	0·23	1·43	1·37
1926	..	0·44	0·67	..	..	..	..	..	..	0·83	0·40	1·84	1·32
1927	..	..	..	..	..	0·06	..	..	0·23	..	2·33	2·54	3·68
1928	..	..	..	0·37	..	..	..	..	0·82	..	..	1·64	2·11
1929	..	..	..	0·02	..	..	0·09	0·97	1·13	..	..	0·45	4·06
1930	..	..	..	..	..	..	..	0·45	..	..	1·10	1·26	3·03
1931	..	..	..	..	..	..	..	..	..	..	..	0·04	1·58

Month.	July.		August.		September.		October.		November.		December.		Total.
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	
Fortnight													
Year.													
1910	1.77	1.41	5.57	3.22	1.42	4.22	3.37	1.67	1.61	..	..	..	32.25
1911	1.25	0.16	3.80	1.36	0.24	..	..	0.52	..	1.99	..	..	13.71
1912	0.30	9.36	1.45	0.45	0.11	0.56	5.20	1.58	0.19	1.98	..	..	23.28
1913	1.88	2.53	1.53	0.78	0.63	1.90	2.20	..	..	..	..	..	27.20
1914	2.46	9.01	5.88	1.15	2.27	2.76	0.34	..	0.50	..	0.05	..	30.73
1915	2.12	7.94	1.59	0.13	2.47	4.47	0.84	..	0.34	..	..	..	34.73
1916	0.94	3.22	2.82	0.99	5.37	1.90	0.35	3.57	1.06	0.27	..	..	25.57
1917	0.61	1.33	1.29	1.95	0.84	7.53	4.48	2.47	..	4.92	..	..	31.97
1918	0.96	0.06	0.73	1.57	0.74	2.27	1.74	..	0.52	0.59	0.12	..	14.58
1919	3.04	2.65	1.01	3.14	0.40	12.02	0.40	0.75	1.52	1.36	0.10	..	32.50
1920	3.36	1.69	1.86	0.36	0.25	6.94	0.06	2.42	..	..	..	..	22.96
1921	1.62	7.52	1.27	0.57	0.24	0.63	1.27	0.20	0.08	..	..	..	16.15
1922	1.88	4.22	0.63	1.10	0.32	0.19	2.28	0.17	4.99	..	..	..	24.92
1923	1.08	5.22	1.60	0.36	0.95	3.27	0.15	0.08	..	..	..	..	15.56
1924	0.69	1.61	0.72	3.06	0.06	6.02	0.14	0.11	..	0.23	..	..	21.13
1925	1.48	1.58	0.99	0.97	0.06	3.60	0.84	0.07	0.24	0.70	..	..	14.11
1926	6.73	3.47	3.68	3.63	1.89	5.29	0.03	0.32	0.14	..	..	..	30.18
1927	1.93	3.58	0.49	0.68	0.46	5.24	0.40	0.92	3.02	..	..	..	25.57
1928	1.96	4.01	0.88	4.28	0.45	5.17	0.22	1.26	..	..	..	..	23.17
1929	3.45	0.77	0.48	0.67	0.29	5.61	2.36	..	0.27	..	0.03	0.03	20.68
1930	3.85	1.76	0.46	0.55	3.30	0.63	3.58	1.84	1.60	..	0.14	..	30.05
1931	2.69	2.69	1.80	1.65	0.18	7.49	2.56	0.09	2.85	..	0.27	..	23.89

### RATNAGIRI FARM I.

To ascertain the effects of the following manures equal to 20 lbs. of N per acre on Rice Crop.

Land—Low-lying "Mala".

Plots—2 gunthas each.

Lay-out—Duplicated.

Rice—Vaksal variety, transplanted.

Treatments—

- (1) No manure.
- (2) Urine earth.
- (3) Cattle folding.
- (4) Rice husk.
- (5) Nightsoil.

## Year 1915: Method I.

Treatment.			Yields in lbs.		Average Grain.	Percentage.	Error Significance.
			Grain.	Grain.			
1	..	..	128	128	128	100	} 8.4
2	..	..	160	144	152	119	
3	..	..	177	160	168.5	132	
4	..	..	168	160	164	128	
5	..	..	156	160	158	123	
<i>Year 1916.</i>							
1	..	..	54	67	60.5	100	} 23.4
2	..	..	65	76	70.5	117	
3	..	..	82	88	85	140	
4	..	..	84	72	88	145	
5	..	..	58	77	67.5	112	
<i>Year 1917.</i>							
1	..	..	52	72	62	100	} 34.2
2	..	..	92	76	84	152	
3	..	..	80	56	68	110	
4	..	..	64	76	70	113	
5	..	..	64	56	60	97	

## Year 1918 and 1919.

Treatment.			Yields in lbs.		Average grain.	Percentage.	Error significance.
			Grain 1918.	Grain 1919.			
1	..	..	122	120	121	100	..
2	..	..	117	143	130	107	..
3	..	..	107	140	123.5	102	..
4	..	..	137	107	122	101	..
5	..	..	130	171	150.5	124	..

From the result of the first two years it is possible to say that treatments 3 and 4 stand out, but the conclusion is subject to further amendment, because of the discrepancies occurring in later years.

### RATNAGIRI FARM II.

*To test the comparative effects of Night soil and Poudrette manures on Rice Crop.*

*Land*—Low-lying “*Malá*”

*Plots*—2 gunthas each.

*Lay-out*—Duplicated.

*Rice*—*Vaksal* variety, transplanted.

*Treatments*—

- (1) No manure.
- (2) Night soil (=20 lbs. N per acre).
- (3) Poudrette (=20 lbs. N per acre).

Treatment.	Yields in lbs.		Average Grain.	Percent-age.	Error Signifi-cance.
	Grain.	Grain.			
<i>Year 1919.</i>					
1 .. ..	158	168	163	100	} 12·3
2 .. ..	165	143	154	94	
3 .. ..	155	164	160	98	
<i>Year 1920.</i>					
1 .. ..	122	136	129	100	} 11·1
2 .. ..	130	146	138	107	
3 .. ..	119	119	119	92	

The results were treated by method I and for each year separate error significances found. But we see that no conclusion can be drawn from the above, because the variations between treatments are always below the figure for significance.

## RATNAGIRI FARM III.

To test the effect of *Rui* leaves as green manure for Rice Crop.

Land—Low-lying “*Malá*”.

Plots—2 gunthas each.

Lay-out—Duplicated.

Rice—*Vaksal* variety, transplanted.

Treatments—

(1) No manure.

(2) *Rui* leaves 8,000 lbs. per acre.

Treatment.	Yields in lbs.		Average Grain.	Percentage.	Error Significance.	Net Profit per plot.
	Grain.	Grain.				
<i>Year 1917.</i>						
1 .. ..	52	56	54	100	} 9	} -0·01
2 .. ..	76	80	78	144		
<i>Year 1918.</i>						
1 .. ..	61	72	66·5	100	} 24·6	} 1·95
2 .. ..	90	108	99	149		
<i>Year 1919.</i>						
1 .. ..	128	135	131·5	100	} 16·7	} 3·41
2 .. ..	170	207	188·5	143		

These figures were worked out by method I.

Irrespective of the high errors in 1918 and 1919 the treated plots give always more than 40 per cent. above the non-treated plot. The net profits also show that the treatment gives much benefit financially also. Hence the treatment has some positive effect.

## RATNAGIRI FARM IV.

To ascertain the comparative effect of Bone-meal and Groundnut cake as manures for Rice Crop.

Land—Low-lying “*Malá*”.

Plots—2 gunthas each.

Lay-out—Duplicated.

Rice—*Vaksal* variety, transplanted.

*Treatments—*

- (1) No manure.  
 (2) Bone-meal = 20 lbs. N per acre.  
 (3) Groundnut cake = 20 lbs. N per acre.

Years.		Treatments.		
		Grain yields in lbs.		
		1	2	3
1916	.. ..	54	96	67
		67	100	80
1917	.. ..	52	92	96
		72	80	76
Average ..		61	92	80

Treating by method III and considering four replications for each treatment we have the standard error equal to 13·91 and the error for the difference between means equal to  $\frac{13 \cdot 916}{\sqrt{4}} = 6 \cdot 958$ .

The difference between the means of the treatments 1 and 2, and 1 and 3 are decidedly significant. But we will not be far from right if we say that comparatively the bone-meal treatment may prove better than the other treatment.

The average net profits in rupees per plot are as follows :—

Treatment.	Net profit. Rs.
1 .. ..	0·58
2 .. ..	0·21
3 .. ..	0·60

This shows that the bone-meal treatment is economically bad due to the cost of bone-meal. We have more or less equal net profits for no-manure and groundnut cake treatments.

#### RATNAGIRI FARM V.

*To compare the effects of Sulphate of ammonia, Fish manure and Undi-cake as manure for Rice Crop.*

*Land—Low-lying "Malá".*

*Plots—2 gunthas each.*

*Lay-out—Duplicated.*

*Rice—Vaksal variety, transplanted.*



*Treatments—*

- (1) No treatment.
- (2) Sulphate of Ammonia (= 20 lbs. of N per acre.)
- (3) Fish manure (= 20 lbs. of N per acre.)
- (4) *Undi* cake (= 20 lbs. of N per acre).

Years.		Treatments.			
		Grain yields in lbs.			
		1	2	3	4
1916	.. ..	{ 73	77	115	69
		{ 65	111	96	92
1917	.. ..	{ 60	120	108	112
		{ 76	60	76	68
Average ..		69	92	99	85

Treating by method III with four replications we get the standard error of difference between two means is equal to 11.08. Hence a difference of 23.27 and above between means is significant.

Judging from the above standard we see that treatments 2 and 3 are significant while 4 though not significant is slightly better than the no-manure treatment. But the results obtained are not quite satisfactory because we obtain a high error and hence nothing can be confirmed on the point without further investigations.

The average net profits in rupees per plot are as follows :—

Treatments.	Net profit.
	Rs.
1 .. ..	0.80
2 .. ..	0.86
3 .. ..	1.41
4 .. ..	1.08

Which shows the advantage in treatment 3.

## RATNAGIRI FARM VI.

*Continuation of V and VI combined for the years 1920 and 1921 on single plot, with Bone-meal treatment excluded.*

*Treatments—*

- (1) No manure.
- (2) Groundnut cake (=20 lbs. of N per acre).
- (3) Fish manure (=20 lbs. of N per acre).
- (4) Sulphate of Ammonia (=20 lbs. of N per acre).
- (5) *Undi* cake (=20 lbs. of N per acre).

*Lay-out—Unreplicated.*

Years.	Grain yield in lbs.				
	Treatments.				
	1	2	3	4	5
1920 .. ..	113	151	173	137	148
1921 .. ..	130	155	152	139	140
Average ..	122	153	163	138	144
Net profit in Rs. per plot ..	3.53	3.75	5.66	3.74	4.45

Examining the above figures in view of our remarks in Experiments IV and V, it may be suggested that the Fish manure treatment may prove to be the best, both in its yielding capacity and financial benefit. Hence further experiments may be conducted to confirm this experience beyond doubt.

## RATNAGIRI FARM VII.

*To test the effect of various oil cakes as manures for Rice Crop.*

*Land—Low-lying "Malá".*

*Plots—2 gunthas each on average.*

*Rice—Vaksal, transplanted.*

*Lay-out—Duplicated.*

*Treatments—*

- (1) No manure.
- (2) Castor cake (=20 lbs. of N per acre).
- (3) *Undi* cake (=20 lbs. of N per acre).
- (4) Groundnut cake (=20 lbs. of N per acre).

Year 1913.

Treatment.						Grain yield in lbs.	Percentage.
1	..	..	..	..	..	48	100
2	..	..	..	..	..	77	160
3	..	..	..	..	..	53	110
4	..	..	..	..	..	....	....

Treatment.	Yields in lbs.		Average.	Percent- age.	Error Signifi- cance.			
	Grain.	Grain.						
<i>Year 1914.</i>								
1	..	..	..	76	80	78	100	} 21
2	..	..	..	100	80	90	115	
3	..	..	..	84	112	98	126	
4	..	..	..	100	104	102	131	
<i>Year 1915.</i>								
1	..	..	..	128	128	128	100	} 21
2	..	..	..	..	..	..	..	
3	..	..	..	184	168	176	138	
4	..	..	..	184	128	156	122	

Method I was used and we are unable to see anything.

Treatment.	Net profits per plot.				
					Rs.
1	..	..	..	..	1.52
2	..	..	..	..	0.09
3	..	..	..	..	2.24
4	..	..	..	..	1.98

The treatments 3 and 4 give more net profits than treatment 1.

## RATNAGIRI FARM VIII.

To test the effect of bone manure and fish manure on Rice.

Land—Low-lying "Malá".

Plots—2 gunthas each.

Lay-out—Duplicated.

Rice—Vaksal, transplanted.

Treatments—

(1) No manure.

(2) Fish manure equal to 20 lbs. N per acre.

(3) Bone-meal equal to 20 lbs. N per acre.

Treatment.	Yields in lbs. per plot.		Average.	Percentage.	Error Significance.
	Grain.	Grain.			
<i>Year 1913.</i>					
1 .. .. .	48	..	..	100	..
2 .. .. .	80	..	..	167	..
3 .. .. .	104	..	..	202	..
<i>Year 1914.</i>					
1 .. .. .	88	96	92	100	} 9.4
2 .. .. .	102	104	103	112	
3 .. .. .	124	136	130	141	
<i>Year 1915.</i>					
1 .. .. .	128	128	128	100	} 15.5
2 .. .. .	180	144	162	127	
3 .. .. .	160	144	152	119	

Treated by method I.

