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SUBSTITUTES FOR RA'B.

BY

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SUBSTITUTES FOR RÁB.

Within the tract of trap soils of Bombay Presidency where the rainfall is heavy it is the custom to prepare the seed beds for rice by burning some substance like loppings of trees or dried dung upon them before sowing the seed. This substance is called ráb. The seedlings are, when ready, transplanted to the fields which usually receive no manure.

Investigations have shown that the value of the ráb does not alone depend upon the manurial matter found in the ashes but is to a large extent due to the heat.

The discussion of the causes of the value of ráb is taken up elsewhere. In this paper it is proposed to give the results of the experiments to find a substitute for ráb.

Attempts have been made from the first year to find practical substitutes for ráb. To a limited extent the practice of treating rice seed beds with other substances than ráb have been resorted to in various localities. Among these are sheep dung from folding and fish manure and I have heard of one case of the use of the oil-cake.

In my experiments I have tried the following classes of manures: (a) indirect manures which include lime, salt and charcoal, (b) general manures, cowdung well rotted and ploughed in, sheep manure and poudrette, (c) special manures as ashes, sulphate of ammonia, superphosphate, nitre, fish and oil-cakes.

Lime.

We will first consider the indirect manures. Lime was used in 1904-05, 1906 and 1908. It was thought that lime might make the soil more porous or perhaps increase the available potash. The statement given below shows the results of lime for three years, compared with no manure and with ráb:—

STATEMENT No. I.

Statement showing the value of lime.

Year.	No treatment.					Ráb.					Lime.				
	1					2					3				
	Plot No.	Yield per acre.		Ratio of seed bed to trans-planted area.	Weight of seedlings for 1/40 acre.	Plot No.	Yield per acre.		Ratio of seed bed to trans-planted area.	Weight of seedlings (green) for 1/40 acre.	Plot No.	Yield per acre.		Ratio of seed bed to trans-planted area.	Weight of seedlings (green) for 1/40 acre.
Grain.		Straw.	Grain.				Straw.	Grain.				Straw.			
1905	11	400	960	1:4	...	5	1,120	1,600	1:5	...	12	533	1,333	1:4	...
1906	8	480	720	1:5	...	...	783	1,077	1:5	...	11	869	1,097	1:4.5	...
1908	12	187	240	1:3.67	258	10	507	400	1:3.21	221	25	520	493	1:3.78	329
Average	...	355.6	640	1:4.22	258	...	803.3	1,025.6	1:4.4	221	...	680.5	1,030.7	1:3.82	329
Actual increase...	...	...	...	...	...	...	447.7	385.6	1.18	-37	...	324.9	390.7	1:0.40	71
Percentage of increase	...	...	...	...	...	...	125.9	60.2	4.2	14.3	...	93	61.0	-9.5	27.5

It will be seen that the average outturn from 4 plots is 680 lbs. grain and 1,031 lbs. of straw which compared to the averages from 3 untreated plots of 389 lbs. of grain and 640 lbs. of straw shows considerable improvement due to lime but when compared with the averages of 3 ráb plots of 803 lbs. of grain and 1,025 lbs. of straw it is seen to be considerably lower.

From these results I draw the conclusion that lime may be a valuable constituent in a manure which is to replace ráb.

Common Salt.

Salt (Sodium chloride) was tried on the unráb seed bed in 1908. It was thought that the salt might liberate plant food and possibly correct any toxic effect. The amount applied was 800 lbs. per acre.

The average yield of two plots of 500 lbs. of grain and 553 lbs. of straw is only a little better than the untreated plots of the year.

Cowdung is burned as a ráb quite generally as substitute for branches and is considered superior to branches. Our experiments confirm this belief. Still the practice seems very wasteful of plant food and I have from the first held that if the manure is well rotted and thoroughly mixed with the soil of the seed beds, as good or better results can be obtained with much less manure.

The usual application of manure for ráb of 44,240 lbs. per acre is enormous being sufficient for sugarcane. If applied without the burning the humus contained in this manure would render the soil more porous, available mineral plant food be supplied and all the nitrogen be saved. By burning Dr. Leather estimates that 3/4 of nitrogen is wasted.

