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FEEDING DAIRY COWS

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This brief publication endeavors to put forth the principles as well as the practices of feeding dairy cows. The major part of the written matter has been presented many times in answer to inquiries regarding the feeding of dairy cattle on Oklahoma farms. It endeavors to answer specific questions relative to the use of home-grown and purchased feeds used in parts of the South. The first few paragraphs are introductory, telling how dairy cows fit into our system of farming. In order to know how to feed a milk cow, one needs to know in what ways the feeds are used, and what classes of nutrients the feeds must provide.

Why do good dairy cows require more and different feeds in order to be most profitable? How does one feed compare with another? Why are legume hays and pastures better than grass roughages and pastures? How much feed does a Jersey cow or a Holstein cow need? What feeds should be ground? These, and other questions, are answered in the next few pages.

During periods of financial depression in agriculture, interest in dairying expands. Single-crop farming usually brings an income during only one season of the year. When insect attack or weather have been unfavorable, or market returns are low due to poor quality or lack of demand for the product, people turn to more dependable methods of farming. Single-crop farming is more or less speculative. When the year's income from speculative farming has been small, and farmers are pressed for money to meet daily living expenses, they turn toward less speculative methods of providing a living. The milk cow, sow, hen and farm garden become more popular. These provide a good living, and aid in tiding over periods of depression. They are dependable sources of farm profit, and should be a part of nearly every farm enterprise.

The milk cow's popularity has a sound basis. The dairy cow provides a cash market for feed and labor every day in the year. She turns pasture grasses, coarse feeds and farm grains into food for the farmer's table. The dairy products provide a better living and at a lower cash outlay for purchased foods. Much of the fertility in the feed crops is returned to the land as manure and becomes available to maintain large crop yields. The more successful dairymen grow legumes and purchase some concentrates such as wheat bran and limited amounts of cottonseed meal. By these acts they add to the fertility of the land. When the milk cow makes farming more profitable in all of these ways is it any wonder that men engaged in dairying with good cows find it a satisfactory part of the farm business?

The greatest success in dairying comes to those who understand and use good management and proper methods of feeding. Dairy cows differ greatly from other classes of cattle in their feed requirements, both in amounts and kinds of feeds needed. Cows must be managed very differently from other classes of cattle, if they are to be most profitable.

HOW THE DAIRY COW USES FEED

A dairy cow uses feed for six different purposes in the body, namely:

1. To maintain the body;
2. To produce the calf;
3. To manufacture milk and butterfat;
4. For growth, if not of mature age;
5. For work in grazing;
6. To build body fat.

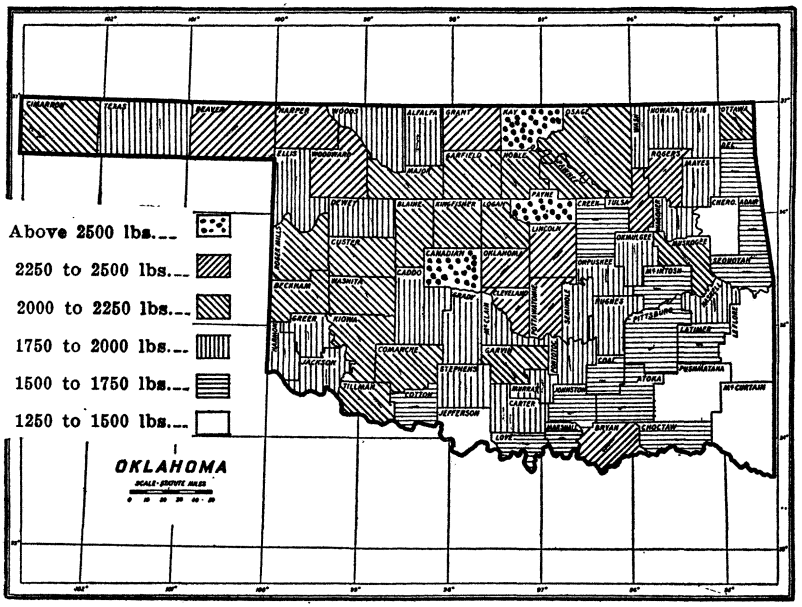

Figure 1.—Average Milk Yield Per Cow in 1919.

