DAIRY SCIENCE

OHIO AGRICULTURAL RESEARCH AND DEVELOPMENT CENTER

Wooster, Ohio
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FACTORS AFFECTING FEED INTAKE

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Experiment, Georgia

Feed intake is usually measured as pounds of dry materials consumed within a 24-hour period. This measure is adequate if cows are being fed high quality forage and a balanced grain ration but it may be misleading in other circumstances. By the same token, converting dry matter into TDN or net energy is good or bad depending upon the rations being fed. Since most dairy farmers are trying to feed good forage and good grain rations, this discussion is confined to the intake of dry matter.

High producing dairy cows should consume 3.0 to 3.25 lb. of dry matter per 100 lb. of body weight. In most areas, 60 percent of this (1.80 to 1.95 lb.) will be in the form of hay, silage, or pasture and 40 percent (1.2 to 1.3 lb.) will be concentrates.

Of the many factors which influence feed intake, the ones under control of the dairy farmer are forage quality and concentrate formulations.

The dairy cow has a definite capacity to consume feed. This capacity is relatively constant for each cow after the animal reaches maturity. Since her stomach capacity is set, the cow's primary eating problem is time. In 25 feeding trials at the Georgia Experiment Station, cows divided their 24 hours as follows: 8.0 hrs. eating, 7.3 hrs. ruminating, 3.0 hrs. milking, and 5.7 hrs. resting. The cows did not vary their eating time more than an hour per day. Thus, there are about 8 hours per day to get feed into the cow.

Some hays are consumed at a rate of 2 lb. per hour while others may be consumed as fast to 6 to 7 lb. per hour. Grain rations are usually consumed at a rate of 1 lb. each 2 or 3 minutes. Thus, a 1200-lb. cow consuming 15 lb. of grain and 23 lb. of hay must have a hay that she can consume at an average rate of about 3 lb. per hour.

After the cow consumes her forage and grain, she begins another race with the clock. This is the time required to digest the feed, get it through her digestive tract, and have an empty rumen ready for more work. Some feeds require as much as 3 or 4 days for 90 percent of the ration to clear the digestive tract. Other feeds will clear in 36 to 48 hours. It is not surprising that a cow will consume twice as much of one feed as she will of another.

The one factor that seems to best determine both rate of consumption and rate of passage is the digestibility of forage. Thus, intake is best on early cut hay, lush pasture, and top quality silage.

In a study of 59 silos of silage, it was found that silages with the following composition maximized feed intake.
1. Crude protein — typical of the crop

2. Crude fiber — corn silage — under 25% and grass silage — under 28%

3. Dry matter digestibility — at least 65%

4. Silage dry matter — above 25% (optimum at 30%)

Other factors which can be altered to influence intake are physical form of the grain ration, frequency of feeding (particularly silages), using some hay with high silage rations, and feeding a variety of feeds.

Grinding, pelleting, sweetening, or other changes cannot make a good ration out of a poor one. Intake problems are best solved by starting with good forage and adding a good grain ration.
CALCIUM, PHOSPHORUS, VITAMIN D NEEDS OF HIGH-PRODUCING COWS

J. W. Hibbs and H. R. Conrad
Department of Dairy Science

A considerable amount of evidence has been accumulated in recent years which shows that calcium metabolism is markedly influenced by the level of phosphorus in the feed.

Recent studies at the Research Center showed that when phosphorus was low in the ration, so that cows were in negative phosphorus balance (phosphorus output greater than the amount absorbed), absorption of calcium was low. It also was found that vitamin D did not increase calcium absorption when phosphorus balance was negative, as it did when phosphorus balance was positive.

Further evidence that low phosphorus in the ration impairs calcium utilization is found in the results of studies on milk fever. Several researchers have shown that adding phosphorus to a ration, where the roughage was alfalfa and already high in calcium, reduced the incidence of milk fever. Indeed, it may be that rations that are adequate in and balanced for calcium and phosphorus to prevent milk fever may be the key to rations properly balanced in calcium and phosphorus for maximum lifetime production.