The statement below shows the comparison of cow manure and branches ráb and cow manure put in the ground. I have also included poudrette and sheep manure (folding) in the same statement:—

STATEMENT

Showing the value of

Results of transplanted area

Year.	1					2				
	Branches Ráb.					Cowdung Ráb.				
	Plot No.	Yield per acre.		Ratio of seed bed to transplanted area.	Weight of seedlings (green) from 1/40 acre.	Plot No.	Yield per acre.		Ratio of seed bed to transplanted area.	Weight of seedlings (green) from 1/40 acre.
Grain.		Straw.	Grain.				Straw.			
1905 ...	5	1,120	1,600	1:5	...	3	1,620	2,000	1:5	...
1906 ... {	8/5	1,143	1,371	1:5	...	8/8 15/3 2/1	1,420	1,560	1:5	...
	15/1	1,160	1,640	1:5	...		1,600	2,240	1:5.5	...
							1,550	1,760	1:6	...
Average ...	...	1,141	1,470	...	...	...	1,347	1,850	...	...
1907 ... {	8/5	907	1,000	...	...	4/3	1,707	1,600	...	...
	10/9	840	1,027	...	...	3/6	1,467	1,573	...	...
Average ...	...	873	1,013	...	...	...	1,587	1,586	...	...
1908 ...	2	1,160	1,120	1:3.6	324	19	1,547	1,733	1:9.35	1,048
1909 ...	23	1,097	1,027	1:6.3	519	22	1,208	1,193	1:8.3	950
Average ...	...	...	...	...	...	...	...	...	...	...
1910 ...	23	1,018	1,060	1:4.43	209	22	1,079	1,148	1:9.75	464
Total average ...	...	1,055.6	1,230.6	...	...	...	1,466.4	1,645.2	...	...

No. II.

several manures.

set out with seedlings from--

3					4				
Cowdung half quantity.					Urine earth.				
Plot No.	Yield per acre.		Ratio of seed bed to transplanted area.	Weight of seedlings (green) from 1/40 acre.	Plot No.	Yield per acre.		Ratio of seed bed to transplanted area.	Weight of seedlings (green) from 1/40 acre.
	Grain.	Straw.				Grain.	Straw.		
8	1,700	1,850	1 : 5	...	...	...	...	...	...
2/3	1,420	1,680	1 : 6	...	...	...	...	...	...
...	1,560	1,765	...	...	...	...	...	...	...
2/2	1,084	1,244	...	...	...	...	...	...	...
3/5	1,293	1,160	...	...	...	...	...	...	...
...	1,188	1,202	...	...	...	...	...	...	...
18	1,173	1,133	1 : 6.94	761	...	...	...	...	...
20	755	705	1 : 6.8	562	18	1,314	1,229	1 : 7.4	1,055
21	959	759	1 : 6.5	686					
...	857	732	...	624	...	...	...	...	...
19	789	775	1 : 9.15	331	18	726	789	1 : 9.83	483
...	1,146.6	1,188.2	...	...	...	1,020	1,009	...	...

STATEMENT No. II—*continued.*Showing the value of several manures—*continued.*

Results of transplanted area set out with seedlings from—											
		5					6				
		Poudrette.					Sheep folding.				
Year.	Plot No.	Yield per acre.		Ratio of seed bed to transplanted area.	Weight of seedlings (green) from 1/40 acre.	Plot No.	Yield per acre.		Ratio of seed bed to transplanted area.	Weight of seedlings (green) from 1/40 acre.	
		Grain.	Straw.				Grain.	Straw.			
1905	...	15	1,320	1,050	1 : 6	...	...	...	...	...
1906	...	8/9	1,360	1,480	1 : 6	...	8/11	1,360	1,760	1 : 5	...
		15/4	1,560	2,320	1 : 5	...	15/6	1,240	1,800	1 : 5	...
Average	1,413	1,617	...	...	1,300	1,750	...	...
1907	
		
Average	
1908	
1909	...	19	1,233	1,143	1 : 6.5	648	...	...	...	...
Average	
1910	...	16	563	662	1 : 7.7	282	...	...	...	...
Total average	1,207	1,331	...	...	1,300	1,750	...	...

