

SOYBEANS

For Dairy Cows

BY C. C. NELSON AND R. B. BOYD

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SUMMARY

The crops grown on the farms determine in a large measure the rations which are fed to dairy cattle in Iowa. The ratio between the proteins and the carbohydrates and fats in a ration made up of the principal feed crops grown in Iowa is too wide for proper growth or heavy production of milk when fed to dairy cows.

Protein is the nutrient most lacking in Iowa-grown feeds for dairy cattle. It may be furnished in either legume hays or concentrates, and soybeans offer more certain returns and can be used in a greater variety of ways than any other legume that can be grown in the state.

Soybean hay is a satisfactory legume roughage for dairy cows. Although there is some waste, it is worth approximately as much as alfalfa.

Chopping or grinding soybean hay is usually not profitable because of the added cost.

In general, if there is any advantage in growing soybeans with corn for silage, the additional costs for seed and seeding largely offset this slight advantage.

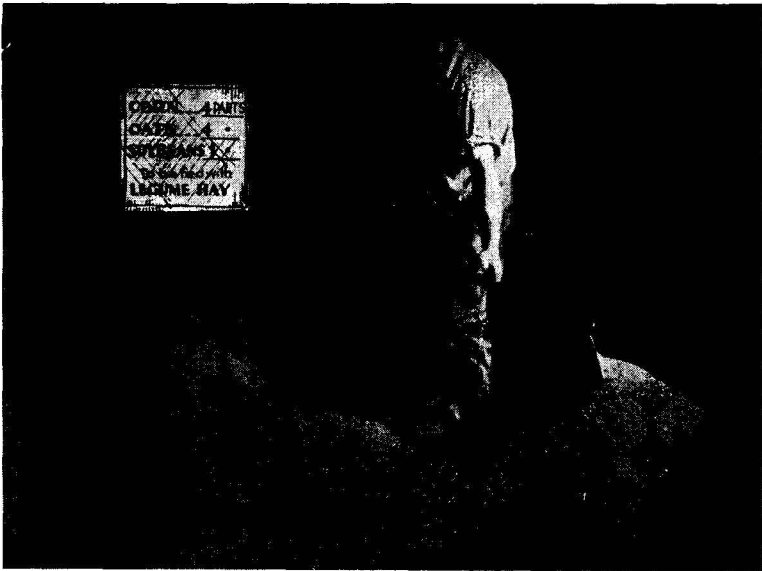


Fig. 1. Dairymen can mix an excellent grain ration at home by using the home-grown protein supplement, soybeans.

Soybean straw is low in protein and high in fiber and about 40 percent of it is refused by cattle. The use of straw of any sort in the dairy ration is not recommended.

Soybeans and soybean oilmeal have a value as protein concentrates in the dairy ration at least equal, if not superior, to other protein supplements.

Maximum milk secretion is favored by a fat intake which is sufficient to provide at least a major part of the fat secreted in the milk. The large amount of fat in soybeans increases their value in the dairy ration.

There is no danger of overfeeding soybeans because of their high fat content, when the ration is properly balanced.

Soybeans do not injure the flavors of either milk or butter when fed as hay or grain, though the feeding of excessive quantities of soybeans (grain) appears to affect the consistency of butterfat. It is safe to feed soybeans, however, when they make up no more than one-third of the grain mixture. The resultant butter usually is not criticized for its body and texture.

For the production of seed the Manchu, Dunfield, Illini and Mukden varieties are best. These, together with the Peking, Wilson, Virginia and Morse varieties, are recommended for hay.

Soybeans preferably should be planted on fall-plowed land 1 or 2 weeks later than corn. They may be planted in rows or drilled or broadcast and may be harvested either with a mower or grain binder.

Soybeans for Dairy Cows

BY C. Y. CANNON AND FLOYD JOHNSTON

SOYBEANS AND THE DAIRY COW'S RATION

In recent years the production of dairy products in Iowa has become an increasingly important source of farm income, although on relatively few farms does milk produce the major income. Usually, dairying is carried on as part of the general farm operation, for it offers an excellent means of profitably disposing of the feeds which are grown.

