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Robert Henry Lush

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Cottonseed Meal Ration and Silage Versus Herd Ration, Hay, and Silage

LOUISIANA STATE UNIVERSITY
AND
AGRICULTURAL AND MECHANICAL COLLEGE
AGRICULTURAL EXPERIMENT STATIONS

C. T. Dowell, Director
Cottonseed Meal Ration and Silage Versus Herd Ration, Hay, and Silage

By R. H. Lush

The feeding value of cottonseed meal has been the subject of much study by this and other experiment stations. Agricultural literature formerly contained many warnings against the liberal feeding of cottonseed meal. The results obtained to date indicate that so far as cattle, at least, are concerned, it is a safe and valuable protein feed. However, it is deficient in vitamin A content and is often fed in rations lacking vitamin A and calcium. Unsatisfactory results sometimes obtained in dry lot or winter feeding are due to these deficiencies of the ration, rather than to a harmful substance in the cottonseed meal itself. The work reported here was concerned with correcting those deficiencies by feeding cottonseed meal supplemented with yellow corn or hominy and pasture, silage, and oyster shell flour, in comparison with other feeds. This experimental cottonseed meal ration, or "all Louisiana ration," is also very practical as all of its components can be produced in the state at a lower cost than many dairy feeds. Experimental work was divided into two parts: (1) complete lactation comparisons and (2) winter reversal trials for shorter periods. All feeding trials were carried out in the Louisiana State university dairy herd, with supervision, extra labor, and feed furnished by the experiment station.

I. Comparison of Cottonseed Meal and Soybean Oil Meal

Two groups of six purebred Holstein heifer calves each were started on this phase in November, 1929. Group I received an experimental ration composed of 25 parts soybean oil meal, 75 parts yellow corn, 2 parts oyster shell flour, one part common salt, and corn and soybean silage in winter. Group II received the same ration except that cottonseed meal replaced the soybean oil meal. All other conditions were kept as nearly alike as possible. The heifers were fed according to weight by the Morrison standard except in summer, when silage was replaced by pasture and an average of four pounds of grain was fed daily. Thus all heifers averaged over a pound daily of either cottonseed meal or soybean oil meal, from ten months of age, when they were placed on experiment, until date of freshening. Alluvial land pasture of white clover and Italian rye grass in early spring, replaced by Dallis, Bermuda and Carpet grasses in summer, was available. This was limited somewhat by the dry summer of 1930. From caged areas clipped monthly, a total of 39,566 pounds of grass per acre, equivalent to 9,937 pounds of dried hay, was harvested in the season of 1930. The same areas clipped monthly in 1931 averaged 49,979 pounds of grass per acre, equivalent to 12,763 pounds dried hay, for the season. However, because of uneven distribution of grazing and the presence of other cattle in the pastures, it is difficult to estimate how much these heifers consumed, or that they always had sufficient grass to eat. No dried hay or bedding was consumed until two lactations had been completed.

At the end of the first year there was an average greater gain of only six pounds per heifer for the group fed the soybean oil meal ration than for those fed the
cottonseed meal ration, although the general appearance of hair and condition was slightly in favor of the former. Growth was fairly satisfactory, averaging a pound per day for both groups. An attempt was made to breed all heifers to calve in the early fall of 1931, at an age of 30 to 34 months, but three of the heifers on the soybean oil meal ration aborted four- to six-month fetuses in the early spring months. Blood tests made later indicated that two of these were positive to Bang’s disease. As that disease was present in the herd, it, rather than the ration, was probably the cause of the abortions. The other nine heifers calved normally, despite the fact that heavy grain feeding was continued to within a few days, or the day, of calving. Two heifers receiving cottonseed meal had slightly caked udders, but the average condition was similar to other heifers on a more varied herd ration. The average period of gestation for the three heifers fed the soybean oil meal ration was 277 days, with an average calf weight of 83 pounds. These heifers averaged 1157 pounds in weight and 125.5 centimeters height at shoulders, or a respective gain of 748 pounds and 22.9 centimeters over weight and measurements at the beginning of the experiment. The heifers which were fed cottonseed meal averaged 272 days gestation, a calf weight of 74 pounds, a weight before calving of 1138 pounds, and 127.6 centimeters in height. The respective gains were 738 pounds and 23.4 centimeters over initial weight and measurements. These figures indicate little difference between the groups up to calving time, although the attendants believed the soybean oil meal heifers to show slightly smoother hair and condition. The cost of feeding, however, was $7.12 greater per heifer in group I for the 21 months prior to calving, due to the high cost of the soybean oil meal.