In this and succeeding statements "branches ráb" is taken as the basis of comparison and not "no treatment" because the difficulty of getting a large number of uniform plots made it necessary to reduce their number as far as possible.

It will be seen that the average from nine plots of cowdung ráb is very high, 1,466 lbs. of grain and 1,645 lbs. of straw, if compared with the average of eight plots treated with branches ráb of 1,055 lbs. of grain and 1,230 lbs. of straw.

Cowdung ploughed in.

The third section of the statement shows the results when half the quantity used for burning was ploughed into the land. It was intended that this should be well rotted and worked in early. This was not uniformly the case but still we find cowdung ploughed in giving 1,146 lbs. grain and 1,188 lbs. straw, which is much better than ráb from loppings while not in every case equivalent to cowdung ráb yet, since only half the quantity is required, I am of opinion that cowdung used this way in combination with other manures as lime or gypsum will, to a large extent, solve the problem of a substitute for ráb as it reduces the consumption of the cowdung. It is difficult to fix the price of cowdung as it varies so much under different conditions. The quantity used for ráb is 1,106 lbs. of pure air dry dung per guntha of seed bed or about 10 loads per acre and would cost about Rs. 10 on the average, in addition to which there is the labour of drying or spreading. I give below the comparative cost of cowdung and branches ráb for an acre of rice, that is, for about 8 gunthas of seed bed:—

Year.	Branches.	Dung.
	Rs. a. p.	Rs. a. p.
1904 ...	39 8 8	54 7 8
1905 ...	10 13 4	25 5 4
1906 ...	20 6 8	15 2 2
1907 ...	29 10 6	16 1 10
1908 ...	29 1 0	20 4 0

But these vary so much on account of nearness of ráb source to plot, as allowed by forest officer, and price of manure, that little information can be obtained from studying the prices. In fact, it is very difficult to get at the price of loppings as it all depends upon distance they have to be fetched and nature of the forest from which they are taken. Moreover, in the cultivators' case they do this work themselves, their whole family working, so that they are put to no actual outlay.

One man can bring four head-loads of 60 lbs. each of wet fresh branches per day at average distances, which upon drying loses 56 per cent, so that 500 lbs. of dried branches, the quantity needed for one guntha, costs Rs. 1-2-0. One man brings two head-loads of grass of 50 lbs. each per day, costing Re. 0-12-0. Cost of digging earth, softening, spreading rāb annas 4, or a total of Rs. 2-2-0 per guntha.

Sheep folding.

Sheep folding is a recognised treatment of seed beds in many places. 140 sheep were folded three nights to each guntha of seed bed; for this we paid Rs. 2-11-0, or Rs. 19-11-0 per acre. The average outturn for two plots is 1,300 lbs. of grain and 1,750 lbs. straw, which makes it about the equal of branches rāb.

One very noticeable fact is the high final yield of the seed beds in the case of cowdung manure both as a rāb and as a manure and also of sheep folding and poudrette, which shows that only a trifle of their value is exhausted in the raising of seedlings.

Poudrette.

Night-soil is used very extensively in China and Japan as a manure for rice but owing to the prejudices of the people it is largely wasted in the rice growing tracts of India. That it is a valuable substitute for rāb is seen in the outturn of 1,207 lbs. grain and 1,331 lbs. of straw from five plots.

Here again it becomes next to impossible to get at the cost. We used two cart-loads per guntha or 16 cart-loads per acre of crop. This would now cost at Lonāvā Rs. 22.

Special manures.—The results with the other manures experimented with are given in the statement below :—

STATEMENT No. III.