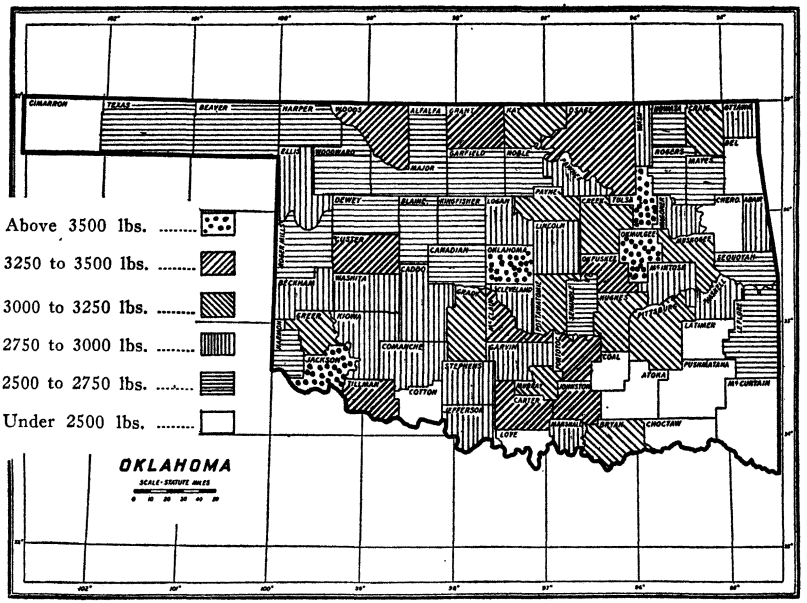

Figure 2.—Average Milk Yield Per Cow in 1924.

The increase in average milk yield per cow (from 2,012 to 2,865 pounds) has been brought about through better feeding, and by improving the quality of the cows through the use of purebred dairy sires.

The amount of milk and butterfat that can be obtained from a milk cow is limited by three factors, which are (1) heredity, (2) feed, and (3) management. Heredity or inheritance limits the maximum amount of milk and butterfat which a cow can produce, when she is provided the best feed and care. Heredity causes the difference between breeds of cattle and between cows of the same breed. Thus Jerseys yield smaller amounts of rich milk, while Holsteins give larger amounts of milk that contain smaller percentages of butterfat. Within any one breed cows vary considerably in their inherited ability to produce milk and butterfat, and in the tendency to be persistent producers.

In order to feed a cow so that she can produce up to her inherited capacity, it is necessary to know the classes of nutrients contained in milk, and to provide them in the feeds used.

Haecker investigated the feed requirements of milk cows. He found that milk low in butterfat, is also low in other food solids. Less pounds of feed are required to make 100 pounds of such milk. He also found that rich milk requires more pounds of feed to produce it, but that less feed is required to make each pound of butterfat in rich milk. This is easily understood when one knows the average composition of such milk, as given in Table I. Note that the cow giving rich milk makes only 1.7 pounds of other milk solids for each pound of butterfat, and that milk low in fat also contains less pounds of other solids in 100 pounds of milk.

Table I. Composition of Milk High and Low in Butterfat Content

	Water %	Fat %	Proteins %	Sugar %	Ash %	Ratio of Fat to Other Solids
Milk high in fat	85.83	5.00	3.45	4.99	0.73	1 to 1.7
Milk low in fat	89.00	3.00	2.68	4.60	0.72	1 to 2.4

In 1923, Professor A. C. Baer of the Dairy Department, purchased twelve common scrub cows for use in experimental work at the Oklahoma Agricultural Experiment Station. These cows were given the same feed and care as the purebred cows in the college dairy herd. A few of these cows had the inherited ability to make a fair amount of milk, and were fairly profitable when properly fed and managed. Most of them did not have the inherited ability to use large quantities of feed to make milk and butterfat.

The best scrub cow produced 5,883 pounds of milk annually for four years and gave birth to a calf each year. In producing this yield of milk, the scrub cow made annually 258 pounds of butterfat, 192 pounds of milk proteins, 291 pounds of milk sugar and 42.76 pounds of ash (mineral matter). Each year she produced more protein, as much ash, three-fourths as much fat and 291 pounds more sugar than was contained in the entire body of a 1250 pound fat steer analyzed at the Missouri experiment station. In addition to putting these food solids into the milk each year, this cow used feed to maintain her own body and to produce a calf.