Iowa has not developed large fluid milk markets, so most of the milk produced in the state is separated, and the cream is used for making butter. A recent government report shows that only 14.3 percent of the milk produced in Iowa is sold as fluid milk. The significance of this is better realized when a comparison is made with other states which rank high in dairy production. In Wisconsin 69.7 percent of the milk produced is sold as fluid milk, in New York 86.0 percent, in Pennsylvania 78.8 percent, in Illinois 53.0 percent and in California 70.1 percent.

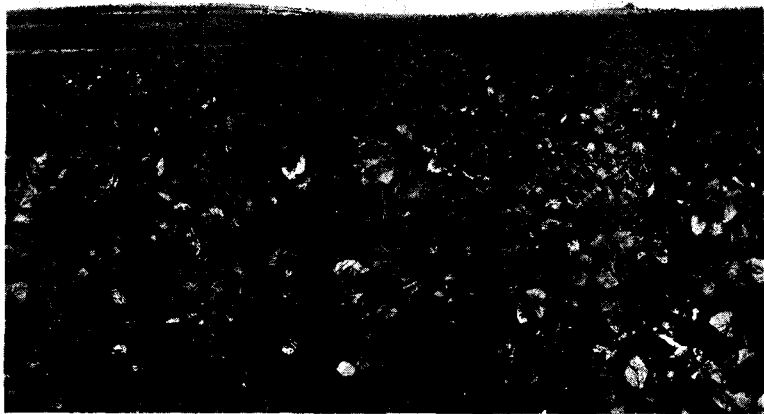


Fig. 2. Maximum yields are secured at the lowest cost when the soybeans are drilled solid, using 2 bushels of seed per acre.

As a general rule, the cash returns from the butter market are not so large as from those markets where the milk is used directly for human consumption, hence the butter-producing areas must cheapen their production costs. Usually the best way to do this is to raise all necessary feeds.

The principal feed crops of Iowa consist of corn, oats, barley, soybeans, alfalfa hay and other hays (tame and wild). These homegrown crops determine in a large measure the rations which are fed to Iowa livestock. If these rations are modified it will come through the purchase of feeds or from a change in crop acreages. If the total yields of all these feed groups were put together to make a single Iowa home-grown ration, it would have a nutritive ratio of about 1 part of protein to 9 parts of carbohydrates or their equivalent. This ratio is too wide for proper growth or heavy production of milk.

Probably the widest average ratio between protein and carbohydrates that would result in efficient growth and milk production is about 1 part of protein to 7.5 parts of carbohydrate equivalent. This means that to make the best usage of the total feed crops which Iowa grows it would be necessary to use additional protein, which now must be purchased. If cottonseed meal were used, it would require approximately 1,300,000 tons to strike the proper balance in Iowa feeds. At present prices (about \$35 per ton, February, 1939) this would mean an expenditure of about \$45,500,000.

Dairy farmers of Iowa should raise this protein rather than obtain it through purchase. It can be done by raising more legumes, such as alfalfa and soybeans. It has been amply demonstrated both by controlled experiments and the experience of Iowa farmers that when alfalfa or red clover cannot be grown, soybeans are probably the best legume crop for most Iowa conditions. Soybeans not only make an excellent forage crop but they also produce a valuable seed which is high in protein content (see table 1).

TABLE 1. ANALYSIS OF SOYBEAN PRODUCTS

(Amounts in 100 pounds)

Feeds	Dry matter Lbs.	Total crude protein Lbs.	Digestible crude protein Lbs.	Total digest- ible nutrients Lbs.
Soybean hay (all analyses)	90.9	14.8	11.1	50.6
Soybean silage	27.2	4.2	2.6	15.0
Soybean straw	88.8	4.0	0.9	36.5
Soybeans, cracked	90.2	36.9	32.8	86.2
Soybean oilmeal (all analyses)	91.7	44.3	37.7	82.2

FEEDING VALUE OF SOYBEANS

Naturally, before one grows a new crop for feed he desires a thorough knowledge of its value compared with the feeds he is using. Thus, soybeans should be compared with other crops (a) as a roughage, and (b) as a grain.