STATEMENT

5					6				
Household ashes.					Sulphate of Potash.				
Plot No.	Yield per acre.		Ratio of seed bed to transplanted area.	Weight of seedling (green) from $\frac{1}{40}$ acres.	Plot No.	Yield per acre.		Ratio of seed bed to transplanted area.	Weight of seedling (green) from $\frac{1}{40}$ acre.
	Grain.	Straw.				Grain.	Straw.		
	Lbs.	Lbs.		Lbs.		Lbs.	Lbs.		Lbs.
25	880	7	1 : 5	...	...	...	...	...	...
$\frac{8}{13}$	777	1,907	1 : 5	...	...	...	...	...	...
$\frac{15}{8}$	800	1,184	1 : 4	...	...	...	...	...	...
...
...
...
...
23	693	800	1 : 3.7	324	21	1,227	1,320	1 : 4.43	367
...
...
...	787.5	1,199.5	1 : 4.42	324	...	1,227	1,320	1 : 4.43	367
...	-260.2	-79.2	1 : -.67	-69.6	...	179.3	41.3	11.76	-26.6
...	-24.8	-6.2	-12.9	-17.6	...	17.1	3.2	-14.6	-6.7

3					4				
Safflower.					Nitro.				
Plot No.	Yield per acre.		Ratio of seed bed to transplanted area.	Weight of seedling (green) from $\frac{1}{40}$ acre.	Plot No.	Yield per acre.		Ratio of seed bed to transplanted area.	Weight of seedling (green) from $\frac{1}{40}$ acre.
	Grain.	Straw.				Grain.	Straw.		
	Lbs.	Lbs.		Lbs.		Lbs.	Lbs.		Lbs.
16	1,333	2,133	1: 7	...	17	747	1,067	1: 5	...
$\frac{8}{7}$	1,440	1,770	1: 5.5	...	$\frac{8}{12}$	1,303	1,623	1: 5	...
$\frac{15}{2}$	1,480	2,000	1: 5.5	...	$\frac{15}{7}$	800	1,280	1: 4	...
$\frac{2}{1}$	1,210	1,280	...	...	...	...	...	...	...
	1,280	1,236	...	...	...	...	...	...	...
$\frac{3}{9}$	1,670	1,461	...	...	...	...	...	...	...
	1,236	1,062	...	...	...	...	...	...	...
15	1,747	1,947	1: 9.85	1,074	22	1,213	1,240	1: 5.8	555
	Niger cake.								
26	1,446	1,432	1: 10.2	1,308	16	1,215	1,413	1: 7.1	772
24	1,720	1,957	1: 8.49	543.5	13	927	897	1: 3.54	157
...	1,456.2	1,627.8	1: 7.75	582.3	...	1,034.1	1,253.3	1: 5.07	494.6
...	408.5	349.1	1: 2.56	188.7	...	-13.6	-25.4	1: -12	101.0
...	39.0	27.3	49.3	47.9	...	-1.3	-1.9	-2.3	25.4

5					6				
Household ashes.					Sulphate of Potash.				
Plot No.	Yield per acre.		Ratio of seed bed to transplanted area.	Weight of seedling (green) from $\frac{1}{40}$ acres.	Plot No.	Yield per acre.		Ratio of seed bed to transplanted area.	Weight of seedling (green) from $\frac{1}{40}$ acre.
	Grain.	Straw.				Grain.	Straw.		
	Lbs.	Lbs.		Lbs.		Lbs.	Lbs.		Lbs.
25	880	7	1:5	...	...	...	...	...	...
$\frac{8}{13}$	777	1,907	1:5	...	...	...	...	...	...
$\frac{15}{8}$	800	1,184	1:4	...	...	...	...	...	...
...
...
...
23	693	800	1:3.7	324	21	1,227	1,320	1:4.43	367
...
...
...	787.5	1,199.5	1:4.42	324	...	1,227	1,320	1:4.43	367
...	-260.2	-79.2	1:-.67	-69.6	...	179.3	41.3	11.76	-26.6
...	-24.8	-6.2	-12.9	-17.6	...	17.1	3.2	-14.6	-6.7

Nitre.