From the above statement, one may understand why the dairy cow's feed must provide protein, mineral matter and other digestible nutrients. A blacksmith does not make wagons without iron and steel, nor does a milk cow yield larger quantities of milk than are provided for by the feed.

CHARACTERISTICS OF FEEDS

Forage crops vary in composition and value for feeding livestock. These crops and their by-products can be separated into groups similar in character and in relative value for use in dairy rations.

When the chemist analyzes a feed, he finds the amount of water, fat, ash and carbohydrate material such as crude fiber and "nitrogen-free extract," (starches and sugars), present in it. The protein, fat, ash and carbohydrates are each useful to the dairy cow.

Proteins are needed for growth. They enter into the composition of muscle, bone and body fluids; maintain the body; are used in developing the body of the baby calf, and make milk proteins. Ash or mineral compounds (lime, phosphates, common salt, etc.) are in the blood and digestive juices. These maintain the skeleton, and especially make the ash in milk. Fats, sugars and starches are burned in the body to provide heat and energy, or are used to build body fat, butterfat and milk sugar. Some crude fiber is necessary to give a limited amount of bulk to the feed, and to aid in digestion. However, feeds that contain too large amounts of crude fiber are usually not desirable in dairy rations under average conditions, because more energy is used in digesting a pound of crude fiber in the body, than the cow gets from this material after it is digested.

Feeds commonly used for dairy cows divide themselves naturally into six general classes, as follows:

1. Legume hays;
2. Grass hays;
3. Farm grains and oil seeds;
4. Milling by-products;
5. Succulent feeds and pasture crops;
6. Miscellaneous feeds.

The important differences between the legume and grass roughages are that the legumes provide more protein and mineral matter. The cow depends upon the roughage for lime, since all of the farm grains and milling by-products are poor sources of this mineral. On the other hand, the grains and milling by-products provide a large amount of digestible protein, starch, sugar and fat in a concentrated form as well. The grains and especially the milling by-products are the most important sources of the phosphate portion of the mineral matter. Roughages usually contain at least 25 per cent to 30 per cent of crude fiber. Feeds containing more than 30 per cent of crude fiber are not desirable in dairy rations except under rather unusual conditions, as for example, a lack of bulky feeds (oats, bran, etc.) in the grain ration or a shortage of more valuable roughages. Succulent feeds are high in water content, but vary widely in other characteristics.

The characteristic feed values which distinguish the different classes of typical southwestern feeds are illustrated in Table II. Note the wide differences in the content of water, digestible crude protein, total digestible nutrients, crude fiber, lime and phosphorus between these classes of feeds.

If a cow is to be fed only a single feed, she will thrive longer and produce more milk and butterfat on a legume hay alone, than on any other single feed. It is impossible to even have a cow survive for a long period of time when fed only on straw, or on cottonseed hulls, or even on a ration consisting solely of grains. Even on a ration of alfalfa hay, the cow cannot eat enough of such bulky material to permit her to be a very heavy producer of milk and butterfat. The Kansas experiment station found that grade Holstein cows receiving only alfalfa hay could produce an average of 150 pounds of butterfat yearly, even though they had an inherited capacity to make far larger yields. When a grain allowance was fed along with roughage, these cows made larger and more profitable yields.

In general, roughages are the main source of lime in the rations of milk cows. Roughages are relatively high in crude fiber, and on this account yield less total digestible nutrients than do farm grains. Roughages as a whole are low in phosphates (needed for bone, blood and milk), though legume hays contain over twice the amounts found in grass hays. BECAUSE LEGUME HAYS CONTAIN SO MUCH MORE DIGESTIBLE PROTEIN AND MINERAL MATTER, AND ARE APPROXIMATELY

EQUAL TO GRASS HAYS IN OTHER RESPECTS, THEY ARE THE BASIS OF MOST GOOD DAIRY RATIONS. Legume hays are widely used on this account, and usually result in larger yields and greater profits per cow than can be obtained under most conditions with grass hays.