ROUGHAGE VALUE OF SOYBEANS

Since alfalfa is recognized as probably the best legume hay, most of the feeding trials compared soybean hay with it. This was done in a trial at the Iowa Agricultural Experiment Station where, in addition to soybean hay or alfalfa, the dairy cows were fed corn silage and grain. The results may be summarized as follows:

Ratio of Production from Equal Amounts of Feed Consumed		Milk	Fat
(Based on alfalfa as a standard)			
Alfalfa hay		100	100
Soybean hay		97	98

The two hays have about the same value for the portion that is consumed. Soybean hay usually is coarse and woody, and the tendency at first, is to be discouraged with the possibilities of this crop. On feeding, however, it is relished by the cows. Though there is some turn-back due to the coarse stems, it is doubtful if much nutritional value is lost.

A few trials have been conducted to determine the saving in purchased protein feed that might be made through using soybean hay. The one conducted by the Minnesota Station is illustrative of the results. This investigation compared soybean hay with timothy hay. Soybean hay was found to be more palatable—the cows ate 34 percent more soybean hay than timothy hay—and feeding soybean hay resulted in a saving of 46 percent in concentrates. To supplement the timothy hay required the buying of 53 percent of the concentrates needed to balance the ration as against 5 percent when soybean hay was fed. The remainder of the grain mixture was grown on the farm.

WHEN SHOULD SOYBEANS BE CUT FOR HAY?

Soybeans when used as hay will give the greatest returns if they are cut at the time the pods are about half to three-fourths full and before the lower leaves begin to turn yellow and drop. When cut earlier (at full bloom) the protein content is higher, about one-third higher than alfalfa (average analysis), but the tonnage per acre is relatively low. The results of feeding trials show that if one wishes to reap the largest yields of both hay and protein it is better to cut the beans from the

time the pods are half filled until they are well filled rather than to cut them earlier.

SHALL SOYBEAN HAY BE GROUND OR CHOPPED?

Because of the large, coarse stems found in soybean hay, part of the hay is always refused by cattle. This raises the question as to whether it would be profitable to grind or chop this hay before feeding it.

These practices have been tested through many experiments which show that grinding or chopping decreased the waste of soybean hay. Even with this decrease in waste all investigations reveal that it usually is not profitable to chop or grind the hay because of the added cost.

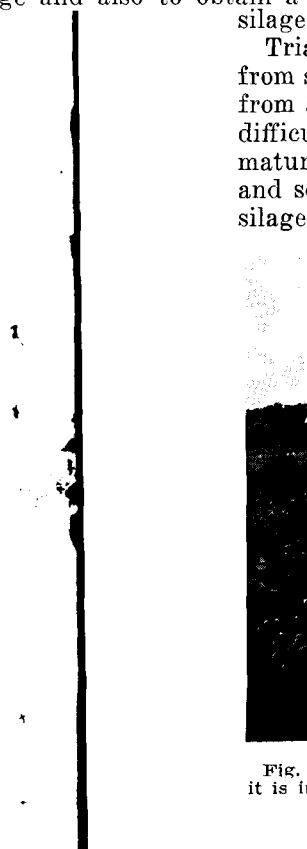
SOYBEANS IN SILAGE

Dairymen who need a well-balanced, cheap feed for their cows have been attracted to the possibility of raising soybeans with the corn crop for silage. Through this means they hoped to increase the yield per acre of silage and also to obtain a

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Fig. 4. Mixing ground ear corn, ground oats and cracked soybeans, all of which can be grown at home.

Corn silage has practically the same value as the corn-soybean silage. Corn silage has a higher net energy value per ton, because the soybean forage does not contain so much grain as the corn forage which it replaces. The silage made of corn and soybeans contains more protein, which makes up for its lower net energy value. In general, if there is any advantage in growing soybeans with corn for silage, it is so slight that it has not been measurable in most feeding trials. In one trial where mixed silage was used, it contained 1.82 percent of protein; whereas the corn silage contained 1.54 percent of protein. Though the yields per acre are usually a little larger when soybeans are grown with corn, the additional costs for seed and seeding largely offset this slight advantage in tonnage.

SOYBEAN STRAW

Soybean straw from mature plants harvested for seed is low in protein (see table 1) and high in fiber, containing 2.8 percent digestible protein and 36.8 percent fiber as compared with 1.0 percent digestible protein and 36.3 percent fiber in oat straw. Whenever soybean straw is fed, about 40 percent of it is refused by cattle. The use of straw of any sort in the dairy ration is not recommended.