Nitre was obtained from Northern India and applied at the rate of 400 lbs. per acre of seed bed transplanted. The price of Nitre fluctuates widely; in 1908 it cost Rs. 8 per Bengali maund; that is, for an acre of rice the cost will be about Rs. 12 or Rs. 13, which is cheaper as compared to ráb under our conditions which costs about Rs. 30. From the statement it will be seen that from one guntha of seed bed on the average six times that area can be transplanted. The outturn average of six plots of 1,050·8 lbs. grain and 1,253·5 lbs. of straw per acre shows that it is fully equal, when used in these quantities, to branches ráb but it is not quite equal to cowdung ráb. Nitre may, therefore, be considered one of the most hopeful substitutes for loppings.

Ashes.

Village ashes were tried in 1905, 1906 and 1908. The average outturn from four plots is 787·5 lbs. grain and 1,195·5 lbs. of straw, while poorer than ráb, still it is decidedly better than no treatment. Ashes may form a useful ingredient of a ráb mixture. Here again it is difficult to get at their cost as it is not a commercial commodity in India. Ashes have cost us about Re. 1 per 100 lbs. But they could not of course be had in any quantity at this price.

Fish manure.

Fish manure is already used, but to a very limited extent. For the coast tract it is no doubt the cheapest and best substitute for ráb and its use should be extended. The noticeable thing about the results is that it produces sturdy well tillering plants so that a larger area can be transplanted from the same area of seed bed than most of the other treatments tried. The great value of this manure for rice is demonstrated when the seed bed is replanted for a crop of grain, and the enormous yields of 2,500 lbs. of grain and nearly 4,000 lbs. of straw obtained. While the average outturn from four plots of 1,703·75 lbs. of grain and 2,099·25 lbs. of straw places it above even cowdung ráb or any other treatment so far considered. Now as to its cost unfortunately I am not able to quote its price in the below-ghát localities but at Lonávla, where on account of railway charges it is dear, it cost between Rs. 3 or Rs. 4 a maund; we used $2\frac{1}{2}$ to 4 maunds per guntha of seed bed; this brings the outlay per acre at Rs. 40 to Rs. 80 at Lonávla, but on the coast it ought not to cost much over half this amount bringing the rate thus within the reach of the cultivator. Whether this quantity might not be somewhat reduced I cannot say without more experience. It is dried and reduced to a powder and mixed with the soil.

Sulphate of Potash.

Sulphate of Potash manure was tried in 1908 at the rate of 15 lbs. 13 ounces per guntha of seed bed costing Rs. 1-9-3. The seedlings did not tiller well as only 4.4 gunthas could be transplanted from one guntha of seed bed. This brings the cost up to Rs. 14 per acre. The outturn is given below :—

Field area.		Seed bed area.	
Grain.	Straw.	Grain.	Straw.
1,227	1,320	800	720

Sulphate of Ammonia.

Sulphate of ammonia promises very well and is fully equal to nitre.

Oil-cakes. Safflower.

Oil-cakes have been tried every year from 1904. Safflower cake was taken as the type but in 1907 and 1908 several others were compared with it. If Ryan cake is excepted the average for the oil-cakes surpasses any and all other substances tried as substitutes except fish, and nearly equals cowdung ráb.

Karanj and Niger seed, Undi and Ryan cakes are all available in different parts of the rice-growing region. I can only give their prices at Lonávla but this would vary considerably in other parts. At Lonávla the prices are :—

Niger Rs. 2 to Rs. 2-8-0 per maund of 80 lbs.

Karanj Re. 1 to Rs. 1-4-0 per maund of 80 lbs.

varying according to the supply. Undi and Ryan cost about twice as much as these because they had to be brought a long distance. Safflower was taken from Poona where it fetches from Rs. 2 upwards per maund. They were applied according to their nitrogen content, which worked out at the following quantities per guntha of seed bed: Safflower cake 2 maunds, Undi 5 maunds, Karanj 4 maunds, Niger and Ryan 4 maunds each. Taking the areas transplanted into consideration we got the cost of rice per acre for safflower cake (2 maunds per guntha for 6.6 guntha at Rs. 2-4-0) Rs. 31-13-6, for niger cake (4 maunds per guntha for 4.5 gunthas at Rs. 2-4-0 per maund) Rs. 36-6-0, and for Karanj cake (2½ maunds at Rs. 1-4-0 per maund for 5 gunthas) Rs. 17-3-0.