A 1400-lb., non-pregnant cow milking 80 lb. per day will need to consume daily 118 g. of calcium and 89 g. of phosphorus in her feed. If she would eat 48 lb. of dry total ration containing 0.55% calcium and 0.40% phosphorus (Ca:P ratio = 1.38:1), her daily intake of calcium would be 120 g. and phosphorus 87 g. This would meet her needs based on the new 1965 National Research Council standard, assuming her absorption of calcium and phosphorus doesn't fall below the normal level due to the effect of advancing age, lack of vitamin D, or the presence of anti-vitamin D factor (reported to be associated with high carotene intake) in the feed.

To more intelligently formulate rations with well balanced calcium and phosphorus, it will be necessary to know with reasonable accuracy the calcium and phosphorus content of the feeds to be fed, especially the roughages where calcium and phosphorus are widest. The liberal use of corn silage, grasses, and grain concentrates supplemented with high phosphorus carriers will help in solving the problem of high calcium, low phosphorus intake when alfalfa and other legume roughages are fed.

At present, adequate supplementation with phosphorus and perhaps with vitamin D in amounts yet to be determined offers the best guarantee of maximum utilization of both calcium and phosphorus from the rations of high producing cows.

The following tables show the calcium and phosphorus relationships in different grain mixtures and different total rations for high producing cows where different sources of calcium and phosphorus supplements are used.
Calcium and Phosphorus Relationships in Different Grain Mixtures for High Producing Cows

<table>
<thead>
<tr>
<th>Grain Mixture</th>
<th>Ca (lb)</th>
<th>P (lb)</th>
<th>Total Ca (lb)</th>
<th>Total P (lb)</th>
<th>Ca:P Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1a) No Ca and P supplement added</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Shelled corn</td>
<td>600</td>
<td>0.02</td>
<td>54.5</td>
<td>708.2</td>
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<tr>
<td>Oats</td>
<td>200</td>
<td>0.09</td>
<td>61.7</td>
<td>299.6</td>
<td></td>
</tr>
<tr>
<td>Soybean oil meal</td>
<td>200</td>
<td>0.29</td>
<td>262.3</td>
<td>581.1</td>
<td></td>
</tr>
<tr>
<td>Salt</td>
<td>10</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1010</td>
<td>0.09</td>
<td>398.5</td>
<td>1588.9</td>
<td>0.25:1</td>
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<tr>
<td>(2) 1% Bonemeal added</td>
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<td></td>
</tr>
<tr>
<td>Shelled corn</td>
<td>600</td>
<td>0.02</td>
<td>54.5</td>
<td>708.2</td>
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<td>581.1</td>
<td></td>
</tr>
<tr>
<td>Salt</td>
<td>10</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>Bonemeal</td>
<td>10</td>
<td>32.10</td>
<td>1420</td>
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<td>Total</td>
<td>1020</td>
<td>0.40</td>
<td>1855.8</td>
<td>2233.6</td>
<td>0.84:1</td>
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<tr>
<td>(3) 1.5% Monosodium phosphate added</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shelled corn</td>
<td>600</td>
<td>0.02</td>
<td>54.5</td>
<td>708.2</td>
<td></td>
</tr>
<tr>
<td>Oats</td>
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<td>0.09</td>
<td>61.7</td>
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<td>262.3</td>
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<tr>
<td>Salt</td>
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<td>--</td>
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<td>25.00</td>
<td>1702.0</td>
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</tr>
<tr>
<td>Total</td>
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<td>398.5</td>
<td>3291.4</td>
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* 16.6% Total protein
### Calcium and Phosphorus Relationships in Different Total Rations for High Producing Cows