The results are consistent. In two years the treatment 3 stands high whereas in the other year the treatments 2 and 3 stand equal. Comparing net profits which are as follows:—

Treatment.	Net profit per plot.
	Rs.
1 .. .. .	1.69
2 .. .. .	1.99
3 .. .. .	1.35

We see that treatment 2 is the most profitable.

## RATNAGIRI FARM IX.

To ascertain the effect of Bone-meal (10 lbs. N per acre) on Rice Crop.

Land—Low-lying "Malá".

Plots—2 gunthas each.

Lay-out—Duplicated.

Rice—Vaksal variety, transplanted.

Treatments—

(1) No manure.

(2) Bone-meal (10 lbs. of N per acre).

Year 1918.

Treatments.	Yields in lbs. per plot.		Average.	Percent- age.	Error Signifi- cance.
	Grain.	Grain.			
1 .. ..	47	65	56	100	29
2 .. ..	94	86	90	161	..

Treatments.	Years.			Average.
	1919	1920	1921	
	Yields in lbs.			
	Grain.	Grain.	Grain.	
1 .. ..	136	113	130	126
2 .. ..	152	96	166	138

Treated by method I.

In the above data judging from the results of 1918 alone we can safely assert that the treatment with Bone-meal is significant to a great extent. This is also confirmed by comparing the net profit per plot which is Re. 1.34 for the non-treated plot and Re. 1.54 for the treated plot.

The difference between the treated and non-treated plot is not so conspicuous for the next three years when the experiment was conducted on single plot, but yet, as the net profits are Rs. 3.6 and 4.06 per plot, respectively, we can favour the Bone-meal treatment to the no-manure treatment.

## RATNAGIRI FARM X.

To ascertain the effects of  $P_2O_5$  as manure for Rice Crop.

Land—Low-lying "Malá".

Plots—2 gunthas each.

Lay-out—Duplicated.

Rice—Vaksal variety, transplanted.

Treatments :—

(1) No-manure.

(2) 112 lbs. of  $P_2O_5$  (Rock-phosphate) per acre.

Treatments.	Yields in lbs.		Average.	Percent- age.	Error Signifi- cance.
	Grain.	Grain.			
<i>Year 1919.</i>					
1 .. ..	128	136	132	100	} 22.2
2 .. ..	132	170	151	114	
<i>Year 1920.</i>					
1 .. ..	90	101	95.5	100	} 42.6
2 .. ..	62	102	82.0	89	
<i>Year 1921.</i>					
1 .. ..	105	120	112.5	100	} 2.02
2 .. ..	123	150	136.5	121	

Year.		Treatments.	Net profits per plot.
			Rs.
1919	.. ..	1	3.44
	.. ..	2	3.08
1920	.. ..	1	3.12
	.. ..	2	1.88
1921	.. ..	1	2.02
	.. ..	2	2.85

It is clearly seen that the treatment by phosphate has given no good result. In one year it gives a yield below the non-treated plot. In the other two years the differences are not significant.

Financially also, the treatment does not fare well. Hence nothing can be said in favour of the treatment so far as the above results are concerned.

## RATNAGIRI FARM XI.

To compare the relative effects of various manures on Rice Crop with a basic manure—F. Y. M. 10 carts.

Land—Upland "Kuryat".

Plots—2 gunthas each.

Lay-out—Duplicated.

Rice—"Patni" variety; broadcasted.

Treatments :—

- (1) 10 carts of F. Y. M. per acre.  
 (2) Do. plus Undi cake = (20 lbs. of N. per acre).  
 (3) Do. plus Fish manure ( do. )  
 (4) Do. plus Bone-meal ( do. )  
 (5) Do. plus Castor cake ( do. )  
 (6) Do. plus Sulphate of Ammonia. ( do. )

Treatments.	Yield in lbs.		Average.	Percent- age.	Error Signific- ance.
	Grain.	Grain.			
<b>Year 1913.</b>					
1	62	80	71	100	} 31·8
2	72	85	78·5	111	
3	64	75	69·5	98	
4	91	65	78	110	
5	53	88	70·5	99	
6	..	..	..	..	
<b>Year 1916.</b>					
1	39	41	40	100	} 10·5
2	81	84	82·5	206	
3	69	65	67	168	
4	73	65	69	173	
5	..	..	..	..	
6	77	69	73	183	
<b>Year 1917.</b>					
1	49	53	51	100	} 16·0
2	104	93	98·5	193	
3	88	81	84·5	166	
4	74	78	76	149	
5	..	..	..	..	
6	100	79	89·5	175	

These were treated by Method I :—

Treatments.	Average net profits per plot. Rs.
1	0·54
2	1·87
3	1·04
4	— 0·61
5	0·18
6	1·14

The above figures show distinctly that both statistically and economically the treatment No. 2 stands out best for all the years, though the difference between this treatment and the check treatment is not significant in 1913, due to the abnormal error. The next comes treatment No. 6 which gives a high yield and also a net profit which is next to the treatment 2. Though the results of the two years 1916 and 1917 show the treatments 3 and 4 are more or less equal, the high cost of bone-meal in 4 makes it quite uneconomical as seen from the net profit of  $-0.61$  in using it, and hence the third best treatment is treatment No. 3 (Fish manure). Treatment No. 5 has been tried only for one year and even there the net profit is considerably low and hence it may be left out of account.

*N.B.*—The above experiments have been conducted in the year 1914 and 1915 also, but as they are not satisfactory their figures have been neglected.

*Fortnightly Rainfall recorded at Ratnagiri Station from 1913 to 1931.*

Year.	Month.											
	January.		February.		March.		April.		May.		June.	
	Fortnight.											
	1st.	2nd.	1st.	2nd.	1st.	2nd.	1st.	2nd.	1st.	2nd.	1st.	2nd.
1913	..	..	..	..	..	..	..	..	..	1.04	16.17	8.32
1914	..	..	..	..	..	..	..	..	0.06	..	5.46	27.68
1915	..	..	..	..	0.17	..	0.03	0.09	..	0.18	..	30.20
1916	..	..	..	..	..	..	..	..	..	5.89	28.58	14.71
1917	..	..	1.16	..	..	..	..	..	..	..	17.22	18.24
1918	..	..	..	..	..	..	..	..	0.04	10.91	5.01	11.54
1919	..	0.36	..	..	..	..	..	..	..	0.06	22.52	9.42
1920	0.01	..	..	..	..	..	..	..	..	..	8.80	5.04
1921	..	..	..	..	..	..	..	..	..	..	17.27	14.67
1922	..	..	..	..	..	..	..	..	..	1.26	10.01	26.63
1923	..	..	..	..	..	..	..	..	..	..	2.92	11.45
1924	..	..	..	..	..	..	..	..	..	..	11.37	17.91
1925	..	..	..	..	..	..	..	..	..	1.31	10.40	18.84
1926	0.66	..	..	..	..	..	..	..	..	..	11.34	9.64
1927	..	..	..	..	..	..	..	..	..	..	9.65	18.67
1928	..	..	..	..	..	..	..	..	..	..	19.78	11.38
1929	..	..	..	..	..	..	..	0.35	..	..	20.54	19.02
1930	..	..	..	..	..	..	..	0.03	1.00	..	6.24	36.95
1931	..	..	..	..	..	..	0.11	..	0.18	..	5.92	14.86



Year.	Month.												Total.
	July.		August.		September.		October.		November.		December.		
	Fortnight.												
	1st.	2nd.	1st.	2nd.	1st.	2nd.	1st.	2nd.	1st.	2nd.	1st.	2nd.	
1913	19.11	12.01	3.03	4.73	3.13	0.82	3.80	..	..	..	..	..	72.16
1914	15.82	24.73	17.23	12.70	14.46	5.66	0.98	..	0.02	..	0.65	..	125.45
1915	10.28	23.90	5.08	5.23	20.49	3.67	4.56	0.09	0.71	..	..	..	104.68
1916	16.66	13.88	22.53	5.53	18.66	9.62	0.37	8.61	7.92	1.27	..	..	154.14
1917	4.27	19.53	11.40	20.87	13.95	4.62	5.40	4.31	0.05	0.14	..	..	121.16
1918	10.76	3.49	8.48	7.79	2.51	0.43	..	..	1.80	1.28	..	..	64.04
1919	16.32	20.64	6.33	6.08	7.64	2.63	4.59	1.64	0.10	0.45	..	..	98.78
1920	15.46	6.14	7.54	5.23	2.50	0.98	1.71	0.01	..	..	..	..	53.42
1921	12.14	13.40	11.26	9.09	5.40	8.51	4.04	..	0.30	..	..	..	102.08
1922	24.30	22.03	1.80	8.59	2.27	2.92	0.75	0.08	1.98	..	..	..	102.62
1923	43.23	16.56	7.04	1.85	5.86	6.30	..	..	..	..	..	..	95.21
1924	32.94	4.37	2.94	11.71	2.65	5.51	2.12	..	..	..	..	..	93.52
1925	6.42	7.82	15.04	6.13	4.26	..	1.87	..	1.15	..	..	..	73.24
1926	16.39	17.45	35.88	13.75	7.21	5.69	1.37	..	..	..	..	..	119.37
1927	11.29	11.51	4.94	6.31	0.46	13.96	7.78	0.01	2.05	..	..	..	91.83
1928	18.75	22.70	3.77	23.69	1.31	6.11	2.66	3.56	0.38	..	..	..	114.09
1929	18.44	5.24	8.51	6.18	2.26	7.30	4.14	..	0.71	..	..	0.96	94.25
1930	4.74	8.53	12.76	4.76	14.30	1.82	6.86	2.98	..	..	..	..	100.97
1931	40.56	41.07	15.43	9.04	2.36	6.64	13.62	0.22	1.70	..	2.75	0.02	154.46

## RATNAGIRI FARM.

Prices of rice and straw in lbs. per Rupee.

Year.	Patni.	Paddy.	Vaksal.	Straw.
1913	..	..	..	160
1914	..	..	..	200
1915	..	..	..	200
1916	..	..	23.1	200
1917	..	..	26.9	200
1918	..	..	12.8	200
1919	..	..	21.3	200
1920	..	..	15.0	200
1921	..	..	20.6	200

*Cost of Cultivation—Rupees per acre.*

Year.						Uplands "Kuryal".	Lowlands "Mala".
1913	..	..	..	..	..	29·00	44·33
1914	..	..	..	..	..	25·20	40·20
1915	..	..	..	..	..	28·56	45·31
1916	..	..	..	..	..	33·43	46·37
1917	..	..	..	..	..	40·10	51·00
1918	..	..	..	..	..	43·14	57·81
1919	..	..	..	..	..	60·93	76·06
1920	..	..	..	..	..	56·20	68·58
1921	..	..	..	..	..	52·30	67·87

This does not include any overhead charges, and are for no-manure plots.

**RATNAGIRI FARM.**

• *Prevalent prices of various manures in lbs. per rupee.*

Year.	Sulphate of Am- monia.	Bone- meal.	Fish manu- re.	Ground- nut cake.	Undi- cake.	Dens- tured salt.	Rock- phos- phate.	Lime.	Cow- dung.	Night- soil.	Arti- leaves.
1913	6·7	18·5	25·0	22·0	112·0	182·0	20·6				
1914	6·7	18·5	25·0	18·5	84·0	125·0	..	..	..	..	..
1915	7·0	11·0	13·0	20·0	112·0	128·0	..	..	..	..	..
1916	5·5	15·0	29·0	26·4	80·0	128·0	..	280	1,025	..	..
1917	6·0	17·0	32·0	22·4	98·0	123·0	..	250	960	..	520
1918	3·0	13·0	28·0	..	66·0	128·0	20·6	280	..	..	395
1919	3·0	11·2	28·0	..	70·0	128·0	20·6	280	1,383	..	395
1920	8·0	12·0	30·0	11·0	70·0	..	15·0	..	..	4,000	..
1921	8·0	12·0	30·0	14·0	65·0	..	15·0	..	..	4,000	..

The cost of manuring per acre with Urine earth is Rs. 5·69 (approx.).

Cattle folding .. 4·81 ..

Elce bush .. 1·56

## SURAT FARM I.

*Crop—Cotton-Jowar Rotation.*

To ascertain the comparative effects of the following bulky manures applied at the rate of 5 tons per acre every 2nd year to cotton alone—

- (1) Rotted cactus,
- (2) *Mohua* refuse,
- (3) Poudrette,
- (4) Tank-mud,
- (5) F.Y.M.,
- (6) Town sweepings, and
- (7) No-manure.

Plots—4 gunthas each exclusive of ring

Lay-out—Duplicated.

*N.B.*—The results of 1911-12 were omitted throughout because it was a very bad year. In 1913-14 and 1914-15 there was no manure applied to plots of treatment 4, hence in judging the effects of this treatment the results of the above two years were left out of consideration though the yields are given in the table.