The statement below compares the various oil-cakes used :—

Statement No. IV showing the value of cakes.

		1				2				
		Safflower cake.				Undi cake.				
Year.	Plot No.	Yield per acre.		Ratio.	Weight of seedlings (green) from $\frac{1}{10}$ acres.	Plot No.	Yield per acre.		Ratio.	Weight of seedlings (green) from $\frac{1}{10}$ acres.
		Grain.	Straw.				Grain.	Straw.		
1906 ...	$\frac{16}{1}$	Lbs. 978	Lbs. 1,289	1:6	...	$\frac{16}{2}$	Lbs. 1,168	Lbs. 1,520	1:6	...
1910 ...	1	1,240	1,053	1:0.76	571	...	...	...	...	...
		3				4				
		Karanj cake.				Niger cake.				
Year.	Plot No.	Yield per acre.		Ratio.	Weight of seedlings (green) from $\frac{1}{10}$ acres.	Plot No.	Yield per acre.		Ratio.	Weight of seedlings (green) from $\frac{1}{10}$ acres.
		Grain.	Straw.				Grain.	Straw.		
1906 ...	$\frac{16}{3}$	Lbs. 1,456	Lbs. 1,856	1:6	...	$\frac{16}{4}$	Lbs. 1,472	Lbs. 1,792	1:7	...
1910 ...	3	1,307	1,107	1:4.34	528	2	1,253	1,000	1:4.27	561
		5				6				
		Ryan cake.				Castor cake.				
Year.	Plot No.	Yield per acre.		Ratio.	Weight of seedlings (green) from $\frac{1}{10}$ acres.	Plot No.	Yield per acre.		Ratio.	Weight of seedlings (green) from $\frac{1}{10}$ acres.
		Grain.	Straw.				Grain.	Straw.		
1906 ...	$\frac{16}{5}$	Lbs. 942	Lbs. 942	1:6.5	1,182	...	Lbs. ...	Lbs. ...	...	...
1910 ...	...	...	...	...	...	4	1,280	1,133	1:5.28	693

To sum up the results of our investigation of substitutes for ráb we may state that fish, nitre, sulphate of ammonia and oil cakes are the most promising and that these may be safely advocated in the following quantities :—

Fish 120 lbs. per guntha of seed bed.

Safflower cake (80 lbs.) 1 maund per guntha of seed bed.

Niger, Karanj, Ryan 120 lbs. ($1\frac{1}{2}$ maunds) per guntha of seed bed.

Undi 150 lbs. per guntha of seed bed.

Poudrette and sheep folding may be advocated wherever possible. The use of the former needs encouragement. Poudrette varies very much in composition but about one cart-load per guntha should be applied. Nitre should be applied at the rate of 20 lbs. per guntha of seed bed and sulphate of ammonia at the rate of 15 lbs.

Cowdung rotted and well mixed with the soil at the rate of a small cart-load per guntha is to be recommended.

In the statement below the various substances used as substitutes for ráb are arranged in order of their average outturns on per plot. It gives quantities to be applied, average outturn, cost per acre of rice, cost per unit (1 maund, 80 lbs.) of rice for seed bed treatment :—

Statement No. V.