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<tr>
<th>Total Ration</th>
<th>Ca (%)</th>
<th>P (%)</th>
<th>Daily Intake (lb)</th>
<th>Ca Intake (g/d)</th>
<th>P Intake (g/d)</th>
<th>Ca:P Ratio</th>
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<tr>
<td>Alfalfa (17.5% protein)</td>
<td>1.61</td>
<td>0.24</td>
<td>28</td>
<td>204.7</td>
<td>30.5</td>
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<tr>
<td>Corn and cob meal</td>
<td>0.11</td>
<td>0.04</td>
<td>20</td>
<td>10.0</td>
<td>3.6</td>
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<tr>
<td></td>
<td>0.99</td>
<td>0.16</td>
<td>48*</td>
<td>214.7</td>
<td>34.1</td>
<td>6.3:1</td>
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<td></td>
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<tr>
<td>Alfalfa (17.5% protein)</td>
<td>1.61</td>
<td>0.24</td>
<td>28</td>
<td>204.7</td>
<td>30.5</td>
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<tr>
<td>Grain mix (1)</td>
<td>0.09</td>
<td>0.35</td>
<td>20</td>
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<td>31.8</td>
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<td></td>
<td>0.98</td>
<td>0.29</td>
<td>48*</td>
<td>212.9</td>
<td>62.3</td>
<td>3.4:1</td>
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<td>1% Bone meal added to grain</td>
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<td></td>
<td></td>
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<tr>
<td>Alfalfa (17.5% protein)</td>
<td>1.61</td>
<td>0.24</td>
<td>28</td>
<td>204.7</td>
<td>30.5</td>
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<tr>
<td>Grain mix (2)</td>
<td>0.40</td>
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<td>36.3</td>
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<td>1.11</td>
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<td>48*</td>
<td>241.0</td>
<td>74.1</td>
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<td>1% Monosodium phosphate added to grain</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Alfalfa (17.5% protein)</td>
<td>1.61</td>
<td>0.24</td>
<td>28</td>
<td>204.7</td>
<td>30.5</td>
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<tr>
<td>Grain mix (3)</td>
<td>0.09</td>
<td>0.71</td>
<td>20</td>
<td>8.2</td>
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<tr>
<td></td>
<td>0.98</td>
<td>0.43</td>
<td>48*</td>
<td>212.9</td>
<td>94.0</td>
<td>2.3:1</td>
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<tr>
<td>1% Bone meal added to grain</td>
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<td></td>
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<tr>
<td>Alfalfa (17.5% protein)</td>
<td>1.61</td>
<td>0.24</td>
<td>14</td>
<td>102.3</td>
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<td>Corn silage</td>
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<td>19.1</td>
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<tr>
<td>Grain mix (2)</td>
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<td>0.48</td>
<td>20</td>
<td>36.3</td>
<td>43.6</td>
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<tr>
<td></td>
<td>0.72</td>
<td>0.33</td>
<td>48*</td>
<td>157.7</td>
<td>72.3</td>
<td>2.2:1</td>
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<tr>
<td>1% Monosodium phosphate added to grain</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
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<td>14</td>
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<td>0.07</td>
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<tr>
<td>Grain mix (3)</td>
<td>0.09</td>
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<td>20</td>
<td>8.2</td>
<td>63.5</td>
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<td></td>
<td>0.60</td>
<td>0.42</td>
<td>48*</td>
<td>129.6</td>
<td>92.2</td>
<td>1.4:1</td>
</tr>
</tbody>
</table>

* Air Dry Basis
In the feeding of potentially high-producing dairy cows during the period of heavy milk production, few considerations are more important than maintaining maximum voluntary feed intake. This report compares two approaches to the problem of maintaining maximum intake of digestible nutrients: (1) high-protein forage with minimum grain and (2) free choice grain with corn silage.

A requisite for maximum consumption of any particular ration is high digestibility. Only average milk production can be maintained even in the best cows if they digest less than 65% (60% TDN content) of the dry matter in a ration (Ohio Farm and Home Research, 1964:49 (1): 13.). On the other hand, most cows reach their inherent capacity for milk production when they are digesting from 67% to 75% (62% to 70% TDN content) of the dry matter from the feed consumed.

In the first phase of a 2-year study, two groups of cows were compared on widely different rations. Each ration was composed of commonly used feed sources considered to be highly digestible.

The high-protein forage ration was composed of 3 parts of field chopped dehydrated alfalfa hay (19% to 21% total protein), 3 parts corn silage (wet basis), and 1 part corn and cob meal. On the dry basis, these ration constituents were present in a 3:1:1 ratio. Maximum amounts of grain eaten were 10 to 12 lb. daily. Supplements of bonemeal and salt were also fed.

The high protein forage ration was compared with free choice feeding of a high protein (18% total protein) grain concentrate ration in conjunction with corn silage. The concentrate ration consisted of corn and cob meal, soybean oil meal, bone meal, and salt. Maximum amounts of grain concentrate eaten were 36 to 42 lb. daily.

The 305-day milk yields are noteworthy in these experiments. Among cows fed the high-protein chopped alfalfa, the highest producing Holstein yielded 22,777 lb. of milk and 720 lb. of fat. The highest producing Jersey yielded 9800 lb. of milk and 503 lb. of fat.