	Jowar.						Grain yields in lbs. per plot.									
	1909-10		Aver- age.	1910-11		Aver- age.	1912-13		Aver- age.	1913-14		Aver- age.	1914-15		Aver- age.	
	I	II		I	II		I	II		I	II		I	II		
1	66	47	57	80	72	76	33	40	37	69	51	60	72	54	63	
2	57	59	58	82	105	94	50	50	50	102	95	99	87	83	85	
3	59	80	70	103	108	106	79	80	80	108	138	123	116	112	114	
4	47	61	54	66	54	60	36	32	34	50	62	56	54	50	52	
5	59	56	58	83	71	77	46	40	43	75	87	81	77	69	73	
6	72	56	64	72	75	74	44	49	47	48	73	61	80	62	71	
7	65	55	60	62	57	60	26	35	31	49	48	49	52	43	48	
Signi- ficance.	15.9			13.1			5.9			18.2			6.6			

The figures were treated by Method III.

So far as this crop is concerned we see that treatment 3 has invariably given the best yield, which is quite significantly better than any other treatment in all cases except in the first two years, even where the difference between this and the next best treatment, i.e. 2, is just below the significance. Treatment 2 stands next in all the years throughout. Treatments 5 and 6 come together as next though 5 gives a slightly better yield in some cases. Treatment 1 comes next closely. Treatment 4 is very poor, mostly equal to the no-manure treatment.

## Cotton—Seed-cotton yields per plot in lbs.

	1908-09			1909-10			1910-11		
	I	II	Average.	I	II	Average.	I	II	Average.
1 ..	40	27	34	37	36	37	31	34	33
2 ..	35	30	33	39	38	39	35	38	37
3 ..	34	35	35	43	40	42	41	53	47
4 ..	36	34	35	39	34	37	32	31	32
5 ..	35	35	35	37	47	42	36	43	40
6 ..	33	36	35	38	38	38	33	30	32
7 ..	36	32	34	39	47	43	32	29	31
Significance ..	5.6			5.9			6.0		

	1912-13			1913-14			1914-15		
	I	II	Average.	I	II	Average.	I	II	Average.
1 ..	62	53	58	..	38	38	44	41	43
2 ..	77	74	76	39	42	81	55	60	58
3 ..	88	101	95	42	58	50	54	72	63
4 ..	55	46	51	34	30	32	38	32	35
5 ..	67	62	65	39	39	39	47	52	50
6 ..	60	60	60	39	37	38	49	47	48
7 ..	48	43	46	35	35	35	37	35	36
Significance ..	8.0			7.0			8.6		

The figures were treated by Method III.

For this crop, 1908-09 shows absolutely no difference in treatments. In other years, treatment 3 stands best significantly better than all the treatments except 2 in the years 1909-10 and 1914-15. Treatments 2, 5 and 6 seem to stand together on the whole as the next best ones, though there is a significant difference between them showing that 2 may be slightly better than the others in certain cases. The other two treatments 1 and 4 are equal to the no-manure treatment and hence not effective. The variations in the effects of the treatments are not so pronounced in the case of cotton as in the case of *jowar*.

The average plot yields for all the years for the crops are as—

Treatments.	1	2	3	4	5	6	7	Average Significance.
Jowar	58	77	98	49	66	63	49	12
Cotton	40	47	55	38	45	42	37	7

Summing up for the whole rotation pourette gives undoubtedly the best yields followed by *mohua* refuse as the next best. F.Y.M. and town sweepings show equal effects, coming next to the above. Rotted cactus and tank-mud show very little effect over the no-manure plots.

## SURAT FARM II.

### Crop—Cotton-Jowar Rotation.

To ascertain the effects of increasing doses of F. Y. M., the manure being given in alternate years to cotton alone.

Plots—Acre yields in lbs. are given.

Lay-out—Unreplicated.

Dose of F.Y.M. per acre in tons.	Cotton.				Jowar.			
	Seed-cotton in lbs. per acre.				Grain yields in lbs. per acre.			
	1919.	1920.	1921.	Average.	1919.	1920.	1921.	Average
N $\bar{u}$	348	456	354	386	612	696	1,252	853
5 tons	428	520	408	452	1,008	548	1,232	929
7.5 tons	424	532	404	453	1,264	496	1,184	981
10 tons	392	456	376	408	1,096	720	1,200	1,005
12.5 tons	852	472	364	396	956	760	1,220	979
15 tons	276	408	328	337	812	776	1,080	889
17.5 tons	332	492	256	360	876	676	1,252	936
20 tons	316	472	300	383	764	688	1,176	876
22.5 tons	356	636	408	467	644	584	1,232	820
25 tons	356	624	432	471	620	704	1,296	873

It is seen that increasing the dose of F.Y.M. over 10 tons per acre is not attended with corresponding increase in yields. The yields begin to decrease for higher quantities of F.Y.M. in both the crops. There must be some special reasons for the high yields of cotton for 22.5 and 25 tons

treatments. Perhaps the high yields in 1920-21 for these treatments are responsible for the high average; and have to be explained.

### SURAT FARM III.

#### Crop—Cotton-Jowar Rotation.

To ascertain the comparative effects of—

- (1) 10 tons F.Y.M. in trenches,
- (2) 7.5 tons F.Y.M. in trenches *plus* 2.5 tons on ridges, before sowing,
- (3) 7.5 tons F.Y.M. in trenches *plus* 2.5 tons on ridges at sowing,
- (4) no manure. All per acre.

Plots—4 gunthas each, ridges 5 feet apart and 14 inches high.

Lay-out—Duplicated.

N.B.—Two sets of plots are taken and in each set the crops are rotated, beginning with *jowar* in one and with cotton in the other. The manure is given to *jowar* alone in the former set of plots and to cotton alone in the latter.

#### Set "A" (Manure to jowar).

	Jowar—Grain yields in lbs. per plot.											
	1922-23			1924-25			1926-27			1928-29		
	i	ii	Average.	i	ii	Average.	i	ii	Average.	i	ii	Average.
1	98	105	102	134	136	135	106	120	113	182	165	174
2	100	93	97	133	128	131	84	107	96	166	152	159
3	107	100	104	140	130	135	100	121	111	159	153	156
4	102	110	106	110	109	110	79	100	90	85	90	88
Significance	8.9			5.2			8.5			10.4		

	Cotton—Seed-cotton yields in lbs. per plot for the above set of plots.											
	1923-24			1925-26			1927-28			1929-30		
	i	ii	Average.	i	ii	Average.	i	ii	Average.	i	ii	Average.
1	66	68	67	54	56	56	78	63	71	76	69	73
2	61	54	58	50	44	47	67	56	62	62	59	61
3	62	53	58	58	39	49	78	60	69	64	53	59
4	54	61	58	41	39	40	54	54	54	44	51	48
Significance	7.9			10.4			8.4			8.2		

## Set "B" (Manure to cotton alone).

Cotton—Seed-cotton yields in lbs. per plot.

	1922-23			1924-25			1926-27			1928-29		
	i	ii	Average.	i	ii	Average.	i	ii	Average.	i	ii	Average.
1	77	75	76	113	117	115	55	61	58	109	118	114
2	70	69	70	105	108	107	56	59	58	98	110	104
3	70	72	71	105	112	106	50	55	53	111	110	110
4	65	67	66	98	102	100	43	43	43	62	65	64
Significance	2·2			1·8			2·8			6·2		

Jowar—Grain yields in lbs. per plot.

	1923-24			1925-26			1927-28			1929-30		
	i	ii	Average.	i	ii	Average.	i	ii	Average.	i	ii	Average.
1	122	114	118	116	134	125	105	102	104	138	157	148
2	111	109	110	128	133	131	102	109	106	115	137	126
3	108	110	109	125	132	129	106	96	101	85	133	109
4	99	98	99	90	87	89	69	70	70	77	77	77
Significance	3·4			8·0			7·6			20·9		

All the figures were treated by method III.

The effects of the various treatments on *jowar* are as follows:—

Considering the *jowar* yields on both the sets of plots, there is no significant difference among the treated plots in 1924-25, 1925-26, and 1927-28, though they give significantly better yields than the no-manure plots. In the years 1922-23 and 1926-27 treatments 1 and 3 stand out better than treatment 2, which gives a lower yield. In the remaining three years the first treatment stands out best, the other two treatments falling lower though distinctly better than the no-manure plot.

Summing up, all the treatments are significantly effective over the no-manure treatment. Treatment 1 has given the best yield throughout. The other two treatments can be taken to be equally effective, though it is possible that treatment 3 may prove slightly better than 2.

The effects of the treatments on cotton are as follows:—

Treatment 1 is the best yielding one throughout, being significantly better than the other treatments except in one or two cases when treatment 2 or 3 closely follows it. Treatments 2 and 3 seem to be equal in 5 years out of nine. The treatments are all significantly better than the no-manure except in two years where treatments 2 and 3 become equal to it.

## Cotton (Seed cotton yields in lbs. per plot).

Treatments.	1907-08				1909-10			
	1	2	3	Average.	1	2	3	Average.
1 .. ..	88	91	90	90	83	81	73	79
2 .. ..	52	52	51	52	41	41	40	41
3 .. ..	58	70	65	64	47	43	50	47
4 .. ..	87	92	76	85	71	56	69	65
Significance ..	8·2				8·3			

It may be observed that, for both *jowar* and cotton in all years the treatments are maintaining the following order of descending yields 1, 4, 3 and 2, though in 1906-07, *jowar* gives better yields for treatment 4 than for 1 though the difference is not significant. The difference between 1 and 4 is significant only in two cases, one in *jowar* (Bazaar seeds) 1908-09 and one in cotton 1909-10 in both cases treatment 1 being above treatment 4.

The difference between treatments 2 and 3 is also significant in only two cases, once in *jowar* (Bazaar), 1906-07 and then for cotton 1907-08, in both cases treatment 3 standing better than 2 which is so throughout even if the difference is not significant.

Hence we can safely conclude that the treatments by night soil in trenches or beds go together standing out significantly better than F.Y.M. (both treatments) in all cases. As between themselves, night soil in beds may be more effective than in trenches and evidently F.Y.M. 40 carts is better than F.Y.M. 20 carts.

## Jowar-Cotton Rotation.

For the same experiment, results of average acre yields of both *jowar* and cotton are given for a series of years from 1904 to 1915. These are given below and averaged.



## Yields in lbs. per acre.

Years.	Seed cotton yields per acre.				Jowar grain yields per acre.			
	Treatments.				Treatments.			
	1	2	3	4	1	2	3	4
1904-05 ..	..	..	..	..	2,723	1,886	2,156	2,166
1905-06 ..	52	142	161	88	..	..	..	..
1906-07 ..	..	..	..	..	1,220	715	931	1,334
1907-08 ..	898	513	638	847	..	..	..	..
1908-09 ..	..	..	..	..	1,559	620	769	1,226
1909-10 ..	789	408	465	651	..	..	..	..
1910-11 ..	..	..	..	..	1,420	844	1,067	1,219
1911-12* ..	50	52	52	50	..	..	..	..
1912-13 ..	..	..	..	..	588	630	767	824
1913-14 ..	591	306	323	445	..	..	..	..
1914-15 ..	..	..	..	..	991	735	856	945
1915-16 ..	413	236	222	330	..	..	..	..
Average ..	549	321	362	472	1,419	905	1,091	1,286

\*Bad year.

The treatments stand in the same order for both crops in giving yields. Treatment 2 gives the lowest and though 3 gives slightly higher yield the difference is not much. 4 shows a distinctly higher yield than 3. and 1 also is still higher. Hence on the whole Night soil is distinctly advantageous over F.Y.M. and Night soil in beds may be slightly better than that applied in trenches.

## SURAT FARM V (x).

## Cotton-Jowar Rotation.

To ascertain the comparative effects of:—

- (1) Poudrette 5 tons every second year,
- (2) Night soil put in one dose equivalent to Poudrette for ten years period (25 tons of Poudrette),
- (3) Check (no-manure),

for the above rotation.

Plots—One-third acre each. But yields are given per acre.

Lay-out—Unreplicated.

Note.—Two sets of plots are taken, manure being given to jowar on alternate years for one, and to cotton on alternate years for another. The results of plot yields for manured and unmanured years are separated, and compared.

The following gives the average yields of the crops for all the 8 years :—

Treatments.	1	2	3	4	Average significance.
<i>Jowar</i> .. ..	127	119	119	91	9.0
Cotton .. ..	78	71	72	59	6.0

The above figures show that F.Y.M. in trenches alone has proved to be the best treatment for the rotation. Addition of F.Y.M. on ridges gives a lower yield than the above. It seems to be immaterial whether the additions are made before sowing or at sowing. Of course all the treatments are effective.

#### SURAT FARM IV.

##### *Crop—Cotton-Jowar Rotation.*

To compare the (1) Dharwar system, i.e., 5 tons of F.Y.M. in alternate years to *jowar* alone.

(2) Surat system, i.e., 5 tons F.Y.M. in alternate years to cotton alone with

(3) 2.5 tons F.Y.M. every year to both the crops.

Lbs. yields per acre are given below.

Every year one yield for *jowar* and one for cotton is given for each treatment.

Years.	Cotton.			<i>Jowar</i> .		
	Seed cotton yields in lbs. per acre.			Grain yields in lbs. per acre.		
	Treatments.			Treatments.		
	(1)	(2)	(3)	(1)	(2)	(3)
1908-09 .. ..	298	334	321	688	635	664
1910-11 .. ..	355	432	352	692	595	603
1911-12 .. ..	..	..	..	..	..	..
1912-13 .. ..	545	590	540	414	390	365
1913-14 .. ..	269	300	322	842	847	675
1914-15 .. ..	421	476	422	683	620	633
1915-16 .. ..	220	285	270	542	652	652
1916-17 .. ..	572	795	545	775	795	675
Average .. ..	383	459	399	663	648	610
Significance .. ..	91.5			126.0		

The figures were treated by method III.