Table II. Composition of Different Classes of Feeds

	Water %	Digestible Crude Protein %	Total Digestible Nutrients %	Crude Fiber %	Lime CaO %	Phosphorus P_2O_5 %
Legume roughages:						
Alfalfa hay	8.6	10.6	51.6	28.3	1.95	0.54
Soybean hay	8.6	11.7	53.6	24.9	1.72	0.68
Cowpea hay	9.7	13.1	49.0	22.5	2.54	0.96
Peanut hay, pulled (nuts removed)	9.5	6.9	57.8	24.3	1.49	0.25
Peanut hay, mowed	18.1	7.0	52.8	20.7	1.77	0.29
Grass roughages:						
Prairie hay	6.5	4.0	47.9	30.5	0.60	0.24
Sudan hay	5.5	3.7	51.4	26.9	.....	.....
Kafir fodder, dry	9.0	4.1	52.9	26.8	0.27	0.30
Sorghum fodder, dry	9.7	2.8	52.1	26.1	0.39	0.23
Johnson grass hay	10.1	2.9	50.1	30.2	.....	0.42
Miscellaneous roughages:						
Oat straw	11.5	1.0	45.6	36.3	0.39	0.21
Wheat straw	8.4	0.7	36.9	37.4	0.29	0.13
Corn cobs	10.0	0.4	48.1	31.8	0.02	0.11
Cottonseed hulls	9.7	0.3	37.0	43.8	0.18	0.08
Peanut shells	9.1	0.4	38.1	56.6	0.31	0.15
Farm grains:						
Corn, No. 2 dent	14.9	7.1	81.7	1.9	0.02	0.66
Kafir	11.8	9.0	80.0	2.3	0.02	0.57
Darso	11.7	9.2	79.8	3.6	0.02	0.49
Oats	9.2	9.7	70.4	10.9	0.14	0.81
Soybeans	9.9	33.2	94.1	4.3	0.29	1.37
Milling by-products:						
Wheat bran	10.1	12.5	60.9	9.5	0.09	2.95
Corn gluten feed	8.7	21.6	80.7	7.1	0.35	0.62
Cottonseed meal, choice grade	7.5	37.0	78.2	8.1	0.36	2.67
good	7.9	31.6	74.8	11.5	0.35	2.66
Linseed oilmeal	9.1	30.2	77.9	8.4	0.51	1.70
Succulent feeds:						
Corn silage	73.7	1.1	17.7	6.3	0.12	0.16
Kafir silage	69.2	0.8	15.4	9.9	0.09	0.10
Sorghum (cane) silage	77.2	0.6	13.3	6.9	0.11	0.08
Mangels	90.6	0.8	7.4	0.8	0.02	0.04
Field pumpkins	91.7	1.1	6.7	1.3	.....	0.09

The above data are secured from the eighteenth edition of "Feeds and Feeding" by special permission of Director F. B. Morrison, of the New York Experiment Station; Ohio Bulletin 255; Minnesota Bulletin 229; Texas Bulletin 222, and analyses by Willis D. Gallup and N. B. Guerrant at the Oklahoma Agricultural Experiment Station.

Farm grains—corn, kafir, barley, oats, etc.—are especially valuable sources of digestible nutrients, as they contain little crude fiber. They are especially lacking in lime. Farm grains provide more phosphorus than the roughages, but are not quite as valuable in this respect as are the milling by-products.

The oil-bearing seeds—cottonseed, peanuts, soybeans and flax—often have a higher cash value on the market than as dairy feeds, and so can be profitably exchanged for cottonseed meal, linseed oilmeal, and other high-protein milling by-products. Large amounts of whole cottonseed fed over an extended period sometimes have an injurious effect upon the cow, and

should not be fed for this reason. The problem of feeding whole cottonseed is discussed in more detail in another paragraph.

Milling by-products such as wheat bran, cottonseed meal, linseed and soybean oilmeals, peanut oilmeal and feed, corn gluten feed, etc., are generally the richest sources of protein and phosphorus in the dairy cow's ration. They contain less carbohydrates than the farm grains, but have slightly more crude fiber. Because of their effect upon the animal, some of the oilmeals give better results when used only in the amounts needed to balance the ration. Protein feeds are often higher in price than carbohydrate feeds, and on this account it is profitable to limit their use to the above amounts.

Succulent feeds include a wide variety of crops of varying characteristics. Among these are the winter pastures such as wheat, rye, barley and winter oats. Root crops, especially mangels, are important in Oklahoma with small dairy herds. Silage can be used profitably with larger herds, and may be made from sweet and grain sorghums, corn, sunflowers, or other crops adapted to this purpose. Pumpkins, stock squashes, sugar beet pulp and other miscellaneous products are included in the list of succulent dairy feeds.