Among the cows fed grain concentrate free choice with the corn silage, the highest producing Holstein cow yielded 21,090 lb. of milk and 665 lb. of fat. The highest producing Jersey yielded 11,552 lb. of milk and 639 lb. of fat. The combined average yield of the three Holsteins on these rations was 20,271 lb. Both protein sources were used efficiently.

These results provide evidence for the high nutritive value of immature high-protein forages. Moreover, it is suggested that the total protein requirement of cows producing up to 105 lb. of milk...
daily may be met with alfalfa as the sole source of protein concentrate and a minimum level of grain feeding.

There is no question that feeding of excellent quality forage is a practical means of obtaining high milk production. Similarly, the high productivity obtained with cows fed free-choice grain concentrates and corn silage offers an alternative program when such feeds become economical or managerial choices.
YOUR STORED FEEDING PROGRAM

Avery D. Pratt
Department of Dairy Science

Stored feeding is not new. It has been practiced since man first domesticated animals. The making of hay is a familiar example. Stored feeding for summertime use is relatively new, however, and it has both advantages and disadvantages.

The labor required for making and storing hay and silage is great compared with driving cows to and from pasture. Power and machine costs also are high. On the other hand, the increase in degree of utilization of the forage crop justifies higher harvesting costs.

Pasture research at the Research Center has shown from 20 to 30 percent more milk per acre from rotational than from continuous grazing. Strip grazing has returned about 15 percent more milk per acre than rotational grazing due to more complete utilization of the crop grown. Green chopping alfalfa-bromegrass and feeding in dry lot has resulted in double the milk per acre compared with continuous grazing.

Blowing the green crop into the silo in a continuous operation is more economical of time than interfering with other farming operations to harvest a single load each morning and afternoon. With modern equipment, one man can fill silo alone. However, one man to do the chopping and two men to haul the crop makes a more efficient operation.

The use of a modern silage distributor avoids the necessity of keeping a man in the silo. A silo unloader and bunk feeder reduce the time and labor required for feeding.

Stored feeding makes it necessary to substitute capital for labor. At present labor costs, this substitution is usually economical as it permits a man to care for more animals. Often the number of cows that can be milked is the limiting factor and automated feeding helps to approach that maximum number.

Stored feeding eliminates the necessity for chopping under adverse circumstances such as during rain, when the ground is wet, or on week-ends and holidays. This practice also provides more flexibility in the feeding program in dry weather. This crop may be cut when conditions are optimum and fed regardless of the weather.

Digestibility of 72 percent has been obtained on hay and high dry matter silage, both made when alfalfa-bromegrass was in the bud stage. This was the same as for green chop cut at the same stage of maturity. The loss by fermentation of 6 to 10 percent of the dry matter content of the crop in the silo is usually compensated for by a saving in time. The use of a silo that is not airtight, or poor sealing of the surface, may result in losses of 15 percent even when little spoilage is visible.

The more intensive methods usually require more careful supervision and workmanship to be successful.
Quality Forage Pays

Hay must be made before the stems become woody and unpalatable and digestibility low or milk production will suffer. The same is true of crops cut for the silo. Research has shown that hay has the same digestibility as the green crop from which the hay is made.

Earlier research at this Center has shown a decline in digestibility of dry matter from .3 to .5 percent daily from May 25 to June 20. As digestibility declines, the slowly digested fiber keeps the rumen distended and the cow does not get hungry as soon as when digestibility is rapid. Thus, with low digestibility, intake decreases.

High Dry Matter Silage

Research has shown that cows will eat at least as much and sometimes more dry matter from haylage than from hay. Making of haylage makes it possible to store the crop sooner than when it is made as hay. Since there are more periods of two rainless days than of three, more crop can be stored as haylage without rain damage.

The use of temporary silos for storage of high dry matter silage is not advisable. For this type of silage to keep well, air must be completely excluded. In a tower silo, the weight of overlaying materials packs the crop below and excludes the air. This is not accomplished as well in horizontal silos or stacks where 7 feet is usually the maximum depth.

Silage must be fed faster from a horizontal silo than from a tower silo. When the plastic cover is loosened to permit feeding from the end of a bunker, trench or stack, air is admitted under the cover and deterioration starts. In a tower silo, only the feeding surface is exposed to the air and so less deterioration occurs.