After freshening, the respective grain rations were gradually increased at the rate of one pound grain to each three pounds of milk produced. Milk production reached 40 pounds daily in all cases, and nearly 60 pounds daily with five heifers. Thus consumption of grain was 18 pounds daily in some cases, with an average of over 16 pounds daily for the first six months of lactation. As one-fourth of the grain mixture was either cottonseed meal or soybean oil meal, the heifers consumed four pounds daily of these high protein feeds for six to ten months with no ill effects, except in one case. A heifer receiving 18 pounds of the soybean oil meal per day developed an inflamed vulva at one period of estrum. A local veterinarian pronounced it typical protein poisoning, but a marked feed reduction overcame the condition in a few days. No other feed irregularities occurred and the heifers readily ate their large rations of concentrated feeds without digestive disturbances. Silage was fed at the rate of six pounds per 100 pounds live weight during the winter, but it was impossible to maintain that consumption on warm, humid days of fall and early spring. Sixty pounds daily were consumed by the larger heifers in cool weather. Heifers were milked and fed three times daily with the regular herd.

All heifers were re-bred to freshen within twelve to thirteen months, with the exception of one, which became a non-breeder because of difficult calving. This heifer, receiving cottonseed meal ration, was eliminated from the experiment. Normal heifers had a gestation period of 279 days on the soybean oil meal ration and 282 days on the cottonseed meal ration. At the end of ten months’ lactation, the remaining heifers were dried off and the ones in group I given the cottonseed meal ration, while the others in group II were given the soybean oil meal ration. About four pounds daily were fed for forty days prior to calving, and after freshening the same rate of feeding was followed with the reversed rations as in the first lactation. Silage consumption was greater during this lactation, reaching 70 pounds daily for the larger heifers. No feeding difficulties were encountered and production was again
very high on these rations. At the end of ten months' lactation, these heifers were dried off and the remaining five normal heifers carried through a third lactation on a herd ration, hay, and limited silage as explained later. One of the original eight experimental heifers developed a foot infection and was sold, while one on each of the two rations was not bred in time to calve with the other five heifers. These three are eliminated for third lactations. Results are given in Table 1 for the different lactations. There was very little difference in the average production for the soybean oil meal ration over cottonseed meal in the first lactation. The difference was slightly more in the second test, with an average of 11,022.7 pounds of four per cent fat corrected milk for both lactations on soybean oil meal, which was only 125.7 pounds more than on the cottonseed meal ration. This difference is hardly significant and of no economic importance. At the feed prices current in 1931-1933, and with milk at $1.60 per hundred weight, the returns per cow per year were $19.04 more on the cottonseed meal ration than on the soybean oil meal ration. Moreover, the heifers gained an average of 43 pounds per lactation in live weight while consuming the cottonseed meal ration and only nine pounds on the soybean oil meal ration. This phase of the experiment demonstrated that there is little difference between cottonseed meal and soybean oil meal for growth or milk production, that bulky feeds are not necessary in the grain mixture, and that satisfactory milk production can be maintained without hay when this type of ration is fed.

**TABLE 1**

**Average Pounds of Four Per Cent Fat Corrected Milk in 305 Day Lactations**

<table>
<thead>
<tr>
<th>Ration Fed</th>
<th>First</th>
<th>Second</th>
<th>Average First and Second</th>
<th>Third Herd Ration and Hay</th>
<th>Difference Between Third and Average of First and Second</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soybean oil meal, no hay</td>
<td>10,855.1</td>
<td>11,190.3</td>
<td>11,022.7</td>
<td>8,996.8</td>
<td>-2,237.8</td>
</tr>
<tr>
<td>Cottonseed meal, no hay</td>
<td>10,750.2</td>
<td>11,043.9</td>
<td>10,897.0</td>
<td>8,612.7</td>
<td>-406.7</td>
</tr>
<tr>
<td>Average both rations for heifers with 3 lactations</td>
<td>10,738.8</td>
<td>11,730.4</td>
<td>11,234.6</td>
<td>9,019.4</td>
<td>8,612.7</td>
</tr>
<tr>
<td>Herd ration plus hay</td>
<td>8,686.2</td>
<td>9,352.6</td>
<td>9,019.4</td>
<td>8,612.7</td>
<td>8,612.7</td>
</tr>
<tr>
<td>Difference in favor of experimental rations</td>
<td>2,052.6</td>
<td>2,377.8</td>
<td>2,215.2</td>
<td>384.1</td>
<td>1,831.1</td>
</tr>
<tr>
<td>Net difference (less 384.1)</td>
<td>1,666.3</td>
<td>1,993.7</td>
<td>1,831.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Per cent net increase over herd ration and hay</td>
<td>19.18</td>
<td>21.32</td>
<td>20.30</td>
<td></td>
<td>4.46</td>
</tr>
</tbody>
</table>