The chief characteristics which all succulent feeds have in common, are that they are high in water content, very palatable, have a beneficial mild laxative effect upon the animal, and furnish digestible nutrients. The best dairy rations contain some succulent feeds throughout the entire year.

Miscellaneous feeds include straws, cottonseed hulls, peanut hulls, oat hulls, so-called stock tonics, etc. In general, cereal straws, hulls and similar feeds contain such a large amount of crude fiber, and so little digestible protein and mineral matter that they are seldom used in dairy rations. Stock tonics often contain some useful feeds such as cornmeal, linseed oilmeal, common salt, and some mineral matter along with small amounts of various drugs. It is better to buy cornmeal, oilmeal, etc., at the feed stores, and to employ a licensed veterinarian to treat sick animals. Well-fed animals are less subject to disease than are those that are neglected and undernourished.

CHARACTERISTICS OF A GOOD DAIRY RATION

Some of the principles just discussed, aid in giving an understanding of the characteristics of a good dairy ration. A sufficient quantity of feed must be provided to meet the cow's needs. The stomachs of a good cow are not large enough for her to depend wholly upon roughages. Roughages alone do not provide a sufficient amount of digestible nutrients to provide for a large quantity of milk and butterfat. Heavy producing cows require both grains and roughages in the ration.

A certain amount of bulk is necessary in the ration to give proper digestive action. Some grains are very concentrated, and so need the addition of other grains to give bulk and aid in giving the digestive juices access to them. Heavy feeds such as ground corn, kafir, cottonseed meal and ground soybeans, need additions of bulky feeds as ground oats and wheat bran. A grain ration is less desirable if it becomes pasty or doughy when wet. Bulky feeds such as bran, oats, corn and cob meal or kafir head chop, permit the grain ration to have a desirable crumbly friable consistency when moistened by the digestive juices.

Variety is necessary in the ration—that is, the ingredients should come from several plant sources. It is possible to make up a ration wholly from a legume, or from the corn plant alone, on which a cow can live and reproduce, but she cannot do her best on such a ration. It is impossible to make up a ration wholly from the oat, or from the wheat plant, that will give satisfactory results. Rations made up from most single plant sources are often lacking in certain minerals, or do not have all of the kinds of proteins necessary to fill the variety of needs in the body of a heavy producing dairy cow. On this account, it is common practice to combine feeds from several plant sources,

such as alfalfa, corn, wheat, oats and the cotton, flax, peanut, or soybean plant into a single good ration. Even then, some extra mineral matter such as common salt is often necessary.

Some succulent feed is needed by the milk cow at every season of the year. Legume and grass pasture, mangel beets and silage are the best succulent feeds in use. The succulent feeds provide digestible material, and are especially useful in the mild laxative action which they exert upon the digestive system of the cow. It has been found that the presence of fresh green feeds aids the cow in some way to digest and utilize the mineral matter, especially the lime and phosphorus in the feeds.

Cost of the ration per day, and the convenience of having most of it home grown, are factors of considerable importance. Effect of feeds upon the animal, and upon the dairy products must also be considered. Highly flavored feeds (such as silage) are given the cow just after milking in order to avoid imparting the flavor to the milk.

FEEDING RULES

The most economical and profitable dairy rations have a legume hay or pasture as a basis. During the winter months, the dairyman is fortunate if he has some succulent feed such as silage or mangels to use with the legume hay. In many parts of the state, winter wheat, barley, rye, and sometimes winter oats are available for pasture during favorable winter seasons. However, they cannot be relied upon wholly. Cereal pastures seldom provide succulence during a summer drouth.

Cows producing more than 150 pounds of butterfat in a year require both roughages and grains in the ration. Separate feeding rules apply to these classes of feeds. The roughages are fed in proportion to the body weight of the animal, while the grain ration is used in proportion to the yield and richness of milk.

1. Feed all the roughages that a cow will eat clean without waste. Careful observation of the feed consumed per day discloses that this usually follows closely one of the feeding rules given below.

   A. 20 pounds of dry hay or fodder per 1000 pounds liveweight, or
   B. 10 pounds of dry hay and 30 pounds of silage per 1000 pounds liveweight, or
   C. 10 pounds of dry hay and 50 pounds of mangels per 1000 pounds liveweight.