SOYBEANS USED AS GRAIN

It appears that soybeans, either cracked or ground, have a value as a protein supplement in the dairy ration at least equal, if not superior, to linseed oilmeal and cottonseed meal, the two concentrated protein supplements most commonly used in Iowa. Soybeans, if sweet, are palatable and are readily eaten by dairy animals. Although varieties vary in their compositions, soybeans contain on the average about 33.2 percent digestible crude protein and 16.1 percent fat. This high quantity of protein places them among the very high protein feeds. Although soybeans contain slightly less protein than choice cottonseed meal, the quality of their protein and the effect of the fat they contain make them as useful in the dairy ration. Whenever they have been compared with linseed oilmeal, they have always proved as valuable and in some cases more valuable, as a milk-producing protein supplement to corn and oats in the grain mixture.

FAT IN SOYBEANS

Because soybeans carry such a large amount of fat two questions arise: What effect does the fat have upon the cow? What effect has this fat upon the quality of the milk and butterfat?

EFFECT OF FAT ON THE COW

In several trials where soybeans were fed to steers it was found that when the steers received daily as much as 2½ to 3 pounds of soybeans they caused scouring, which the investigators thought was due to the high fat intake. In addition, the steers developed a dislike for the beans, which in some cases curtailed their intake. If similar results followed the feeding of soybeans to dairy cows, it would seriously affect their use in the dairy ration.

To check this point, several experiment stations fed dairy cows grain rations consisting of as much as one-half soybeans. Even while feeding these amounts of soybeans, which were larger than the amounts that affected steers, there was no evidence that the soybeans caused scouring or that they lacked palatability; they were eaten as readily at the end of the trials as at the beginning.

Recent investigations have emphasized the value of fat in the dairy ration, and the results point to the conclusion that from a practical standpoint, a maximum milk secretion is favored by a fat intake which is sufficient to provide at least a major part of the fat secreted in the milk. Even when a grain mixture of 1 part corn, 1 part oats and 1 part soybeans—which contains the largest quantity of soybeans in rations recommended by the

Iowa Station—is fed in proportion to milk produced, the fat intake never exceeds the amount of fat produced. Apparently, when the ration is properly balanced, there is no danger of overfeeding soybeans because of their high fat content.

EFFECTS OF FEEDING SOYBEANS ON MILK AND BUTTER FLAVORS AND ON BUTTER QUALITY

All investigators are unanimous in claiming that soybeans do not injure the flavor of either milk or butter when fed as hay or grain, regardless of the amounts fed. The feeding of excessive quantities of soybeans (grain), however, appears to affect the consistency of butterfat. There is some conflict of opinion as to the amount of soybeans that can be fed without noticeably injuring the consistency of butter. No doubt, the kinds of other grains used and the type of roughage fed with the soybeans exert a modifying influence.

It is safe to feed soybeans when they make up no more than one-third of the grain mixture and when fed in combination with the common Iowa feeds such as corn silage, alfalfa or clover hay, corn and oats; the resultant butter usually is not criticized for its texture.

VALUE OF SOYBEAN OILMEAL

Soybean oilmeal or cake is the by-product from the extraction of the oil from the soybeans. When sweet, it is well liked by stock.



Fig. 5. Many farmers secure an excellent quality of hay by curing in cocks.

The digestible protein content of soybean oilmeal is approximately 39.7 percent, while choice cottonseed meal is 37.0 percent, linseed oilmeal is 30.2 percent and gluten meal 37.7 percent. From these figures it can be seen that soybean oilmeal ranks high in its quantity of protein. Recent experiments also show that the quality of the proteins from soybeans is superior for making milk. As both the quantity and quality of the proteins of soybean oilmeal have a high value, good results from feeding the oilmeal are not unexpected.

Soybean oilmeal has proved to be a splendid supplement to a low-protein ration and weight for weight always gives values for milk production equal and in some cases superior to linseed, cottonseed and gluten meals. Though soybean oilmeal is not so commonly fed as some of the other protein supplements, its comparative price should govern its use.

GROWING THE SOYBEAN CROP*

Soybeans offer more certain returns and can be used in a greater variety of ways than any other legume that can be grown in the state. When planted on soils low in fertility soybeans will produce relatively more than small grain and corn; they will grow on acid soils but are benefited when limestone is applied. They are distinctly resistant to drought and to chinch bug damage. Although soybeans are a legume they should not be regarded as a soil-building crop when they are harvested for hay or seed. They are, however, an excellent soil-builder when the whole crop is plowed under.