The treatments show no significant differences, and hence all the three treatments may be regarded as equally effective.

SURAT FARM V. \*

To ascertain the comparative effects of:—

- (1) Night soil, 84·5 carts applied in beds in 1904-05 and no manure afterwards.
- (2) 20 carts of F.Y.M. in 1905-06.
- (3) 40 carts of F.Y.M. in 1904-05.
- (4) Night soil in trenches, 84·5 carts in 1904-05.

Crop—*Jowar*-cotton rotation.

Plots—Vary from 4 to 6 gunthas.

Lay-out—Triplicated.

Yields are calculated to 4 gunthas.

Note.—For *jowar* two sets of plots were taken for each year, one sown with *Perio* selected seeds and the other with *Bazaar* seeds of the same variety.

METHOD III.

*Jowar—Perio selected seeds.*

Treatments.	1906-07				1908-09			
	1	2	3	Average.	1	2	3	Average.
1 .. ..	93	124	115	111	167	177	151	165
2 .. ..	77	85	69	77	58	63	91	71
3 .. ..	101	86	96	94	98	91	63	84
4 .. ..	130	114	125	123	137	167	114	139
Significance ..	21·4				33·9			

*Jowar—Bazaar seeds "Perio".*

Treatments.	1906-07				1908-09			
	1	2	3	Average.	1	2	3	Average.
1 .. ..	123	153	126	134	151	147	136	145
2 .. ..	75	55	67	66	52	40	69	54
3 .. ..	93	84	99	92	63	69	89	74
4 .. ..	128	153	150	144	132	99	86	106
Significance ..	23·8				30·2			

## Yields of Jowar grain per acre in lbs.

Years.	Plots manured.			Plots unmanured.		
	Treatments.			Treatments.		
	1	2	3	1	2	3
1912-13	618	810	964	..	..	..
1913-14	..	..	..	1,713	1,749	1,261
1914-15	1,483	2,104	988	..	..	..
1915-16	..	..	..	1,199	1,468	1,620
1916-17	Til-tur was put in.			..	..	..
1917-18	..	..	..	Til-tur was put in.		
1918-19	Jowar was cut green.			..	..	..
1919-20	..	..	..	1,300	1,254	1,170
1920-21	567	981	921	..	..	..
1921-22	..	..	..	1,146	1,152	1,074
Average	889	1,298	958	1,340	1,406	1,284

Years.	Manured plots.			Unmanured plots.		
	Treatments.			Treatments.		
	1	2	3	1	2	3
1912-13	806	1,177	432	..	..	..
1913-14	..	..	..	592	921	561
1914-15	272	370	393	..	..	..
1915-16	..	..	..	363	366	394
1916-17	Low yields.			..	..	..
1917-18	..	..	..	806	501	404
1918-19	515	563	534	..	..	..
1919-20	..	..	..	459	572	343
1920-21	765	400	459	..	..	..
1921-22	..	..	..	526	507	357
Average	590	630	454	549	573	412

The treatments have uniformly given yields considerably higher than the no-manure except with the *jowar* manured plots. It is also observed that the Night soil has uniformly given a slightly better yield than the Poudrette for both *jowar* and cotton, but it cannot be said that this difference is sufficient enough to conclude that the former is superior to the latter.

### SURAT FARM VI.

#### *Cotton-Jowar Rotation.*

To compare the effects of:—

- (1) Gypsum 2,000 lbs. per acre (as an indirect manure).
- (2) F.Y.M. 5 tons per acre.
- (3) No-manure.

*Lay-out*—Unreplicated.

#### *Seed cotton yields per acre.*

Treatments.	1905-06	1906-07	1907-08	1908-09	Average.
1 .. ..	167	391	570	435	391
2 .. ..	178	293	623	493	397
3 .. ..	142	351	529	458	370

#### *Jowar grain yields per acre.*

Treatments.	1906-07	1907-08	1908-09	Average.
1 .. ..	1,039	1,340	937	1,105
2 .. ..	1,115	1,428	1,242	1,261
3 .. ..	1,062	1,228	888	1,059

The above tends to show that F.Y.M. may prove better than Gypsum for both the crops and hence for the rotation. But the difference is very small for cotton. Both the treatments show higher yields than no-manure.

## SURAT FARM VII.

*Crop—Cotton-Jowar Rotation.*

To judge the residual effects of F.Y.M. on soil; 20 cart-loads F.Y.M. were given in 1915-16 and no manure given since.

Year.	Yields of seed cotton in lbs. per acre.		<i>Jowar</i> grain yields per acre.	
	Experimental plot.	Average for farm.	Experimental plot.	Average for farm.
1915-16 .. ..	320	296	....	....
1916-17 .. ..	....	....	903	499
1917-18 .. ..	545	512	....	....
1918-19 .. ..	....	....	557	499
1919-20 .. ..	420	371	....	....
1920-21 .. ..	....	....	708	712
1921-22 .. ..	374	440	....	....
1922-23 .. ..	....	....	998	779
1923-24 .. ..	478	469	....	....
1924-25 .. ..	....	....	927	743
1925-26 .. ..	476	404	....	....
1926-27 .. ..	....	....	657	742
1927-28 .. ..	458	534	....	....
1928-29 .. ..	....	....	809	930
1929-30 .. ..	415	540	....	....
Average ..	436	446	706	613

The distinct effect of the manure is seen till 1925-26 for cotton and 1924-25 for *jowar*, except in the year 1920-21, when *jowar* shows no effect. After 1924-25, the effect of the manure is not seen.

## SURAT FARM VIII.

*Crop—Jowar and Cotton Rotation.*

To compare the effects of various cake manures applied to the above rotation of crops, equivalent to 20 lbs. Nitrogen per acre.

*Plots*—4 Gunthas exclusive of ring.

*Lay-out*—Duplicated.

*Manuring*—Each cake manure is applied equal to 20 lbs N per acre once in two years before cotton. Hence there is no manure in the year in which *jowar* is grown.

- Treatments*—(1) No-manure.  
 (2) Mill castor cake.  
 (3) *Ghani* castor cake.  
 (4) Crushed *nimb* seed.  
 (5) Crushed cotton seed.

(Yields are in lbs. per plot.)

Treatment..	1908-09		Average.	1909-10		Average.	1910-11		Average.
	Plot yields (cotton).			Plot yields ( <i>Jowar</i> ).			Plot—(Cotton yields).		
	1	2	1	2	1	2			
1 ..	32	37	34.5	58	76	65	30	33	31.5
2 ..	36	35	35.5	73	77	75	31	36	33.5
3 ..	32	37	34.5	74	76	75	33	40	36.5
4 ..	26	34	30.0	42	66	54	25	37	31.0
5 ..	33	36	34.5	58	69	64	31	39	35.0
Significance ..	3.5			11.0			3.8		

	1909-10			1910-11		
	Cotton.			<i>Jowar</i> .		
	1	2	Average	1	2	Average
1 ..	36	37	37.0	70	72	71
2 ..	32	46	39.0	72	81	77
3 ..	36	44	40.0	76	69	73
4 ..	34	41	38.0	66	77	72
5 ..	33	43	38.0	62	69	66
Significance ..	5.0			7.6		

Remarks : Method III.

Comparing the means of yields for treatments for each year in the light of its significance figure, we see that so far as cotton is concerned no significant difference between the treatments is observed except that in 1910-11, where treatments 3 and 5 show a significantly better yield than the no-manure treatment. In the other two years, these two treatments stand equal statistically to the no-manure treatments. But it may be said that *nimb* seed is very disadvantageous because in all the years it has given a low yield though not significantly so in some years.

For *jowar* in 1909-10, treatments 2 and 3 show better yields than 1 and 5. In 1910-11, treatment 2 shows better yields than 5 alone. In 1909-10 treatment 4 is below the no-manure treatment.

Summing up it may reasonably be concluded that the *nimb* seed is manurially disadvantageous for the above crops, and that among the other cakes crushed cotton seed has no appreciable effect whereas the castor cake may have a beneficial effect, but it cannot be confirmed without further investigations.

#### SURAT FARM IX.

*Crop—Cotton-Jowar Rotation with the intervention of "Til" and "Tur".*

To ascertain the comparative effects of—

- (1) Superphosphate 400 lbs. plus Nitre 100 lbs.
- (2) Nitre 160 lbs.
- (3) No-manure.
- (4) Nitrate of Soda 100 lbs.
- (5) Castor cake, 600 lbs.
- (6) F.Y.M. 5 tons.

All manures given every year both to cotton and *jowar*.

Plots— $\frac{1}{8}$  acre each.

Lay-out—Unreplicated.

*N.B.*—Three varieties of *jowar* (i) *Chapti*, (ii) *Perio*, (iii) *Sholapuri* were grown every year for each treatment. Two sets of plots were taken as usual for the rotation. But as the cotton used varied in variety from year to year no yield figures could be taken. Hence only *jowar* figures are given.

The data was manipulated by method III, for each set of plots combining the results of the various years. The results for the set "B" for the first two varieties are not manipulated because of the vitiated nature of the results for 1907-08.

#### *Jowar.*

		Grain yields in lbs. per plot.						
		Set "A".			Average.	Set "B".		Average.
		1906	1908	1910		1907	1909	
(i) <i>Chapti</i> —variety.								
1	.. ..	253	231	240	244	112	233	173
2	.. ..	236	205	283	241	104	249	177
3	.. ..	217	204	222	214	145	220	183
4	.. ..	233	239	269	247	158	235	197
5	.. ..	255	223	248	242	219	239	229
6	.. ..	258	213	277	249	105	220	163
Significance ..		22				Not calculated.		



## Jowar—contd.

		Grain yields in lbs. per plot.						
		Set "A".			Average.	Set "B".		Average.
		1906	1908	1910		1907	1909	
(ii) "Perio" variety.								
1	.. ..	248	308	257	271	135	239	187
2	.. ..	208	209	276	231	136	226	181
3	.. ..	198	203	186	196	169	176	173
4	.. ..	231	248	238	239	182	205	194
5	.. ..	234	215	204	218	195	200	198
6	.. ..	226	241	272	246	162	221	192
Significance ..		43.0				Not calculated.		
(iii) Sholapuri variety.								
1	.. ..	228	280	220	243	235	211	223
2	.. ..	223	233	248	235	193	212	203
3	.. ..	181	188	223	197	204	178	191
4	.. ..	196	240	242	226	200	194	197
5	.. ..	201	247	239	229	220	198	209
6	.. ..	212	308	273	264	236	243	240
Significance ..		38.3				19.5		

The conclusions that can be drawn from the above figures are :

(i) "Chapti" variety—All the treated plots give significantly better yields than the no manure plot. But the difference between the various treatments are not significant, thereby showing that so far as this variety is concerned the treatments have more or less the same effect. The figures of set of plots "B" show any how, some difference between the various treatments but they cannot be reliable.

(ii) "Perio" variety—Treatments 1, 4 and 6 give significantly better yields than the no-manure. The other two are only slightly better than the no-manure. Among the treatments 1, 4 and 6 there is no significant difference but it may be said that 1 may be slightly better than 4 and 6. This is also corroborated by the results for the year 1909-10 in set of plots "B".

(iii) "Sholapuri" variety.—In this case treatments 1, 2 and 6 stand out distinctly better than the no-manure treatment, whereas the other

treatments fall short of the limit by a small amount. We may say that they are better than the no-manure. Among the treatments 1, 2 and 6 there is not much difference except that treatment 6 is slightly higher. In the set of plots "B" treatments 1 and 6 stand best followed by 5. The other two treatments show no appreciable difference from the no-manure.

In general, for *jowar* we may conclude that Superphosphate plus nitre, and F.Y.M. are the best yielding treatments. The others occupy intermediate positions being slightly above the no-manure but not coming up to the level of the above two treatments.

### SURAT FARM X.

#### *Crop—Cotton-Jowar Rotation.*

To ascertain the comparative effects of 10 lbs of N per acre given every year to both cotton and *jowar* in the following forms—

- (1) Nitre.
- (2) Calcium Nitrate.
- (3) Sulphate of Ammonia.
- (4) F.Y.M.
- (5) No-manure.
- (6) Calcium Cyanamide.

All the manures were given as top-dressing in two doses, one at the time of sowing and the other at 6 weeks after germination.

*Plots*—Yields in lbs per 4 guntha-plots are given.

*Lay-out*—Duplicated, but as to results of duplication were not satisfactory, average of the two plots were taken for each year.

*N.B.*—As the plot size varied, the yields given in the table are those obtained from the acre yields reduced to 4 gunthas. A number of such results were combined and treated by method III to obtain an approximate idea of the relative effects of the treatments.

1911-12 was a bad year and hence the results for both cotton and *jowar* for this year are omitted.

In spite of the deficiency in the procedure above we got reasonably approximate though not accurate results.

#### *Cotton.*

		Seed cotton yields in lbs. per 4 guntha plots.							
		1908	1909	1910	1912	1913	1914	Average.	Significance.
1	.. ..	43	49	44	71	45	57	52	....
2	.. ..	42	48	46	80	46	60	54	....
3	.. ..	44	53	44	70	43	52	51	....
4	.. ..	42	33	44	67	39	51	46	3.8
5	.. ..	42	40	42	63	41	46	47	....
6	.. ..	38	39	44	69	42	50	47	....