2. Feed grains in proportion to the yield and richness of milk. Increase the amount of grain slightly when used with lower quality roughages, or with cows yielding over one pound of butterfat daily. The protein content of the grain ration must be such that it is adapted for use with the roughages fed. Cows receiving legume hays require less protein in the grain ration.

If the entire roughage ration consists of legume hay or legume pasture, the entire grain ration may be made up of ground farm grains.

Should Rules B or C be followed, with a good legume hay (leafy alfalfa, soybean, cowpea, or sweet clover hay) and a succulent feed, use a grain ration (see the feed table on page 18) containing 16 percent of total crude protein, feeding:

   D. One pound of grain for each 3 pounds of Jersey milk.
   E. One pound of grain for each 4 to 4½ pounds of Holstein milk.

With cows producing over one pound of butterfat daily, add one to two pounds more grain. If the butterfat yield is up to 2 pounds daily, add three to four pounds more grain per day to the above rules.

With lower quality legume hays (stemmy alfalfa, red or crimson clover, peanut hay, etc.) and a succulent feed, use a grain ration that contains 18 to

20 percent of total crude protein. (See the feed tables on page 18. The amount of grain will need to be increased slightly over the amounts stated above.

Grass hays (prairie, Sudan, Johnson, cane hays and stovers) require the use of a grain mixture containing 20 to 24 percent of total crude protein, and also require that the quantity of grain be increased 10 to 15 per cent above that stated in Rules D and E. With the grass hays which are lower in mineral, it is better if mineral matter be added to the grain. One pound of very finely ground calcium limestone and one pound of finely ground feeding bonemeal may be added to each hundred pounds of grain.

If one must depend upon such low quality roughages, as cereal straws, cottonseed hulls, peanut hulls, etc., it is necessary to use a grain ration containing 24 per cent of total crude protein and to increase the quantity of grain 50 per cent over Rules D and E. It is advisable to add the mineral matter, as stated above.

Common salt should always be accessible, except in the Salt Plains regions, or in localities where the drinking water is high in common salt.

DAIRY FEEDS

Legume Hays:

Alfalfa is the most popular legume hay because of its large yields and high feeding value. The leaves contain more feed nutrients than the stems, and so hay having fine stems and retaining most of its leaves is considered more valuable.

Leafy soybean hay is equal to the best grade of alfalfa, and can be substituted for it pound for pound in the ration. Many varieties of soybeans are somewhat coarse and stemmy. Dairy cows refuse to eat much of the coarser portions of many varieties of soybeans, but relish hay from the finer stemmed varieties. Varieties of soybeans most commonly used in Oklahoma, are the Virginia in the northern section, Laredo in the central and southern sections, and Ootootan and Biloxi soybeans in the extreme southeastern counties.

Where cowpeas can be grown, they make a good quality of hay, about equal in value to alfalfa. Cowpea hay contains slightly more protein than alfalfa, but due to the coarser stems, there is some waste in feeding cowpea hay. The coarser stems contain less digestible nutrients than the finer portions and leaves of the plant. Annual legumes such as these are useful on tenant farms under the one year lease, since a longer time and greater expense are involved in establishing a field of alfalfa.

Sweet clover hay of fine quality is equal to alfalfa. The coarser stems are difficult to cure thoroughly, and make the hay less palatable. Moldy sweet clover hay should not be fed to cattle since this particular kind of mold sometimes has an injurious effect upon the blood, even causing the death of some animals.

Peanuts furnish considerable hay as a by-product of the nut crop. Spanish peanuts have a more erect growth than the larger Virginia and Tennessee varieties. It is a common practice to cut a hay crop from the erect-growing varieties and to harvest the peanuts with hogs. In many places, peanuts are harvested by pulling and piling the vines in tall narrow cocks about a stake with cross pieces near the base. When thoroughly cured, the nuts are removed, and the straw used as fodder for milk cows. Peanut hay is lower in protein and mineral matter than other legumes, but is more valuable than the grass hays. As a hay crop peanuts cannot compete with soybeans and cowpeas, but when grown for the nuts, the forage can be used successfully in feeding dairy cows.

Grass Hays:

The grasses are less valuable than legumes as hay crops, since they contain only one-third as much digestible protein and are lower in lime and phosphorus.