The cost per ton of storage of either hay or silage is reduced by repeated use and emptying during the year.

Corn and Legume Silages

For dairymen who have both corn and legume silages, it is more economical to feed them together. Corn is high in energy but low in lime, phosphorus, and protein content. Alfalfa silage is rich in protein and lime and fairly rich in phosphorus. So it supplements corn silage well.

For cows in medium production, a mixture of the two silages with ground corn as a source of energy and steamed bonemeal as a source of phosphorus will meet their nutritional needs. For cows in high production, some protein supplement should be added to the ground corn. If corn silage is fed alone, a large amount of protein supplement must be supplied. If alfalfa haylage is fed as the only forage, protein is wasted for cows in medium or low production.
Summary

Stored crops must be harvested while still immature if the product is to be palatable and highly digestible. Cows on pasture can do selective grazing but this practice is limited when the crop is machine harvested.

Stored feeding permits economy of labor in harvesting and feeding.

The uniformity of crops cut at their peak of quality minimizes the variations in daily production so apparent in some methods of pasturing.

The choice between stored feeding for summer use and the various systems of grazing may be dictated by storage facilities, machinery available, fencing, feeding areas, shade, and personal preferences.
For many years alfalfa has been the standard for comparing the value of forages in dairy cattle feeding. Alfalfa approaches the ideal forage crop—high yield, high quality as shown by animal response in milk production, an excellent protein source, perennial growth, and drought tolerance.

New developments have caused farmers to be interested in alternatives to alfalfa. The alfalfa weevil has appeared in most counties of Ohio and control programs already are required in some areas. The use of male-sterile lines of sorghums has made it easy to produce new combinations of sorghums and sudangrass, resulting in many new varieties on the market. Cheaper nitrogen fertilizer has made the more productive grasses another economic forage alternative, with dry matter yields comparable to alfalfa.

In studies at Wooster, the value of alfalfa in dairy feeding has been shown for grazing, green chop, and stored feed. Over 40 lb. of 4% FCM per day was obtained from the three utilization methods during the summer-feeding period from early May until September 1 from alfalfa-brome grass and a light feeding of grain. Conrad (2) calculated that a ration of early-cut alfalfa-brome grass (before May 31 in northern Ohio) and corn grain will supply the nutrient requirements for up to 80 lb. of 4% FCM per day.

Alfalfa harvested as green chop can yield 4 tons of dry matter per acre and 5 tons of dry matter as hay or silage. Grazing results in somewhat less TDN utilized and less milk per acre than from mechanical harvesting. In studies at Wooster, rotational-grazing required 0.84 acre per cow for a summer season of 118 days, 0.74 acre for daily strip grazing, 0.55 acre for green chopping, and 0.45 acre for stored feeding, using the first crop as silage and the second and third crops for hay. All of these values are based on animals also getting a light feed of grain (ground ear corn and oats).

The recent invasion of Ohio by the alfalfa weevil has caused much concern. Although the best control of the weevil would be resistant alfalfa varieties, these are not available and may not be for some time. Resistance to the weevil has been difficult to find and so far has been found only in a low-yielding Algerian alfalfa. Experiments are underway to attempt to control the weevil by releasing a parasitic wasp which lays its eggs in the weevil larva. It is still too early to know how effective this approach will be for weevil control.

Currently the only control method for the alfalfa weevil is the use of insecticides. Application of insecticides costs about $9 to $11 per acre for spray applications and $13 to $16 where three applications are needed (1). This includes the cost of custom application. For 4-ton yields, this would be an increased cost of about $2.25 to
$2.75 per ton for two applications and $1.80 to $2.20 per ton for 5-ton yields.

There are some objections to spraying because of interference with spring work and to driving spray rigs over standing hay. Many farmers do not have spray rigs. Custom spraying with wide-boom rigs or by air overcomes these objections to some extent.

There are a number of alternatives to growing alfalfa. These need to be considered carefully because each requires changes in cropping management and feeding programs.

Birdsfoot trefoil and red clover are legume alternatives to alfalfa which do not require weevil control. Trefoil will yield two-thirds to three-quarters as much as alfalfa, generally about a ton less compared with good alfalfa yields. It is more difficult to establish and seed costs are much higher than for alfalfa. Trefoil will generally be successful only in northern Ohio.