		(Grain yields in lbs. per 4 gunthas plots.)						
		1909	1910	1912	1913	1914	Average	Significance.
1	.. ..	77	103	55	86	84	81	....
2	.. ..	92	111	72	91	86	90	....
3	.. ..	61	103	56	87	80	77	....
4	.. ..	80	79	50	86	67	72	8·6
5	.. ..	77	85	51	72	75	72	....
6	.. ..	84	83	48	87	74	75	....

So far as cotton is concerned the first three treatments stand together on the whole better than the last three treatments. Treatment 2 gives a slightly higher yield than 1 and 3 though not significant. For *jowar* treatment 3 goes down and joins the last three treatments. Treatment 2 has shown the highest yield. Treatment 1 stands next closely followed by 3.

Though, in details, the above results may not be accurate we are safe in concluding that the first three treatments are better than the last three.

### SURAT FARM XI.

#### *Crop—Cotton-Jowar Rotation.*

To ascertain the comparative effects of—

- (1) No top-dressing.
- (2) Top-dressing with Calcium Nitrate 10 lbs. N per acre.
- (3) Top-dressing with Sulphate of Ammonia 10 lbs. N per acre with a basic manure of 5 tons Farm Yard Manure on alternate years.

*Plots*—Size not given. Yields per acre were given. They have been reduced to 4 guntha-plots for calculation.

*Lay-out*—Duplicated.

## Jowar..

Treatment.	Grain yields in lbs. per plot.														
	1916-17		Aver- age.	1917-18		Aver- age.	1918-19		Aver- age.	1920-21		Aver- age.	1921-22		Aver- age.
	(i)	(ii)		(i)	(ii)		(i)	(ii)		(i)	(ii)		(i)	(ii)	
1 ..	56	54	55	54	51	53	42	37	40	62	66	64	88	82	85
2 ..	67	65	66	62	61	62	53	40	47	..	..	..	83	78	81
3 ..	62	65	64	58	57	58	54	55	55	71	83	77	75	80	78
Signi- ficance	3.0			1.3			7.4			12.8			6.4		

## Cotton.

Treatment.	Seed-cotton yields in lbs. per plot.														
	1916-17		Aver- age.	1917-18		Aver- age.	1918-19		Aver- age.	1920-21		Aver- age.	1921-22		Aver- age.
	(i)	(ii)		(i)	(ii)		(i)	(ii)		(i)	(ii)		(i)	(ii)	
1 ..	56	56	56	39	39	39	31	24	28	48	45	47	45	46	46
2 ..	54	58	56	38	39	39	39	43	41	..	..	..	46	46	46
3 ..	52	55	54	33	34	34	35	37	36	42	56	49	45	42	44
Signi- ficance	3.5			0.7			6.2			12.8			1.3		

The average yields of *jowar* and cotton for all the years are :—

	Treatment.				<i>Jowar.</i>	<i>Cotton.</i>
1	..	..	..	..	59	43
2	..	..	..	..	63	45
3	..	..	..	..	66	43
	Significance ..				6.1	4.9

The figures were treated by Method III.

The table for *jowar* shows no difference between the two top-dressings and both these are significantly better than the no top-dressing. For the cotton there seems to be no significant effect due to the top-dressings.

## SURAT FARM XII.

*Crop—Cotton.*

To ascertain the comparative effects of the following top-dressings :—

- (1) No top-dressing.
- (2) 20 lbs. N as  $\frac{3}{4}$  Sulphate of Ammonia and  $\frac{1}{4}$  Castor cake.
- (3) 15 lbs. N as  $\frac{3}{4}$  Sulphate of Ammonia and  $\frac{1}{4}$  Castor cake.
- (4) 20 lbs. N as Sulphate of Ammonia.
- (5) 15 lbs. N as Sulphate of Ammonia.

All per acre with a basic manure of 5 tons F.Y.M.

Plots—2.5 gunthas each.

Lay-out—5 replications randomised.

N.B.—Two sets of 25 plots each were taken, one set with flat plots, and the other with ridges.

Year—1928–29.

*Seed—Cotton yields per plot in lbs.*

Set "A"—Plots, with ridges.

	Plot yields.							Analysis of variance.			
	(i)	(ii)	(iii)	(iv)	(v)	Average.		D	S	Variance	(Method IV).
1 ..	28	25	24	24	26	25	Treat ..	1	23.60	5.9	..
2 ..	25	35	27	29	24	28	Blocks ..	4	50.00	12.5	..
3 ..	33	27	29	26	25	28	Error	16	112.40	7.03	..
4 ..	29	28	25	24	29	27					
5 ..	29	30	27	25	27	28					

As the variance due to treatments is less than that due to errors there is no significant effect due to treatments.

Set "B"—Flat plots.

	Plot yields.							Analysis of Variance.			
	(i)	(ii)	(iii)	(iv)	(v)	Average.		D	S	Variance	(Method IV).
1 ..	34	28	27	33	31	31	Treatment	4	92.8	23.2	..
2 ..	30	36	33	14	35	30	Blocks ..	4	673.6	163.4	..
3 ..	36	32	19	11	27	25	Errors ..	16	630.6	39.4	..
4 ..	36	37	15	26	25	28					
5 ..	38	36	33	17	26	29					

As there is a greater difference due to error than due to treatments there is no significant effect due to treatment.

In both cases the variance due to treatments is less than that due to errors and hence the treatments show no significant effects.

## SURAT FARM XIII.

*Crop—Cotton-Jowar Rotation.*

To ascertain the comparative effects of :—

- (1) No top-dressing.
- (2) 20 lbs. N. per acre as sulphate of ammonia.
- (3) 15 lbs. N. per acre as sulphate of ammonia.
- (4) 20 lbs. N. per acre as a mixture of sulphate of ammonia and castor cake.
- (5) 15 lbs. N. per acre as a mixture of sulphate of ammonia and castor cake.

*Lay-out*—5 replications tried as (1) randomised and (2) latin square.

*Note.*—On the whole 100 plots were taken in four square blocks of 25 plots each. In 1929–30 cotton was sown in ridges of 5' × 2' in the first block, in randomised arrangement of five replications per treatment. In the next block cotton was grown in flat plots 5' × 2' in the same arrangement. In 1930–31 *Jowar* was grown in both the blocks with the same arrangement of treatments.

In the remaining two blocks (50 plots) *Jowar* was sown in 1929–30, in two latin squares and cotton was grown (1) Ridges 5' × 2' in one block and (2) Flat 5' × 2' in another in the year 1930–31. Yields of *Jowar* in these blocks for 1929–30 are not available.

The plot yields of each block are manipulated by Fisher's method of Analysis of Variance for each crop and the results show no significance due to the treatments in most cases.

The arrangement of the lay-out is put in short thus :—

Block.	Crop in 1929–30.	Crop in 1930–31.
1 .. ..	Cotton (Randomised) Ridges ..	<i>Jowar</i> .
2 .. ..	Cotton (Randomised) Flat ..	<i>Jowar</i> .
3 .. ..	<i>Jowar</i> ..	Cotton (Latin Square Ridges).
4 .. ..	<i>Jowar</i> ..	Cotton (Latin Square Flat).

BLOCK I—*Cotton " Ridges "*.

(1929–30.)

Treatments.	Yields of seed-cotton per plot.					Average.
	1	2	3	4	5	
1 .. ..	28	25	24	24	26	25·4
2 .. ..	29	26	25	24	29	26·6
3 .. ..	29	30	27	25	27	27·6
4 .. ..	25	35	27	29	24	28·0
5 .. ..	33	27	30	26	25	28·2

*Analysis of Variance.*

Kind of variance.	Degrees of freedom.	Sum of squares.	Variance.	Half Log <sub>e</sub> V
Treatments ..	4	26.95	6.74	} No significance due to treatments.
Blocks ..	4	42.15	10.54	
Errors ..	16	124.15	7.77	

BLOCK 2—*Cotton "Flat"*.

Treatments.	Yields of seed-cotton per plot.					Average.
	1	2	3	4	5	
1 .. ..	34	28	27	32	31	30.4
2 .. ..	36	37	15	26	25	27.8
3 .. ..	33	36	33	17	26	29.0
4 .. ..	30	36	33	14	34	29.4
5 .. ..	36	32	19	11	27	25.0

*Analysis of Variance.*

Kind of variance.	Degrees of freedom.	Sum of squares.	Variance.	Half Log <sub>e</sub> V
Treatments ..	4	86.25	21.56	} No significance.
Blocks ..	4	689.5	172.4	
Errors ..	16	625.7	39.1	

In both these cases the variance due to treatments is less than that due to error therefore there is no significant effect due to the treatments.

**BLOCK 1—Jowar (Randomised).**  
(1930-31)

Treatments.			Yields in lbs. per plot.					Average.
			1	2	3	4	5	
1	..	..	109	85	100	83	89	93.2
2	..	..	122	108	95	98	101	104.8
3	..	..	90	91	100	101	105	97.4
4	..	..	101	112	115	115	95	107.6
5	..	..	108	89	109	103	91	100.0

*Analysis of Variance.*

Kind of variance.			Degrees of freedom.	Sum of squares.	Variance.	Half $\text{Log}_e V$
Treatments	..	..	4	660.0	165.0	2.5501
Blocks	..	..	4	263.6	65.9	2.0917
Errors	..	..	16	1544.4	96.5	2.2823

Value of 5 per cent. point of  $Z$  for  $n_1 = 4$  and  $n_2 = 16$  is  $= 0.5505$ . Hence there is no significance due to treatments.

**BLOCK 2—Jowar (Randomised).**  
(1930-31)

Treatments.			Yields in lbs. per plot.					Average.
			1	2	3	4	5	
1	..	..	106	99	123	96	115	107.8
2	..	..	111	135	113	107	124	118.0
3	..	..	115	128	113	130	98	116.8
4	..	..	107	118	123	119	102	113.8
5	..	..	116	99	118	109	80.	104.4

*Analysis of Variance.*

Kind of variance.			Degrees of freedom.	Sum of squares.	Variance.	Half $\text{Log}_e V$
Treatments	..	..	4	687.76	171.94	2.5705
Blocks	..	..	4	592.76	148.24	2.4965
Errors	..	..	16	2380.64	148.79	2.4986

As in the previous case here also there is no significance.



BLOCK 3—*Cotton-Ridges (Latin Square).*  
(1930-31)

Treatments.	Yield of seed-cotton in lbs.					Average.
	1	2	3	4	5	
1 .. ..	36	38	29	24	24	....
2 .. ..	42	36	55	30	35	....
3 .. ..	35	32	31	28	24	....
4 .. ..	35	35	27	27	27	....
5 .. ..	34	38	36	40	32	....
Treatment means ..	29	35·8	31·8	33·2	32·2	32·4

*Analysis of Variance.*

Kind of variance			Degrees of freedom.	Sum of squares.	Variance.	Half Log <sub>e</sub> V
Rows .. ..	..	..	4	193·2	48·3	1·9365
Columns .. ..	..	..	4	254·8	63·7	2·0747
Treatments .. ..	..	..	4	120·8	30·2	1·7020
Error .. ..	..	..	12	57·2	4·765	0·7798

5 per cent. value of Z for  $n_1 = 4$  and  $n_2 = 12$  is = 0·5907. Hence there is significance.

BLOCK 4—*Cotton-Flat (Latin Square).*  
(1930-31)

Treatments.	Yield of seed-cotton in lbs.					Average.
	1	2	3	4	5	
1 .. ..	36	33	39	33	37	....
2 .. ..	31	27	28	26	40	....
3 .. ..	34	32	39	38	38	....
4 .. ..	39	32	22	29	41	....
5 .. ..	38	35	34	38	44	....
Treatment means ..	31·6	31·8	32·6	36·8	33·8	33·3

*Analysis of Variance.*

Kind of variance.			Degrees of freedom.	Sum of squares.	Variance.	Half Log <sub>e</sub> V
Rows .. ..	..	..	4	177·04	44·26	1·8929
Columns .. ..	..	..	4	230·24	57·56	2·0243
Treatments .. ..	..	..	4	90·64	22·66	1·5586
Error .. ..	..	..	12	170·32	14·19	1·3247

There is no significance due to treatments.

In all the above cases there is no significant effect due to treatment except in one case of Latin Square cotton in ridges. In this case, the significance in the difference between 2 treatment means works out to be 3.00 and hence treatments 2 and 4 stand out together better than 3 and 5 which are themselves better than the control (no-manure) treatment. In many of these cases though not significant, the above order of importance in treatments holds good.

### SURAT FARM XIV.

#### Cotton.

To ascertain the comparative effects of :—

(1) Calcium Nitrate 80 lbs. *plus* superphosphate 160 lbs.

(2) Calcium Nitrate 80 lbs *plus* superphosphate 160 lbs.  
*plus* 2.5 tons F.Y.M.

(3) F.Y.M. 8 tons

per acre.

*Plots*—Yields per acre have been reduced to 4 guntha plots for calculation.

*Lay-out*—Duplicated.

*Note*.—The cost of manures in treatments 2 and 3 amount to Rs. 20 per acre.

Data manipulated by Method III.

Treatments.	1913-14 Yields in lbs.			1914-15 Yields in lbs.		
	1	2	Average.	1	2	Average.
1 .. ..	33	37	35	40	41	41
2 .. ..	32	36	34	42	46	44
3 .. ..	35	33	34	41	46	44
Significance ..	..	3.7	..	..	2.2	..

For the first year all treatments show equal yields and for the second year, treatments 2 and 3 are better than 1.

### SURAT FARM XV.

#### Crop—Cotton-Jowar Rotation.

To ascertain the comparative effects of :—

(1) Sulphate of ammonia 60 lbs. *plus* superphosphate 224 lbs. *plus* F.Y.M. 1.5 tons per acre.