Sweet sorghums, including cane and Sudan grass, give heavy yields of dry hay per acre.

Prairie hay is a mixture of bluestem, Indian, the gramma, reed and other native grasses. The relative feeding value of prairie and Sudan hays depends upon fineness of foliage, and earliness of cutting. Hay cut early is less woody.

The stovers from corn, grain sorghums and sweet sorghums are almost equal to prairie hay in feeding value, when cut early and stored away from the weather. When the stalks are allowed to stand in the field to be leached by rains and the leaves blown away by winds, the largest part of their feed value is lost. This is one of the large wastes of farm feeds in the South.

Miscellaneous Roughages:

The cereal straws, especially from wheat, barley and rye, are low in digestible feed nutrients and in mineral matter. Oat straw is more valuable than other cereal straws, but less nutritious than prairie hay. Oat hulls and peanut shells likewise are practically valueless as dairy feeds. Ground corn cobs and cottonseed hulls are similar in composition and feeding value. All of these feeds are high in content of crude fiber, and so yield little digestible material to the cow over and above the energy required to digest them. Some of these feeds serve an excellent purpose in feeding fat steers, since they furnish bulk to the ration at a low cost, but only under exceptional conditions should they be used in feeding dairy cattle.

Farm Grains:

The farm grains, except oats, contain very little crude fiber, and provide much digestible material to the cow. They contain more phosphorus than any of the roughages, but are very low in lime content. Since good dairy cows cannot eat enough hay to provide the amount of digestible material needed for a large flow of milk, it is necessary to use grain in the ration, feeding it in proportion to the yield and richness of the milk, as stated in the Feeding Rules. With cows yielding over one-half pound of butterfat daily in summer, it is profitable to feed some grain when on pasture. Not all of the returns from feeding grain to cows on pasture are derived during that immediate time. The cows do not lose in body weight as rapidly. They hold up in milk flow longer. Grain properly used to supplement pasture, usually returns from five to seven dollars' worth of butterfat extra in the year for each dollar's worth of grain fed during the summer. All grains should be ground for dairy cows.

Corn is the most important grain used in feeding livestock, since it yields so heavily under good soil and moisture conditions. Corn provides much digestible starch, but is low in protein and mineral matter. The grain sorghums are nearly as valuable as corn, many of them containing slightly more protein but less starchy material. They are less palatable than corn. Grain from the sweet sorghums is approximately nine-tenths as valuable as corn, though cows find it less palatable. In some regions barley is grown and substituted for corn in the ration, pound for pound. Barley is almost as valuable as corn. It should be rolled or coarsely ground, and should be used in combination with bulky grains such as ground oats and wheat bran. Rye is similar to corn and barley, but cows find it unpalatable. On this account, rye is seldom fed to dairy cows.

Oats are widely used in dairy rations. They are bulky, high in protein, and contain more mineral matter than any of the other farm grains mentioned. The best dairy rations nearly always contain ground oats.

The Oil Seeds:

The oil-bearing seeds more often have a market value out of proportion

to their value as dairy feeds. On this account, these are usually exchanged on the market for milling by-products such as the various oilmeals, gluten feed and wheat bran. The high oil content of many of these seeds causes them to have an extremely laxative action when fed in too large amounts.

Soybeans were introduced from the Orient a century ago, but were grown little until the United States Department of Agriculture introduced new and better varieties since 1900. Soybeans are high in oil, protein and phosphorus contents, and are palatable to dairy cows when fed freshly ground. Soybeans vary widely in length of growing season and moisture requirements, as well as in rankness of growth and seed yields. The Virginia and Laredo soybeans are grown over most of the state, while the Ootootan and Biloxi varieties are adapted to the very southeastern section.

Only two Oklahoma counties reported any flax grown, in the agricultural census of 1925. Flax is seldom fed to livestock, but its milling by-product, linseed oilmeal, is a popular protein feed in the North.

Whole cottonseed is not a desirable nor economical feed for livestock. A ton of whole cottonseed mills out on the average, 917 pounds of cottonseed cake or meal, 582 pounds of hulls, 332 pounds of oil, 69 pounds of linters, besides the loss of water and waste during the cleaning and oil-milling processes. The linters, water and waste have no commercial calue as feeds. It is not economical to use the oil as feed, and in addition, its extremely laxative action is objectionable. The hulls contain a large percentage of crude fiber, and are low in digestible protein and mineral matter. They contain 37 per cent of total digestible nutrients, which compares to the content of wheat straw and is less than that in ground corn cobs. For the dairy cow, the useful part of the ton of cottonseed is the 917 pounds of cake or meal. The whole seed may be exchanged for oilmeal profitably in most years.