Red clover-grass mixture will give yields comparable to alfalfa-grass the first year. However, second-year meadow would require $8 to $9 worth of nitrogen fertilizer (80 to 90 lb. per acre) plus the cost of several applications to equal the yield of alfalfa-grass.

Pure stands of bromegrass or orchardgrass with high rates of nitrogen fertilizer will yield as much as alfalfa-grass mixtures if moisture is adequate. The cost of the extra fertilizer would be $12 to $14 per acre (120 to 140 lb. of nitrogen) plus the cost of several applications. In dry years, grass yields will be much less than from drought-tolerant alfalfa. Studies at New Jersey have shown considerable lower intake and digestibility with nitrogen-fertilized orchardgrass than with alfalfa, resulting in lower milk production.

Sudangrass and sorghum-sudangrass crosses are used primarily as green chop and grazing. Under a green chop program, these materials will yield 3 to 4 tons of dry matter per acre. Good quality forage can be obtained from these materials but yield and quality is lower than alfalfa-grass. During the past 3 years, alfalfa-bromegrass has consistently outyielded sorghum-sudangrass materials by a ton or more per acre. Dry matter digestibility of sorghum-sudangrass as green chop was 60% to 62% in the Wooster studies, compared to 72% for early alfalfa-bromegrass (May 25-29 harvest).

Another consideration is the annual cost of reseeding and nitrogen fertilizer for growing sorghum-sudangrass materials. The cost of annual seeding is about $15 per acre for seedbed preparation, seeding, and seed. Nitrogen fertilizer is necessary to obtain high yields, adding another $10 per acre (100 lb. of nitrogen per acre) plus application costs (1).

Corn silage is suggested as an alternative to alfalfa, particularly for winter feeding. It is primarily a high-energy feed and
is not a replacement for alfalfa in the sense that alfalfa is a high protein feed. Each complements rather than replaces the other.

Summary

A number of possible alternatives to alfalfa have been discussed. Alfalfa is an excellent forage and is unsurpassed in terms of yield and quality. Forage alternatives to alfalfa all have some limitations which need to be considered carefully before changing the forage program.

Control of the alfalfa weevil requires an added cost in growing alfalfa. However, alternative crops also require added costs in terms of seed and fertilizer or a reduction in feed quality or yield.

References


Assume that a milk market has the following price structure:

- Class I price - $5.00
- Blend price - $4.00
- Class II price - $3.00

If a farmer decides to sell an extra 100 pounds of milk daily in that market, what price will he receive for that extra milk? What is that extra milk actually worth on the basis of how it is utilized? The answers to these two questions are that he will get paid $4.00 but the additional milk will have an actual market value of only $3.00.

This illustration explains why many people feel that present blend pricing procedures have a basic defect. The blend price provides an extra incentive for producers to increase their marketings as compared to the Class II price. When many producers in the market decide to increase marketings because the blend price appears favorable, the blend price starts decreasing because the Class II price then becomes a more important factor in determining the blend price.

With a Class I base plan in operation, the incentive that producers now have to expand production in response to the blend price would be diminished. Producers would be paid the Class II price for additional marketings instead of the blend price.

At the present time, proposed national legislation would amend the Agricultural Marketing Agreement Act of 1937 to permit assignment of Class I bases to individual dairy farmers. Under this legislation, Class I bases could be assigned to producers selling milk in a Federal Order market if two-thirds of the producers in the market approved the plan in a referendum. Since most of the 15,000 Grade A dairy farmers in Ohio sell their milk in Federal Order markets, the potential impact in this state is substantial.

In a market where the plan has been approved, a producer would be assigned a base in terms of his normal production volume as related to the market's utilization of Class I milk. For example, if a producer shipped 1 percent of a market's total milk supply during the base establishing period (which might be a recent 12-month period), then that producer would be assigned a Class I base which would guarantee him the Class I price for 1 percent of the market's total Class I utilization for a given pay period. For milk he marketed in excess of 1 percent, the producer would receive the Class II price (not the blend price as in the present situation.)
It should be emphasized that the Class I base plan is not a means of controlling production. A dairy farmer would be free to market as much milk as he desires.

Consumer milk prices and Class I and Class II prices would not be affected. The total amount of money in the market pool to be paid producers would not be affected. Only the method of paying producers, in terms of a base price and an excess price, would differ from current procedures.