(2) The above mixture *plus* 80 lbs. KCl.

(3) 3 tons F.Y.M.

*Plots*—Yields per acre given. They are reduced to plots of 4 gunthas for calculation.

*Lay-out*—Duplicated.

*Manuring*—Manures given once in two years before cotton only.

*Note*.—As usual two sets of plots are taken each year one for each crop. But as only very few complete rotations are available due to missing of certain year's results, both the sets are combined and the results are compared in general for each crop.

Data of each year manipulated by Method III.

*Cotton—Yields of seed cotton per 4 gunthas.*

Treatments.	1912-13			1913-14			1914-15		
	1	2	Average.	1	2	Average.	1	2	Average.
1 .. ..	31	50	41	32	33	33	42	30	36
2 .. ..	26	51	39	25	31	28	46	34	40
3 .. ..	41	57	49	26	30	28	46	33	40
Significance .. ..	..	4.9	..	..	2.6	..	..	1.0	..

Treatments.	1916-17			1918-19			1919-20		
	1	2	Average.	1	2	Average.	1	2	Average.
1 .. ..	44	33	39	31	36	34	26	29	28
2 .. ..	44	34	39	34	39	37	26	21	24
3 .. ..	44	35	40	37	41	39	30	24	27
Significance .. ..	..	1.04	..	..	0.7	..	..	5.2	..

Out of the six years, two years' results have shown ((1916-17 and 1919-20) that all treatments are equal. But in others the treatments may be ranked in the order 3, 2, 1 for yields. Treatment 2 sometimes joins the better treatment 3 and sometimes with 1, the inferior. Anyhow the results tend to favour with the F.Y.M. manure treatment (3).

*Jowar—Grain yields in lbs. per plot.*

Treatments.	1913-14			1914-15			1916-17			1918-19			1919-20		
	1	2	Average.	1	2	Average.	1	2	Average.	1	2	Average.	1	2	Average.
1 .. ..	61	60	56	89	89	89	62	67	65	63	62	63	64	62	63
2 .. ..	66	67	67	85	82	84	69	71	70	53	55	54	75	62	69
3 .. ..	76	81	79	79	78	79	76	66	71	53	54	54	76	67	72
Significance .. ..	8.8	..	..	1.6	..	..	8.4	..	..	1.6	..	..	10.12	..	..

For *Jowar* also, the two years 1916-17 and 1919-20 show that there is no significant difference between the treatments. In two of the remaining three years, treatment 1 stands best, 2 comes next and 3 comes last. But in 1913-14 the order is reversed, treatment 3 standing out best, 2 next and 1 being the lowest. The results are not consistent and hence no reliable conclusions can be based upon these observations so far as this crop is concerned.

### SURAT FARM XVI.

#### *Crop—Cotton-Jowar Rotation.*

To ascertain the comparative effects of supplying plant food constituents singly every two years to cotton.

*Plots*—Yields given per acre were reduced to 4 guntha plots for calculation.

*Lay-out*—Duplicated.

*Note*.—As usual two sets of plots are taken one for each crop in each year.

Data manipulated by Method III.

*Treatments*—

- (1) Potassium sulphate 100 lbs. per acre.
- (2) Superphosphate 300 lbs. per acre.
- (3) Sulphate of ammonia 100 lbs. per acre.

#### *Set of Plots A.*

Treatments.	Yield of seed-cotton per plot.									Yields in lbs. per plot.			
	Cotton, 1910-11			Cotton, 1912-13			Cotton, 1914-15			Jowar, 1911-12	Jowar, 1913-14		
	1	2	Average.	1	2	Average.	1	2	Average.		1	2	Average.
1 ..	32	38	35	57	61	59	43	38	41	Bad Year.	58	70	64
2 ..	35	38	37	57	65	61	43	41	42		56	72	64
3 ..	39	34	37	63	49	56	48	41	45		55	53	54
Significance ..	..	5.5	..	..	7.3	..	..	2.7	..	..	..	10.0	..

#### *Set of Plots B.*

Treatments.	1909-10 (Cotton).			1913-14 (Cotton).		
	1	2	Average.	1	2	Average.
1 ..	35	37	36	31	31	31
2 ..	35	39	37	29	27	28
3 ..	28	35	32	30	30	30
Significance ..	..	2.6	..	..	1.2	..

Treatments.	1910-11 ( <i>Jowar</i> ).			1912-13 ( <i>Jowar</i> ).			1914-15 ( <i>Jowar</i> ).		
	1	2	Average.	1	2	Average.	1	2	Average.
1 ..	69	84	77	40	60	50	53	74	64
2 ..	63	66	65	37	59	48	54	72	63
3 ..	60	70	65	29	45	37	47	72	60
Significance ..	..	6·7	..	..	3·4	..	..	3·8	..

So far as cotton is concerned, the effects of the treatments are not different to a sufficient degree and when they show a little significant difference they are inconsistent. Hence we may say that the treatments more or less give the same effect to cotton.

But in the case of *Jowar*, it is observed that the first two treatments stand together better than the third in three cases out of four. Even in the other case the first treatment stands better than the other two. Hence for *Jowar* the first two, i.e. sulphate of potash and superphosphate, may be taken to produce better effects than sulphate of ammonia.

#### SURAT FARM.

##### *A statement showing prices of Jowar and Cotton.*

Year.	Seed-cotton lbs. per Rs.	<i>Jowar</i> . lbs. per Rs.
1905-06	..	..
1906-07	..	..
1907-08	..	..
1908-09	..	..
1909-10	..	6·4
1910-11	..	6·4
1911-12	..	7·6
1912-13	..	7·6
1913-14	..	9·0
1914-15	..	10·75
1915-16	..	8·0
1916-17	..	6·0
1917-18	..	3·33
1918-19	..	3·75
1919-20	..	4·0
1920-21	..	5·7
1921-22	..	3·7
1922-23	..	3·7
1923-24	..	3·2
1924-25	..	4·4
1925-26	..	5·0
1926-27	..	6·1
1927-28	..	5·7
1928-29	..	5·5
1929-30	..	6·4
1930-31	..	8·0

Statement showing the Rainfall by Fortnight on the Agricultural Station, Surat, from 1904-1912

Month.	1904 Fortnight.		1905 Fortnight.		1906 Fortnight.		1907 Fortnight.		1908 Fortnight.		1909 Fortnight.		1910 Fortnight.		1911 Fortnight.		1912 Fortnight.	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
January	..	..	..	..	..	..	..	..	0·26	..	..	..	0·03	..	0·04	..	..	..
February	..	..	..	..	0·04	0·19	..	..	..	..	0·05	..	..	..	..	..	..	..
March	..	..	..	..	..	..	..	..	..	..	..	..	..	..	0·07	0·08	..	..
April	..	..	..	..	..	..	..	0·02	..	..	..	0·03	..	..	..	..	..	..
May	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
June	2·12	..	..	1·00	4·13	5·93	4·17	1·49	0·20	2·55	1·07	10·60	2·56	12·51	3·80	1·40	0·10	5·82
July	4·75	..	8·88	7·61	1·51	9·00	0·11	16·22	25·47	4·78	13·22	18·81	6·60	1·30	1·79	0·29	8·72	23·96
August	1·74	..	0·67	0·33	3·35	4·54	9·44	3·30	1·31	4·71	4·81	2·80	6·42	0·72	4·90	2·41	2·65	2·84
September	3·91	..	0·71	0·39	1·45	0·18	0·61	..	0·29	1·81	6·31	0·26	0·04	1·01	0·89	1·82	2·10	..
October	0·88	..	..	..	0·10	..	..	..	..	..	0·38	..	1·29	0·02	..	..	1·00	..
November	..	..	..	..	..	..	..	..	..	..	..	..	0·27	..	..	..	..	3·60
December	..	..	..	..	..	..	..	..	..	..	0·53	..	..	..	..	..	..	..
Total	13·40		19·59		30·40		35·36		11·38		53·87		32·77		17·49		51·06	

N.B.—Figures by fortnight for 1904 are not available and hence the figures shown represent the rainfall during the whole month.

Statement showing the Rainfall by Fortnight on the Agricultural Station, Surat, from 1913-1921.

No. II Bk Q 7-22

Months.	1913 Fortnight.		1914 Fortnight.		1915 Fortnight.		1916 Fortnight.		1917 Fortnight.		1918 Fortnight.		1919 Fortnight.		1920 Fortnight.		1921 Fortnight.		
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	
January	..	..	..	..	..	..	..	..	..	..	..	..	0'03	..	3'93	..	..	..	0'11
February	..	..	..	0'10	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
March	..	..	0'12	..	0'12	..	..	..	..	..	0'03	..	..	..	..	..	..	..	..
April	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
May	..	..	0'02	..	..	..	..	0'41	2'62	1'53	0'05	0'90	..	..	..	..	..	..	..
June	9'27	0'16	1'90	20'38	0'03	0'64	3'20	2'06	3'53	8'35	0'26	0'88	0'58	2'72	7'14	0'62	0'41	0'40	
July	3'27	5'16	8'06	10'59	1'13	5'18	4'83	14'14	7'79	4'98	11'50	0'75	9'20	6'50	6'20	4'31	2'24	25'18	
August	0'70	2'98	1'25	0'77	3'11	0'04	13'49	3'35	2'09	6'86	1'19	1'85	6'75	4'08	3'12	1'39	5'24	2'94	
September	2'54	0'17	8'25	8'29	1'00	2'27	5'20	5'47	4'06	1'88	0'24	..	0'66	3'88	0'12	2'01	6'65	5'06	
October	0'10	..	..	..	3'60	..	0'07	3'94	15'60	1'16	..	..	2'73	..	..	..	..	..	
November	..	..	1'33	..	..	..	..	..	..	..	..	..	..	0'04	..	..	..	..	
December	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
Total	..	33'85	..	60'95	..	27'02	..	67'16	..	60'39	..	17'65	..	38'07	..	28'84	..	48'23	

Statement showing the Rainfall by Fortnight on the Agricultural Station, Surat, from 1922-1931.

Months.	1922 Fortnight.		1923 Fortnight.		1924 Fortnight.		1925 Fortnight.		1926 Fortnight.		1927 Fortnight.		1928 Fortnight.		1929 Fortnight.		1930 Fortnight.		1931 Fortnight.	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
January ..	..	..	..	..	..	..	..	..	0·67	0·70	..	..	..	..	..	..	..	..	..	..
February ..	..	..	0·41	0·18	0·04	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
March ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
April ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	0·08	..	..	..	..	..
May ..	..	..	..	..	..	..	..	1·75	..	..	..	..	..	..	..	..	..	..	..	..
June ..	..	14·70	..	0·05	0·67	6·69	10·78	6·55	..	0·97	0·45	9·51	2·91	..	0·78	8·26	0·11	16·32	0·14	0·21
July ..	5·24	8·25	5·79	8·83	9·73	4·01	1·41	1·45	15·68	13·28	5·93	6·41	8·59	3·27	33·78	0·54	10·41	5·54	16·67	9·12
August ..	0·55	1·52	3·02	3·52	1·33	11·79	3·82	0·33	11·68	8·90	1·05	1·99	2·11	1·85	1·80	1·45	2·19	0·26	10·34	4·70
September ..	3·60	7·57	0·30	2·66	2·28	3·82	1·04	..	6·65	6·60	0·99	3·25	0·38	5·90	..	0·45	5·34	0·06	0·38	3·50
October ..	..	..	..	..	0·71	0·10	..	..	..	..	2·15	..	0·49	0·33	0·32	..	..	0·95	6·09	2·17
November ..	0·05	..	..	..	..	..	0·06	..	..	..	2·88	..	..	0·29	..	..	..	..	0·06	..
December ..	..	..	..	..	..	..	..	..	..	..	..	0·02	0·04	..	..	0·88	0·10	..	..	..
Total ..	41·48		24·71		41·17		27·19		65·13		34·68		26·21		48·29		41·28		53·88	



## SURAT FARM.

*Statement showing Cost of Cultivation.*

Year.	Cost of cultivation per acre.				
				Cotton.	Jowar.
				Rs.	Rs.
1906-07	..	..	..	47·81	55·39
1907-08	..	..	..	46·24	49·38
1908-09	..	..	..	46·62	50·10
1909-10	..	..	..	48·50	50·06
1910-11	..	..	..	48·20	52·56
1911-12	..	..	..	42·26	51·43
1912-13	..	..	..	45·95	47·52
1913-14	..	..	..	41·40	48·14
1914-15	..	..	..	40·98	44·27
1915-16	..	..	..	40·88	42·70
1916-17	..	..	..	46·70	44·26
1917-18	..	..	..	44·18	49·50
1918-19	..	..	..	41·90	46·50
1919-20	..	..	..	44·32	46·84
1920-21	..	..	..	45·78	52·98
1921-22	..	..	..	48·01	50·70
1922-23	..	..	..	58·50	54·01
1923-24	..	..	..	53·10	79·70
1924-25	..	..	..	55·31	74·53
1925-26	..	..	..	55·52	59·46
1926-27	..	..	..	56·57	63·42
1927-28	..	..	..	59·50	57·40
1928-29	..	..	..	59·80	64·50
1929-30	..	..	..	56·53	67·20
1930-31	..	..	..	54·58	61·60

SURAT FARM.

Statement showing Prices of Manures.