Average hay yields for a 10-year period of from 2 to 2½ tons per acre have been obtained with the better varieties on the experiment station fields at Ames. Seed yields for the same period have averaged from 20 to 22 bushels.

VARIETIES OF SOYBEANS

When grown for the production of seed the Manchu has been the standard in the state through a period of years. More recently this variety has been replaced to a considerable extent by Dunfield, Mukden and Illini. These four are the best of the available general purpose varieties. The Mukden, a new variety first released by the Iowa Station in 1932, has yielded about 10 percent more hay than the Manchu; the seed mottles less and the plant makes a more erect growth, with fewer side branches than any other general purpose variety yet tested.

The later maturing varieties, such as Peking, Wilson, Virginia and Morse, yield more hay than the general purpose va-

* Information on the growing of the crop is contributed by H. D. Hughes and F. S. Wilkins of the Farm Crops Subsection of the Iowa Agricultural Experiment Station, who have conducted extensive investigations with soybeans since 1910.



Fig. 6. The ordinary smoothing harrow with the teeth sloped is most generally used to cultivate soybeans after planting.

rieties mentioned, but they mature too late to be depended upon to ripen seed. The general purpose seed varieties are also used for hay with entirely satisfactory results.

SEEDBED AND CULTIVATION

The seedbed should be thoroughly prepared, and as many as possible of the weed seeds in the surface soil should be encouraged to germinate before the beans are planted. Beans preferably should be planted on fall-plowed land, but in any event the field should be disced at such intervals in the spring as may be necessary to germinate and kill the weed seed. Bean ground should be cultivated thoroughly just before planting and should be harrowed after the beans are planted and before the plants are up. The ordinary smoothing harrow with the teeth sloped is used most generally to cultivate beans drilled thickly like small grain. In general three cultivations are recommended, the first when most of the plants are about 1 inch high, the second when the plants are 2 to 3 inches high and the third time when they are 5 to 6 inches high.

PLANTING

The best time to plant is 1 or 2 weeks later than corn. Planting may be delayed until the first of June with entirely satisfactory results. The fact that planting can be delayed makes it possible to kill the weeds before the crop is started.

The rate of planting will depend upon the method of seeding and the variety used. When such varieties as Manchu, Dunfield, Illini and Mukden are planted in 36-inch rows, a bushel of seed per acre is recommended. When the crop is planted with a grain drill or when seeded broadcast, 2 bushels (120 pounds) per acre are recommended.

The largest yields have been obtained by planting in 6 to 8-inch rows with a grain drill using 2 bushels of seed per acre for Manchu and beans of similar size. It is advisable for the new grower to plant in rows and cultivate. When planted in rows it is important to have a thick stand of beans; 1 bushel of seed per acre gives better yields than smaller amounts.

INOCULATION

Inoculation is necessary when the soybean bacteria are not already present in the soil, and as these bacteria are not generally distributed in Iowa, the only safe procedure is to inoculate. Soil from a field where well-inoculated beans have been grown can be used, or cultures obtainable from most seed companies are satisfactory.

HARVESTING THE CROP

The ordinary method of harvesting for seed is to cut with a grain binder and shock and to thresh with a regular grain separator, with the speed of the separator cylinder reduced about one-half.

When soybeans are seeded thickly, like small grain for hay, the most rapid method of handling the crop is to allow the



Fig. 7. A good method of harvesting for seed is to cut with a grain binder.



Fig. 8. Soybeans that are to be used for hay can be cut with a grain binder and placed in long six-bundle shocks; this permits the hay to become thoroughly cured. Weathering does not seem to affect the quality of soybean hay so much as other hays.

beans to remain in the swath until the plants are well cured, then rake when the hay is tough from dew so as not to lose an excessive amount of leaves. Many farmers obtain an excellent quality of hay by curing in cocks, but this method must be recognized as requiring more labor than other methods.

An increasing number of growers are cutting for hay with the grain binder and placing the bundles in long, six-bundle shocks. The beans are allowed to remain in the shock without handling in any way, regardless of the weather, until thoroughly cured. This method is not feasible when the growth is very heavy and badly tangled.

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