Some producers would find the plan helpful to their net income position, while others would not. Any milk producer with variable costs less than the Class II price, however, would hurt their income position if they cut production back to their base amount of milk.
FLUID MILK PRICING

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Dairymen receive a blend price for their milk, derived from two different prices based upon the eventual use of the milk. Why this pricing system? The unique nature of the product is partially responsible.

Milk is highly perishable, bulky in fluid forms, and somewhat seasonal in production. Strict sanitary requirements are set for milk used in fluid form. Demand for manufactured dairy products is quite different from the demand for fluid milk.

To strengthen their bargaining position, early cooperatives moved away from "flat pricing" to a concept of "classified pricing" based on the use made of the milk. Classified pricing helped farmer organizations bargain for a higher price for milk used in fluid form, channeled surpluses into manufacturing uses at competitive prices, and helped increase dairy farmer income.

Under the Northeast Ohio Federal Order, prices are established for each class of milk as follows:

**Basic Price:** Average price per cwt. f.o.b. for manufacturing milk plants in Minnesota and Wisconsin as reported by USDA (represents the general value of milk when converted into dairy products such as butter, cheese, and nonfat dry milk and sold on the national market).

**Class I Price:** Basic price plus a specified differential designed to account for extra costs of producing inspected milk, transportation, and other economic conditions. The differential is subject to a supply-demand adjustment, based upon relationship of supplies to Class I sales.

**Class II Price:** Basic price or butter-powder-formula price plus 10 cents, whichever is lowest. The butter-powder price is based upon the wholesale prices of butter and non-fat dry milk as reported at the major Chicago market.

**Pooling:** Method of distributing money among producers supplying milk to a market. In Northeast Ohio, there is a market-wide pool. The market administrator compiles the amount of milk used in each class each month. The total pounds of milk used in each class are multiplied by the price established for that class, these values are added together and then divided by the total pounds of milk to get a uniform pool or blend price.

**Producers Settlement Fund or Equalization:** Method used for handlers to have equal costs based upon their use of milk.

The fluid milk pricing system is based upon the characteristics of milk as a product and the differences in demand for fluid milk and manufactured dairy products.
The nerve and hormonal pathways in milk letdown: Dairymen today are still trying to match the calf in obtaining a complete milk letdown at milking time. As knowledge of the forces involved in obtaining a good letdown increases, a closer simulation to the ideal letdown obtained by the suckling calf is obtained.

The letdown response involves two pathways: the nerve pathway from the udder to the hypothalamus and the hormonal pathway from the hypothalamus to the udder. The hypothalamus is a ventral subdivision of the brain that is involved in the formation and release of oxytocin (the milk letdown hormone).

The letdown response is initiated by stimulating nerve endings in the skin of the udder, especially the skin of the teats. These nerve endings are primarily stimulated by pressure and warmth. This is the basis for the recommendation of a 30-second massage with warm water when washing the udder. A vigorous message is more beneficial than a light, delicate washing of the teats only.

A nerve impulse travels from the nerve endings to the hypothalamus through the spinal cord and stimulates the release of oxytocin from the hypothalamus and pituitary gland into the bloodstream. The oxytocin is then carried to the udder through the arterial blood supply where it acts upon the myoepithelial cells of the udder. The myoepithelial cells are muscle cells within the udder that surround the alveoli (small milk storage sacs) and are responsible for milk letdown when stimulated to contract by oxytocin. The milk is then forced out of the alveoli and passes through the duct system of the udder to the teats, where it is removed by the milking machine.

The time from stimulus to the appearance of milk in the teat is about 1 minute. This determines the time that the milking machine should be put on after the cow is stimulated for milk letdown. The letdown hormone, oxytocin, is rapidly removed from the bloodstream by the kidneys and through its use by the myoepithelial cells. Normally the dairyman has an effective oxytocin time of about 6 to 8 minutes in which milk should be removed from the udder.

The amount of oxytocin released is independent of the amount of milk in the udder but is related to the degree of stimulus.

The effect of back pressure on milk secretion: The amount of back pressure built up in the udder between milkings depends upon the amount of milk secreted and upon the physiological capacity of the udder. The intramammary pressure gradually increases from one milking to the next until the elastic expansion capacity of the udder is reached, at which time there is a distinct increase of intramammary pressure.
Recent work indicates that 80 percent of the storage capacity must be utilized before back pressure interferes with the rate of milk formation. Work carried out at the Research Center indicates that a production level of 65 to 70 pounds of milk on twice-a-day milking is about the level of production where back pressure affects the rate of milk formation.