Name of manure.	Lbs. per Rupee.			Years.			Lbs. per Rupee.					
	1906-07	1909-10	1910-11	1911-12	1912-13	1913-14	1914-15	1915-16	1916-17	1917-18	1918-19	
Farm Yard Manure .. .. .	448	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120
Castor cake (Bombay) .. .. .	88	40	40	..	..	..	..	..	..	..	..	..
Nitre .. .. .	23	17	17	7	7	7	8	..	..	..	..	..
Sodium Nitrate .. .. .	14	10·6	10·6	10·6	10·6	10·6	10·6	..	..	..	..	..
Rotted Cactus .. .. .	..	720	720	720	720	720	720	..	..	..	..	..
Mokua refuse .. .. .	..	2,240	2,240	2,240	2,240	2,240	2,240	..	..	..	..	..
Poudrette .. .. .	..	1,120	1,120	1,120	1,120	1,120	896	..	..	..	..	588
Town-sweepings .. .. .	..	2,987	2,987	2,987	2,987	2,987	2,240	..	..	..	..	..
Castor cake (Local) .. .. .	..	46	46	46	35	40	40	..	..	..	..	..
Neem seed crushed .. .. .	..	168	..	..	..	..	..	..	..	..	..	..
Crushed Cotton seed .. .. .	..	20	..	..	..	..	..	..	..	..	..	..
Cotton-cake .. .. .	..	40	..	..	..	..	..	..	..	..	..	..
Calcium Nitrate .. .. .	..	20	20	10	10·7	10·7	6·2	5·4	5·4	5·4	5·4	..
Ammonium Sulphate .. .. .	..	10·7	10·7	10·7	10·7	10·7	9·1	9·0	9·0	9·0	9·0	..
Calcium Cyanamide .. .. .	..	20	20	9	9	9	4·4	..	..	..	..	..
Superphosphate .. .. .	..	27	27	22	25	25	21·3	21·3	21·3	21·3	21·3	..
Pot. Sulphate .. .. .	..	13·3	13·3	13·3	13·3	13·3	10	10	10	..	..	..
Pot. Nitrate .. .. .	..	..	..	6·5	..	..	..	..	..	..	..	..
Saw-dust .. .. .	..	..	..	100	..	..	149	249	448	..	..	..
Night soil .. .. .	..	..	..	597·8	..	..	..	..	..	..	..	..
Pot. Chloride .. .. .	..	..	..	..	20	20	20	20	20	20	20	..
Tank-mud .. .. .	..	..	..	..	..	Free	..	..	..	..	Free	..

## SEWAGE EXPERIMENTS, POONA FARM.

To ascertain the comparative effects of (1) Effluent from Poona septic tank, (2) 20 tons F.Y.M., (3) 20 tons Poudrette per acre on various crops.

Year 1899-1900.

Crop.	Treat- ment.	Outturn in lbs. per acre.	Value of	Cost of	Net
			outturn.	cultiva- tion.	profits.
			Rs.	Rs.	Rs.
Guinea-grass ..	1	56,308	375·37	121·00	254·37
	2	28,532	190·25	155·31	34·93
	3	39,900	266·00	276·62	— (10·62)
Lucerne ..	1	102,088	510·44	173·68	336·75
	2	74,620	373·12	257·80	115·32
	3	96,180	480·87	332·93	147·94
<i>Bundia (Jowar)</i> ..	1	32,480	219·12	48·56	170·56
	2	18,816	75·25	62·38	12·87
	3	30,912	123·62	190·31	— (66·69)
<i>Nilwa (Jowar)</i> ..	1	44,716	257·44	60·75	196·69
	2	25,648	85·44	68·81	16·63
	3	42,056	140·12	197·00	— (56·88)
Sorghum Amber ..	1	55,132	306·25	52·50	253·75
	2	32,480	108·25	67·06	41·19
	3	52,164	173·87	193·81	— (19·93)
Sorghum Collier ..	1	54,740	296·50	61·18	235·32
	2	29,148	97·12	67·93	29·19
	3	52,192	173·93	194·12	— (20·19)
Maize and Utavali ..	1	59,192	283·31	91·62	191·69
	2	25,424	69·93	96·12	— (26·19)
	3	44,068	117·62	220·50	— (102·88)

## SEWAGE EXPERIMENTS, POONA FARM.

To ascertain the comparative effects of (1) Effluent from Poona septic tank, (2) 25 tons of F.Y.M. per acre, (3) 25 tons of poudrette per acre.

On Sugar-cane. Year 1899-1900.

Treatments.			Outturn in lbs. per acre.	Value of outturn.	Cost of cultivation.	Net profits.
				Rs.	Rs.	Rs.
1	..	..	9,576	652·00	268·75	383·25
2	..	..	8,304	582·00	348·93	233·07
3	..	..	8,752	607·00	453·00	254·00

TABLES FROM "REPORT ON SEWAGE EXPERIMENTS NEAR POONA"  
BY PROF. J. B. KNIGHT.

STATEMENT NO. II—Results at the Poona Farm, 1901-02.

Name of crop.	Yields per acre from plots treated with			
	Effluent.	Farm yard manure 10 tons.	Poudrette 10 tons.	Fresh night-soil.
	Lbs.	Lbs.	Lbs.	Lbs.
Sugarcane .. ..	45,360	38,160	41,304	....
Turmeric and Yams .. ..	5,544	6,384	5,088	3,547
	28,488	22,704	16,584	11,827
Groundnuts and Castors .. ..	1,488	840	480	210
	54	102	300	40
Guinea Grass .. ..	49,590	29,070	37,070	....
Lucerne .. ..	55,330	44,100	56,530	....

TABLE FROM "REPORT ON SEWAGE EXPERIMENTS NEAR POONA" BY PROF. J. B. KNIGHT.

STATEMENT NO. VIII—Three years' results of the Sugarcane Experiments with Sewage, Manjri (old Series).

1	Manurial treatment—Kind.	Results per acre.								Results per acre.								Average.
		Yield.				Value of outturn. Rate per <i>palla</i> .				Cost of cultivation.				Net profits.				
		1900-01	1901-02	1902-03	Average.	Rs. 23'8	Rs. 12'6	Rs. 9'1	Rs. 15'0	1900-01	1901-02	1902-03	Average.	1900-01	1901-02	1902-03		
3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18			
		Lbs.	Lbs.	Lbs.	Lbs.	Rs.	Rs.	Rs.	Average	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	
1	Septic tank Effluent ..	9,977	8,949	5,325	8,083	933	438	193	521	274	171	192	214	859	261	1	307	
2	Dibdin's filter Effluent ..	11,643	7,371	4,822	7,913	1,079	360	175	571	291	163	102	215	788	197	-17	323	
3	Macerating tank Effluent ..	11,211	6,983	3,954	7,382	1,948	341	143	611	309	163	181	218	739	178	-38	293	
4	Poudrette ..	10,411	10,640	5,371	8,807	973	520	195	563	489	366	395	417	484	154	-200	146	
5	Farm Yard manure ..	8,533	8,994	5,348	7,641	802	439	194	478	500	348	428	425	302	91	-234	53	
6	Nigerseed-cake ..	12,994	10,274	4,994	9,420	1,215	402	181	599	496	354	457	469	710	48	-276	164	
7	Safflower-cake ..	11,463	10,994	7,245	9,900	1,072	564	262	633	455	337	428	407	617	227	-166	266	

TABLES FROM "REPORT ON SEWAGE EXPERIMENTS NEAR POONA" BY PROF. J. B. KNIGHT.

STATEMENT NO. IX—Two years results of Lucerne, Experiments with sewage, Manjri.

Plot No.	Manurial treatment.	Results per acre.											
		Yield.			Cost of cultivation.			Value of outturn.			Net profits.		
		1903-04	1904-05	Average.	1903-04	1904-05	Average	1903-04	1904-05	Average	1903-04	1904-05	Average
1	2	3	4	5	6	7	8	9	10	11	12	13	14
		Lbs.	Lbs.	Lbs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
1	Septic tank .. ..	35,080	46,980	41,330	98	73	85·8	238	313	275·8	140	240	190·0
2	Dibdin's filter .. ..	38,410	51,730	45,070	95	73	84·0	256	345	300·8	161	272	216·8
3	Macerating tank .. ..	31,700	45,530	38,615	98	73	85·8	211	296	253·8	113	223	168·0
4	Poudrette .. ..	32,250	39,140	35,695	146	123	134·8	215	261	238·0	69	138	103·8
5	Farm yard manure .. ..	27,800	30,230	29,015	120	104	112·0	185	203	193·8	65	98	81·8
6	Niger-cake .. ..	26,070	29,720	27,895	163	193	178·0	174	198	186·0	11	5	8·0
7	Safflower-cake .. ..	28,800	27,990	28,395	145	166	155·8	192	189	190·8	47	23	35·0

## APPENDIX.

## A Note on the Statistical Methods employed.

## METHOD I.

Reference.—“Experimental Error on Field Trials” by W. B. Mercer and A. D. Hall, Journal of Agricultural Science, Vol. IV, pages 107-132.

This is one of the simple but crude methods of estimating the experimental error, because it does not take into consideration the existence of a variety of causes other than those which we are comparing that go to create a difference between the plot yields. In fact this method recognizes that the difference between two plots of the same treatment is solely due to chance. But recent developments have shown that it is possible to separate certain regular errors such as soil heterogeneity etc., from the errors caused by chance in an experiment. But this method has been applied in these investigations, wherever it was considered convenient and the application of finer methods would not adequately repay the trouble involved.

It may be noted that in two experimental farms Karjat and Ratnagiri most of the results have been dealt with by this method alone.

The general procedure to find out the experimental error by this method can be summarized as follows:—

Let us have in a particular year, an experiment where  $m$  manurial treatments are compared with the help of  $n$  replications for each treatment on a particular crop. The data are tabulated in the following manner, the last three columns being filled up by figures calculated as shown:—

Plots.	1	2	3	...n	Average.	Percent- age.	Percent- age error.	Signifi- cance.
Treatments.								
1	$a_1$	$a_2$	$a_3$	.. $a_n$	$a$	100	$P_1$	..
2	$b_1$	$b_2$	$b_3$	.. $b_n$	$b$	$\frac{b}{a} 100$	$P_2$	..
3	$c_1$	$c_2$	$c_3$	.. $c_n$	$c$	$\frac{c}{a} 100$	$P_3$	$\frac{P \times 3\sqrt{\frac{1}{n}}}{\sqrt{n}}$
4	..	..	..	..	..	..	..	..
$m$	$m_1$	$m_2$	$m_3$	.. $m_n$	$m$	$\frac{m}{a} 100$	$P_m$	..

The plot yields are tabulated as above first and then the averages  $a, b, c$ , etc., of the  $n$  plots for each treatment are found and set down in the next column. Then each of these averages except that of the control treatment is expressed as a percentage of the control-treatment-average. Here treatment 1 is assumed to be the control and the average of the  $n$  plots of this being  $a$  the other averages are shown as percentages in the column headed with percentage.

Then the standard deviation of the quantities  $a_1, a_2, a_3, \dots, a_n$  from their mean  $a$  is found out by dividing the sum of squares of the deviations by  $(n-1)$  instead of by  $n$  as usual, i.e., the standard deviation thus found will be  $\sqrt{\frac{\sum(a-a_1)^2}{n-1}}$ . Then two-thirds

this standard deviation is taken and is reduced to the percentage of the mean  $a$ . This quantity is denoted as the percentage probable error  $p_1$ . It is put in the next column.

Thus  $p_1 = \frac{2}{3} \sqrt{\frac{\sum(a-a_1)^2}{n-1}} \times \frac{100}{a}$ . Thus, for each of the treatments the quantity  $p$  is calculated and we get a series of quantities  $p_1, p_2, p_3, \dots, p_m$  which are put down in the column headed with percentage error. Then the average of these percentage errors is determined and is denoted by  $P$ . This denotes the percentage probable error of a single plot yield. This is multiplied by  $3\sqrt{\frac{1}{n}}$  and divided by  $\sqrt{n}$ . This is what is called “significance”. The percentages of yields are compared in the light of this figure and if the difference between the percentage of the average yields of any two treatments

is greater than the "significance" then the two treatments are said to be different in their effects. Otherwise they are considered as equal.

The method is quite simple but as is seen from the procedure, whatever difference is observed between the plots of the same treatment, is taken to be caused by pure chance, which supposition is evidently wrong because we know that other factors are at work which may be eliminated before determining the variation caused by pure chance alone.

#### METHOD II.

*Reference.*—"The Principles and practice of yield trials", by F. L. Engledow, M.A., and G. Udny Yule, F.R.S., published by the Empire Cotton Growing Corporation, from the "Empire Cotton Growing Review".

The mathematical principles underlying the procedures of this and the next method have been explained at length in the above reference and here we give only the steps of the procedure of the method.

This particular method is applicable only to special cases where the experiment is conducted to compare only two treatments with a number of replications for each treatment. If more than one treatment is to be compared, the next method which is based on the same principles can be resorted to. In this method, however, a set of plots for one treatment is compared with another set of *comparable plots* for another treatment.