**Comparison of Experimental Rations and Herd Ration Plus Hay by Lactations**

Production on the experimental soybean oil meal or cottonseed meal rations was so much better than for other first-calf heifers in the regular herd that a check group has been included in Table 1. This group is designated as "herd ration plus hay" and consists of three Holstein heifers of slightly older age, which were fed a ration of 40 parts corn or hominy, 20 parts each of oats, wheat bran, and cottonseed meal, and one part salt throughout three normal lactations which covered the same period of time as the experimental groups. This herd ration was fed at the same rate per pound of milk as to the experimental heifers. Mixed legume and grass hay and silage were supplied according to appetite. These heifers were fed less grain prior to calving, but were of approximately the same size as the experimental heifers. They were handled in the same manner and pastured with the experimental group, the only apparent difference being in type of grain mixture fed and the replacement of one-
half the silage by hay in winter. The third lactation of the experimental heifers was made under these conditions, as was mentioned earlier. Referring to Table 1, the results can be noted more clearly. During the first lactations, the five heifers on the experimental rations averaged 10,738.8 pounds of fat corrected milk, or 2,052.6 pounds more than the "herd ration plus hay" heifers. In the second lactations, the difference was even greater, the average for both lactations being 2,215.2 pounds in favor of the experimental rations. But in the third lactations of all heifers on the same herd ration and roughage conditions, the experimental heifers produced 2,237.8 pounds less than the average of the two lactations on experimental rations. They produced 384.1 pounds more milk than the check group on the same ration. Therefore, this latter difference may be termed hereditary and is deducted to leave a net difference of 1,831.1 pounds milk, or 20.3 per cent more for the experimental rations than for "herd ration plus hay." The decline for the third lactations of all heifers, when normally an increase would be expected with increased maturity, is probably due to the poorer feed and pasture conditions of 1934, which was a dry year. Grass yields in 1934 were 35,967 pounds per acre, as compared to 41,143 pounds in 1933 and 39,660 pounds in 1932, when the first and second lactations were completed. Adequate grazing was not always available, as more than one animal per acre was maintained on pasture each season.

Applying current feed prices and a milk price of $1.60 per hundred weight for milk produced, one finds the net return per cow per lactation over feed cost for the experimental cottonseed meal ration to be $18.21 greater than with the herd ration and the use of hay. The average analysis of feeds used shows the experimental cottonseed ration to have 6.4 per cent more total digestible nutrients per hundred pounds than the herd ration, which contained bran and oats, more fibrous and less digestible feeds than cottonseed meal and corn. This would explain part of the differences obtained, as the grain was fed at the same rate. The protein content of each ration was approximately the same, being 17 per cent. Since the heifers were on pasture much of the time, there was little danger of a shortage or of poor quality of protein. A likely explanation of the differences is that the increased calcium content of the experimental ration had some effect and that the heifers on the more concentrated grain had greater capacity to eat large amounts of grass outside. The numbers of animals used were so limited that it was decided to repeat this phase with shorter reversal trials in winter, when feed consumption could be measured more accurately.

II. COMPARISON OF EXPERIMENTAL COTTONSEED MEAL RATION AND HERD RATION PLUS HAY BY REVERSAL PERIODS

In the fall of 1932, two groups of five Holstein cows each were started on each ration. Besides the difference in the grain fed to the two groups, mature dehydrated soybean hay was fed at the rate of one pound, and silage at three pounds daily per hundred pounds live weight with the herd ration, while silage alone at the rate of six pounds per hundred pounds live weight was fed with the experimental cottonseed meal ration. The rations were made up in the same proportions as in the earlier work, and corn and soybean silage was used throughout all trials. Cows were milked and fed three times daily, all milk and feed being weighed and recorded. Grain was fed in proportion to milk yield and test, adjusted twice monthly. All experimental cows ran in the same paddock and were otherwise handled alike. At the end of 71 days the rations and roughage were reversed for the two groups, and feeding continued for an additional 71 days. The first ten days of each period were considered
preliminary for feed adjustment, and were not included in the results. The soybean hay, dehydrated at a high temperature, was not very palatable, and after the first few days one pound of molasses diluted with water was poured over each feed for both groups to obtain complete consumption.