Year.	Rank.	Name of substitute.	Average outturn.		Quantity to be supplied per guntha of seed bed.	Cost per acre of rice.	Cost per maund.
			Grain.	Straw.			
	1	Fish ...	1,703'75	2,099'25	120 lbs. ...	Rs. a. p. 7 9 11	Rs. a. p. 0 5 8
	2	Poudrette ...	1,207'	1,331'	200 to 300 lbs. ...	1 12 9	0 2 2
	3	Safflower cake ...	1,457'3	1,653'	80 lbs. ...	7 7 0	0 6 3
	4	Sheep folding ...	1,300'	1,750'	140 sheep for three nights.	23 5 0	1 7 0
	5	Niger cake ...	1,446'	1,432'	45 lbs. ...	22 15 0	1 4 5
	6	Well rotted cowdung.	1,146'6	1,188'2	600 ,, ...	17 6 9	1 3 5
	7	Sulphate of ammonia ...	1,141'	1,105'	15 ,, ...	20 0 0	1 6 5
	8	Nitre ...	1,050'8	1,253'5	10 ,, ...	12 0 0	0 14 7
	9	Urine earth ...	1,020'	1,009'	1,000 ,, ...	6 6 0	0 8 2
	10	House hold ashes.	787'5	1,199'5	132 ,, ...	18 0 0	0 14 7

In addition to the direct solution of the questions mentioned several minor questions have been worked out; first being the comparative value of different rábs in use. Five were tried and the statement below shows the results:—

Statement No. VI showing the value of different rábs.

Year.	1				2			
	No treatment.				Mixed branches Ráb.			
	Plot No.	Yield per acre.		Ratio of seed bed to transplanted area.	Plot No.	Yield per acre.		Ratio of seed bed to transplanted area.
		Grain.	Straw.			Grain.	Straw.	
	Lbs.	Lbs.			Lbs.	Lbs.		
1905 ...	11	400	960	1:4	5	1,120	1,600	1:5
1906 ...	$\frac{1}{8}$	480	1,280	1:4	$\frac{1}{8}$	1,220	1,440	1:5
					$\frac{1}{8}$	1,066	1,533	...
1908 ...	...	...	...	...	$\frac{0}{10}$	907	1,000	...
						848	1,120	...
						840	1,027	...
Average ...	...	440	1,120	1:4	...	1,000	1,286.6	1:5
Actual increase.	...	...	...	...	...	560	166.6	1:1
Per cent. of increase.	...	...	...	...	...	127.2	14.8	2:5

Year.	3				4			
	Ain branches ráb.				Grass ráb.			
	Plot No.	Yield per acre.		Ratio of seed bed to transplanted area.	Plot No.	Yield per acre.		Ratio of seed bed to transplanted area.
		Grain.	Straw.			Grain.	Straw.	
	Lbs.	Lbs.			Lbs.	Lbs.		
1905 ...	2	1,240	1,533	1:5	4	1,107	1,173	1:5
1906 ...	$\frac{1}{1}$	1,280	1,547	1:5	$\frac{1}{1}$	844	1,257	1:5
1908 ...	4a	1,448	1,952	...	...	...	...	...
	4b	1,248	1,376	...	...	...	...	...
Average ...	...	1,304	1,602	1:5	...	975.5	1,215	1:5
Actual increase.	...	864	482.0	1:1	...	535.5	95	1:1
Per cent. of increase.	...	196.3	43	25	...	121.7	8.4	25

Year.	5				6			
	Leaf ráb.				Cowdung ráb.			
	Plot No.	Yield per acre.		Ratio of seed bed to transplanted area.	Plot No.	Yield per acre.		Ratio of seed bed to transplanted area
		Grain.	Straw.			Grain.	Straw.	
	Lbs.	Lbs.			Lbs.	Lbs.		
1905 ...	1	800	1,900	1:6'25	3	1,620	2,000	1:5.
1906 ...	$\frac{1}{18}$	613	853	1:5	$\frac{1}{18}$	2,110	2,300	1:8
1908 ...	...	...	...	...	$\frac{1}{18}$ a	2,093	2,983	...
					$\frac{1}{18}$ b	1,200	1,266	...
Average ...	...	706'5	1,376'5	1:5'62	...	1,905	2,137'2	1:6'5
Actual increase.	...	266'5	256'5	1:1'62	...	1,465	1,072'2	1:2'5
Per cent. of increase.	...	60'6	22'9	45	...	332'9	908	62'5

It will be seen that of all rábs cowdung is the best, that Ain ráb is, as is claimed by the cultivators, slightly superior to mixed branches and that leaf and grass are very inferior substances for ráb.