If there are  $n$  plots in the experiment for each of the two treatments to be compared, the yields of the two sets of comparable plots are tabulated as below:—

Treatments.		Deviations.		Difference of Deviations.	Squares of the differences.
1	2	1	2		
$x_1$	$y_1$	$x_1$	$y_1$	$x_1 - y_1$	$(x_1 - y_1)^2$
$x_2$	$y_2$	$x_2$	$y_2$	$x_2 - y_2$	$(x_2 - y_2)^2$
$x_3$	$y_3$	$x_3$	$y_3$	$x_3 - y_3$	$(x_3 - y_3)^2$
..	..	..	..	....	....
..	..	..	..	....	....
$x_n$	$y_n$	$x_n$	$y_n$	$x_n - y_n$	$(x_n - y_n)^2$
Mean	X	Y			$\frac{\sum(x_n - y_n)^2}{n}$

"S"—denotes the sum of—

The table given above explains sufficiently the various steps to be performed initially. First of all the means X and Y of the plot yields of each treatment are found out. Then the deviation of each plot yield from the mean of the set to which it belongs is found out and put down as  $x_1, x_2, x_3, \dots, x_n$  and  $y_1, y_2, y_3, \dots, y_n$ . Then the differences between the corresponding deviations of the comparable plots are put down in the next column. They are denoted by  $x_1 - y_1, x_2 - y_2, \dots$ . These differences are squared and put down in the next column. Then these squares are added and divided by  $n$  the number of replications and this mean square is denoted by  $\sigma_d^2$ . Then the square root of this mean square is found and naturally it can be denoted by  $\sigma_d$ . It is seen that this quantity is none other than the standard deviation of the differences of the deviations of the plot yields from their respective means. Then the quantity

defined by the equation  $E_d = \frac{\sigma_d}{\sqrt{n}}$  is found by dividing the above standard deviation



by the square root of the number of replications. This is taken to be the standard error of the difference between the two means of the treatments. If the difference between the means of the two treatments, i.e.  $X - Y$ , is more than 2.1 times this standard error  $E_d$  then the treatments are taken to be significantly different. Otherwise the treatments are considered to have equal effects.

### METHOD III.

*Reference.*—Same as for Method II.

So far as the principle underlying is concerned this method is practically an extension of the previous method for more than two treatments. The mathematical reasoning which leads to the important formula in this method is not given here but can be read in detail from the reference cited above. There it is shown how a mere extension of the previous method would be tedious and the short method using a formula is devised to cut short the tedious manipulations of the sums of squares of the differences of deviations for each pair of treatments to be compared with comparable sets of plots.

The following are the various steps to be followed in the finding of the error-significance by this method. The yield data of an experiment where  $m$  treatments are compared with the help of  $n$  replications can be represented as follows:—

Treatments.			Blocks.					
			1	2	3	4	.....n	Average
1	..	..	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	A <sub>4</sub>	.....A <sub>n</sub>	A
2	..	..	B <sub>1</sub>	B <sub>2</sub>	B <sub>3</sub>	B <sub>4</sub>	.....B <sub>n</sub>	B
3	..	..	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	C <sub>4</sub>	.....C <sub>n</sub>	C
..	..	..	..	..	..	..	.....	..
..	..	..	..	..	..	..	.....	..
..	..	..	..	..	..	..	.....	..
m	..	..	M <sub>1</sub>	M <sub>2</sub>	M <sub>3</sub>	M <sub>4</sub>	.....M <sub>n</sub>	M
Average	..	..	X <sub>1</sub>	X <sub>2</sub>	X <sub>3</sub>	X <sub>4</sub>	.....X <sub>n</sub>	X

There are shown  $n$  replications for each of the  $m$  treatments above.  $A, B, C, \dots M$ , are the  $m$  means of the treatments, i.e.  $\frac{S(A_n)}{n} = A, \frac{S(B_n)}{n} = B$ , and so on.

Similarly the quantities  $X_1, X_2, X_3, \dots, X_n$ , are the means of the various columns of figures shown above.

i. e.,  $\frac{A_1 + B_1 + C_1 + \dots + M_1}{m} = X_1; \frac{A_2 + B_2 + C_2 + \dots + M_2}{m} = X_2$ , and so

on. The quantities  $X_1, X_2, X_3, \dots, X_n$  are added and the total divided by  $n$  and the quotient is denoted by  $X$ . It is needless to say that this quantity which we may call the general mean of the plot-yields, is also the mean of the quantities  $A, B, C, \dots, M$ .

Next another table of the same type is formed replacing each plot-yield figure by the deviation of that plot yield from the mean of the treatment to which it belongs. If we denote these deviations by the corresponding small letters so that  $A_1 - A = a_1; A_2 - A = a_2; \dots, B_1 - B = b_1; B_2 - B = b_2$  etc., and so on, the resulting table will be as follows:—

Treatments.			1	2	3	4	.....	n
1	..	..	a <sub>1</sub>	a <sub>2</sub>	a <sub>3</sub>	a <sub>4</sub>	.....	a <sub>n</sub>
2	..	..	b <sub>1</sub>	b <sub>2</sub>	b <sub>3</sub>	b <sub>4</sub>	.....	b <sub>n</sub>
..	..	..	..	..	..	..	.....	..
m	..	..	m <sub>1</sub>	m <sub>2</sub>	m <sub>3</sub>	m <sub>4</sub>	.....	m <sub>n</sub>

Then each of these quantities in this Table is squared and the total sum of such squares is found out. This total sum of squares of the deviations is divided by the total number of plots in the experiment, i.e.  $m \times n$ . The quotient is denoted by  $\sigma_v^2$

Next the sum of the squares of the deviations of  $X_1, X_2, X_3, \dots, X_n$  from their mean  $\bar{X}$  is determined, and is divided by  $n$  and this quantity is denoted by  $\sigma_v^2$ .

Having found out the quantities  $\sigma_v^2$  and  $\sigma_p^2$ , the following equation is given to calculate the quantity  $\sigma_d^2$ , which is the square of the standard error of the experiment:—

$$\sigma_d^2 = \frac{m}{m-1} (\sigma_v^2 - \sigma_p^2)$$

where  $m$  is already known to be the number of treat-

ments. Once the standard error  $\sigma_d$  is determined from the above equation, it is divided by the square root of the number of replications which gives the quantity denoted by  $E_d$ ,

so that  $E_d = \frac{\sigma_d}{\sqrt{n}}$ . This quantity when multiplied by 2.1 gives us what is called the

"significance" with which we compare the means of treatments. If the means of any two treatments differ by more than this "significance" figure then the two treatments are taken to be significantly different in effects, the higher figure being decided as better than the lower figure. If two treatment-means differ by less than this figure we say that the two treatments are more or less the same in effects.

It may be mentioned that in these investigations this method has been taken as the most handy one which is neither complicated nor very crude as the first one. In cases where the same set of plots has been used for a number of years the treatments of plots remaining constant, the plots become comparable and this method is very useful in such cases. We may say that the results obtained by this method are fairly satisfactory and do not contradict in most cases the most probable conclusions.

#### METHOD IV.

*Reference.*—"The arrangement of field experiments and the statistical reduction of the results" by R. A. Fisher, Sc.D., F.R.S., and J. Wishart, D.Sc.

(Technical Communication No. 10 of the Imperial Bureau of Soil Science published in May 1930 from the Rothamstead Experimental Station, Harpenden, Herts, England.)

The above booklet gives a clear exposition of the method which is popularly called "Fisher's method of Analysis of Variance." This is in fact one of the latest developments in the field of Agricultural Statistics, and this method gives a procedure that will lead to conclusions which are more reliable than those of any of the methods hitherto used.

In the first place the word "variance" must be explained as it is a comparatively new term brought into the field of Statistics. In fact it is due to Dr. Fisher the author of this method, that this term was first introduced. He uses this term to denote "the mean value of the squares of errors" or deviations of a distribution from its mean. Hence if we have a distribution consisting of  $n$  observations, the sum of squares of the deviations of the various observations from their arithmetic mean is divided by the number of observations,  $n$ , and this quantity is denoted by "Variance". But it was found that dividing the sum of squares of the deviations by the number of observations is not proper. Hence it is generally divided by one less than the number of observations, i.e. by  $n-1$ , instead of by  $n$  on the basis of the number of independent comparisons that we can make amongst the  $n$  observations. This number  $n-1$  is called "the number of Degrees of Freedom".

As the name itself suggests, the method involves an analysis or separation of the (total) variance in an experiment into its component parts respectively. First of all whenever experimental plot-yields are given, it is necessary to find out what are the component parts of which the variation between plot yields is made up of. There are many factors that account for a difference between plot-yields, and this method attempts at a separation of the differences that can be ascribed to each factor. Evidently the treatments, or the varieties, or both, which it is our aim to compare in the experiment, go to form as one of the factors that create the difference amongst the plot-yields. The other factors will be such as the soil variations from one end of the experimental field to the other etc. These may be called regular factors. Lastly, there is one more factor for which no cause could be ascribed and that is due to pure chance. If we can ascertain separately the effects due to these factors we have a reliable procedure which can disclose to us the results of the experiment by estimating the effects of treatments etc., in comparison with the effects of random variation.

After finding out the component parts which cause the variation between plot-yields, our aim is to find the number of degrees of freedom for each of these factors. The total number of degrees of freedom is however one less than the total number of plots in the experiment. The number of degrees of freedom ascribed to each factor except the "errors" is respectively one less than the number of items in each factor. Thus if there are  $m$  treatments compared in the experiment the number of degrees of freedom ascribable to the treatments is  $m-1$ . If there are  $x$  rows of plots the effects of variations caused by the soil between the various rows has a number of degrees of freedom  $x-1$ , and so on. At last the number of degrees of freedom for the errors is found by subtracting the sum of the numbers of degrees of freedom for factors other than the error, from the total number of degrees of freedom.

The next step will be to find out the sum of the squares of deviations of all the plot-yields from their mean. It is this total sum of squares that has to be divided into various parts according to the various factors. The sum of squares of deviations ascribable to each of the factors is obtained as follows. For instance, we have to find out the sum of squares of deviations ascribable to treatments. For this we take the various means of plot-yields for the treatments. The sum of the squares of deviations of these treatment-means from their mean i.e., the general mean, is determined and multiplied by the number of plots for each treatment. This gives the sum of squares of deviations ascribable to treatments. Similarly this quantity is determined for other factors except for error. Then these sums of squares are added and the sum is subtracted from the total sum of squares, the resulting figure being the sum of squares due to pure chance or "error". Having found these figures, the results are tabulated as below:—

Kind of Variation.			Number of degrees of freedom.	Sum of squares of deviations.	Mean square or "Variance".	$\frac{1}{2} \text{Log}_e V.$
Treatments	..	..	$m-1$	A	$\frac{A}{m-1}$	....
Rows	..	..	$x-1$	B	$\frac{B}{x-1}$	....
....	..	..	....	....	....	....
....	..	..	....	....	....	....
Errors	..	..	....	....	....	....

In the first column the factor which causes the variation is mentioned. In the next column the numbers of degrees of freedom ascribable to the factors are put down. This column is often put under the heading "D" instead of putting the whole name. The sum of the numbers in this column will always be equal to one less than the number of plots in the experiment. The third column gives the various sums of squares of deviations ascribed to the various factors. The fourth column gives the Mean square or what is more often called the "Variance" due to the various factors. Of course the Variance of each factor is arrived at by dividing the sum of squares in the previous column by the number of degrees of freedom. The last column gives half—the natural logarithms of the Variances found in the previous column. The necessity for this figure is explained below.

The significance of factors other than experimental errors is tested by a comparison of the Variance ascribable to that factor with that of error. Variances considerably greater than that due to error are significant, for, had the factor concerned exerted no influence on yield the mean square to be expected will be equal to that due to field errors alone. The main interest lies in the variance due to treatments.

"Although when the variance for treatments is much greater than that for errors, the observed differences between treatments are clearly significant, while if the two variances are nearly equal or if that for treatments is smaller, they are clearly insignificant, yet it is desirable to have some exact test of significance by which to judge the more doubtful

cases. This is known as the z-test." For this test the last column wherein the quantity "half the natural logarithm of the variances are shown respectively," is set down. Now if the number of degrees of freedom for treatments is  $n_1$ , and that due to errors is  $n_2$ , from the table for 5 per cent. points of z (Table VI given at the end of Fisher's Statistical methods for Research Workers) the value corresponding to  $n_1$  and  $n_2$ , above is determined. The difference between the two figures in the last column for treatments and errors gives the observed value of z and this has only to be compared with the 5 per cent. value found from the tables. If the observed value is greater than the 5 per cent. value then the treatments are said to have significant effects. Otherwise the treatments are considered to be not significantly effective, i.e. they are all more or less equal in their effects.

When once the treatments are shown to have significant effects by the above test, we must proceed to compare the treatments among themselves. The square root of the variance due to errors gives the standard error of a single plot yield. Hence the standard error of the treatment mean will be the standard error of the single-plot divided by the square root of the number of replications. Then the standard error for the difference between the two treatment-means that we are comparing will be obtained by multiplying the standard error for one mean by  $\sqrt{2}$ . Hence the standard error for comparing two

treatment-means will be  $\sqrt{\frac{V_e \times 2}{n}}$ , where  $V_e$  is the Variance due to errors, and  $n$  the number of replications for each treatment. This standard error is multiplied by the value of  $t$  observed from the table (Table IV from Fisher's Statistical Methods for Research Workers) corresponding to the number of degrees of freedom due to errors and  $P = .05$ . The resulting figure is called the "Significance". If two treatment-means differ by more than this figure then they are said to be significantly different in effects. If they differ by less they are taken to be equal in effects and no heed is paid to the small difference occurring between their means.

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Do.	Do.	Dharwar	7.
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Do.	Do.	Poona College	10, 67, 264, 265, 266.
Do.	Do.	Surat	10.
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Manures.	Crop.	Farm.	Page.
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