The results for the two 61 day periods showed 504.3 pounds more four per cent fat corrected milk, or an increase of 2.36 per cent, for the experimental cottonseed meal ration than for the herd ration plus hay. There was also 84 pounds less loss in weight. This trial indicated, if no difference existed between the grain rations, that 281 pounds corn and soybean silage were equal to 100 pounds dehydrated soybean hay.

The second trial was conducted in a similar manner, starting in the fall of 1933. Western alfalfa hay of good quality was substituted for the dehydrated soybean hay. No molasses was fed. Net experimental periods of 80 days each were maintained and the results showed 1275 pounds more four per cent fat-corrected milk, or an increase of 8.22 per cent, for the herd ration and alfalfa hay over the experimental cottonseed meal ration. The cows lost weight on both rations, but lost a total of 105 pounds more while receiving the experimental cottonseed meal ration. With allowance for slightly more grain consumed in the periods when silage was fed alone, it would require 386 pounds corn and soybean silage to equal 100 pounds alfalfa hay. The feed replacement value of the alfalfa hay amounted to $16.20 per ton when silage is valued at $4.00 per ton.

The third trial was like the second except that locally grown, dehydrated alfalfa hay was used, and only four cows were used in each group for a 62-day net period. The four per cent fat-corrected milk yield was 275 pounds, or 1.66 per cent, greater for the herd ration plus alfalfa hay than for the experimental cottonseed meal ration. The four cows lost a total of 254 pounds in weight during the periods, but gained 20 pounds while on the experimental cottonseed meal ration. The feed replacement value of the hay amounts to $14.28 per ton, with silage at $4.00 per ton, if no difference exists in the grain rations. With allowance for difference in feed consumption, but disregarding live weight changes, it required 324 pounds of the silage to replace 100 pounds of alfalfa hay.

The average of the three tests indicates that 330 pounds of corn and soybean silage are required to equal 100 pounds of the legume hays used, disregarding live weight changes and grain difference. The average milk production per cow per day was 28.89 pounds on the experimental ration and 29.44 pounds on the herd ration and legume hay, or an increase of 1.9 per cent for the latter method of feeding. However, because of the high cost of legume hay, oats, and wheat bran, the feed cost of producing milk was less every year on the experimental cottonseed meal ration and silage, averaging ten cents cheaper per 100 pounds when the herd ration and legume hay and silage was fed.

Discussion

This work has not been conclusive because of variations in feeds and conditions from year to year. However, since completing this work, twenty heifers have been successfully fed the experimental cottonseed meal ration for periods of a year or longer. Recent work of the Texas, Oklahoma, and especially the Michigan experiment stations have shown that heavy feeding of cottonseed meal or similar feeds is not injurious to cattle. The grain ration is so thoroughly mixed with water in the paunch as to delay the impaction once thought due to heavy rations. Work of the Florida and Minnesota stations on the importance of calcium, as well as our own
observations, point toward oyster shell flour, affording calcium in an otherwise deficient ration, as a very important factor in maintaining production in both experiments. The difference between the lactation methods and reversal trial results may be partly explained by the larger opportunity to obtain and store vitamin A on the experimental cottonseed meal ration in the first experiment. It was noticeable that spring and summer production held up better on that ration than on the herd ration. During the shorter reversal trials the legume hay probably furnished more vitamin A than in the case of the experimental ration, though no actual determinations were made.

This work has demonstrated at least that dairy farmers do not need to include bulky grains, such as oats or wheat bran, in the grain ration when silage or pasture is available. Neither is it necessary to have a great variety of feeds in the ration when pasture and silage are available. The latter roughage and silage apparently can replace all but the best quality hay if calcium and protein are added to the grain ration. If the dairy farmer can produce and feed three and one-half tons of silage for less than the cost of growing, curing, and feeding one ton of legume hay, it is an economical procedure to do so. This “all-Louisiana dairy ration” can be raised or economically purchased in South Louisiana. Where good quality legume hay can be easily cured, as in much of North Louisiana, more of it should be raised and fed. There is little need of a protein supplement other than cottonseed meal when sufficient silage and pasture are supplied to average dairy cows.

**Summary**

The above tests have demonstrated that under our conditions as outlined, legume hay and a bulky grain ration are not necessary for economical production when silage or pasture, corn, cottonseed meal, and adequate mineral matter are fed. There was no apparent difference between soybean oil meal and cottonseed meal for growth or milk production, fed under the above conditions. The average of these two rations produced approximately 20 per cent more milk per lactation than a herd ration of corn, oats, wheat bran, cottonseed meal, mixed hays, and silage.