REFERENCES


WHAT MAKES A COW A COW

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Ruminants, animals with four compartments in their stomach, are expected to produce milk, meat, leather, and wool while consuming rations high in fiber and relatively low in digestibility. In this way, they produce edible and useful products for human consumption from feedstuffs that cannot be used by human beings or monogastric animals such as swine.

Dairy cows are not capable of digesting the fibrous material (cellulose) found in forages. This function is carried out for them by the bacteria and protozoa living in the cow's rumen. These microorganisms digest the cellulose, take out a living wage that they use to live and reproduce, and leave end products useful to the cow. Since both the microorganisms and the cow profit from this process, it is called a symbiotic relationship.

The major energy furnishing end products produced by the microorganisms are acetic, butyric, and propionic acids. Acetic and butyric acid are important precursors of both milk and body fat. Propionic acid is used in the synthesis of lactose (milk sugar).

Although the bacterial population of the rumen remains fairly constant, significant changes take place each time rations are changed. Conrad and Hibbs have found that it takes from 3 to 6 weeks for rumen bacteria to adjust to a sudden change from corn silage to grass-legume silage. Therefore, it is wise to feed the same ration throughout the barn-feeding season. If changes must be made, they should be made gradually.

When urea is included in dairy rations, the rumen bacteria are able to manufacture protein for their own use from the urea and starch in the grain mixture. The dairy cow then digests the bacteria and in this way obtains protein synthesized from the urea. Without the help of bacteria, a dairy cow could not use urea.

Dairy cattle nutritionists have observed that rumen bacteria are capable of synthesizing all of the known B vitamins. Enough of these vitamins are produced to supply the needs of the bacteria and the cow, too. Therefore, B vitamins do not need to be provided in dairy rations.

A brown cow can eat green grass and produce large amounts of nutritious white milk only because of the help she gets from the bacteria in her rumen. So dairy rations are compounded to feed both the microorganisms and the cow. If cows did not have rumens and large populations of rumen bacteria, dairy rations would need to be much like swine rations.
The relationships between type and production have long fascinated dairymen interested in using visual estimates of producing ability. Some external estimates have been used in a selection program long enough so their selective value for further improvement is now gone. A few remain. Some that were talked about probably did not exist, meaningfully, in the first place. Some of these relationships have been reviewed in previous brochures.

Swett, Matthews and Plowman* recently reported on the results of their 30-year study of production and possible related anatomical structures. These reports deal with measures of internal organs and tissues. The highest degree of correlation with production was found for the total weight of blood removed from a cow at the time of slaughter. This relationship was highly significant for both Jerseys and Holstein-Friesian cows. It existed whether the blood weight was compared to either the first lactation or to the highest lactation record. Other relationships found to be significant, or highly significant, were between production and length of the small intestines, liver weight and the weight of the kidneys. A significant correlation was also found to exist between production and the depth of the chest at the ninth vertebra.

Certain significant correlations were found for one breed that did not exist for the other. For example, the amount of fat in either the chest or abdomen was negatively related to production in Jerseys but was not found to be related to production in Holsteins. The length of the large intestine was related to production in Holsteins but not in Jerseys.


Both papers were presented at the Sixtieth Annual Meeting of the American Dairy Science Association, University of Kentucky, Lexington, Kentucky, June 20-23, 1965.
Comparisons also were made between the internal measurements and certain exterior measurements. The weight of the blood was most closely related to the live weight at the time of slaughter. It was next most closely related to the width of the cow as indicated by the pin bones and to height as indicated by any of the common measures for that trait, i.e. withers, hips, or pin bones.

Weights of the endocrine glands (pituitary gland, pancreas, thyroid, and adrenals) were not significantly related to external weights or other measurements or to production records. This finding corroborated other work which also suggests that the weight of these important glands is not related to the production of their particular hormone. The relation of the hormones to udder development and secretion has been established by other investigators.

All of these observations help, therefore, to account for the low relationship between actual producing ability for a lactation and the external anatomy. Anatomical traits that indicate wearing qualities, udder attachments, quality, feet, and legs are more likely to be found related to lifetime production.
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