It is seldom that peanuts are used as feed for dairy cattle. The whole nuts are high in oil and protein, and are too high in price for use in dairy cattle rations. Peanut shells contain from 56 to 59 per cent of crude fiber, 0.4 per cent of digestible protein, and 38 per cent of digestible nutrients. They are less valuable than straw as cattle feed, according to Kellner.

Milling By-Products:

Cottonseed meal is the most important milling by-product produced in the South. It is usually the most economical protein concentrate on the market. Rations for dairy cows in the South should not be without a small amount of it, except in cases where the roughage portion of the ration is made up solely of legume hay. It is not economical nor desirable to feed large amounts of cottonseed meal over a long period of time, because such feeding sometimes results in injury to the animals. Since dairy cows are to be continued on feed year after year, we recommend that the maximum amount of cottonseed meal be limited to not over two pounds per day in Oklahoma, except when used with succulent roughages. Farther south, where fresh green feeds are available, up to three and even four pounds of cottonseed meal per day are fed for short periods. Fresh pasture grasses and silage tend to offset the effects of feeding cottonseed meal in too large amounts.

Soybean cake, or soybean oilmeal is the by-product remaining after this seed is milled for oil. It contains more protein than many grades of cottonseed meal, and is high in digestible nutrients and phosphorus. Soybean oilmeal has a slightly greater laxative effect than cottonseed meal. Cattle find ground soybeans and soybean oilmeal very palatable.

Linseed oilmeal is lower in protein than cottonseed meal, and is expensive in the South due to cost of transportation. It is a very desirable source of protein, and is high in phosphorus. Linseed oilmeal is used in rations for dairy calves, in preference to the cottonseed products.

Peanut oilmeal is less palatable than the other oilmeals mentioned, but when used in small amounts in the ration, is a good source of protein. It is

lower in phosphorus than the other oilmeals, but high in total digestible nutrients.

The corn milling by-products, corn germ oilmeal, gluten meal and gluten feed, are less palatable than many other high protein feeds. When two pounds of cottonseed meal are not sufficient to supply the amount of protein needed in a cow's daily ration, it is a good practice to use linseed oilmeal, ground soybeans, gluten feed or another concentrate high in protein to supplement the ration. The corn milling by-products are lower in mineral matter than those from the other oil seeds. Hominy feed—a corn milling by-product —is similar in value to cornmeal, and is not classed as a source of protein for balancing farm grains in the ration.

Wheat bran is the most widely used of all milling by-products. It contains less than half as much digestible protein as the oilmeals named above, but is the richest source of phosphorus in the cow's ration. Wheat bran (or ground oats) should be in every dairy cow ration, to be mixed with such heavy grains as ground corn, barley, kafir, and soybeans, and the heavy milling by-products as cottonseed meal, linseed oilmeal, gluten feed, and so forth. The bulky character of the bran tends to keep fine starchy feeds from forming a dough in the cow's stomach, when moistened by the digestive juices. In the wheat belt, bran often replaces a large part of the corn or kafir in the ration, when the latter are high in price.

The question sometimes arises whether ground alfalfa can replace wheat bran. These feeds are somewhat similar in protein content, but the wheat bran provides over five times as much phosphorus as the alfalfa meal. One must note the grade of alfalfa used in making the meal, since alfalfa meal is often made from the coarser, less leafy grades of hay, lower in feed value.

SUCCULENT FEEDS AND PASTURES

Succulent feeds serve a very useful purpose in dairy rations. They provide digestible nutrients, and exert a desirable effect upon the digestive system. Succulent feeds are mildly laxative, and are known to aid in the assimilation of mineral matter in the ration. Milk contains over 85 per cent of water, a part of which may be provided by the succulent feeds.

The best succulent feeds are the pasture grasses during the rapidly growing stage. Silage, root crops, and the winter cereal grains take the place of summer pastures during several months of the year. Pumpkins and stock squashes are used during the late autumn in some parts of eastern Oklahoma.

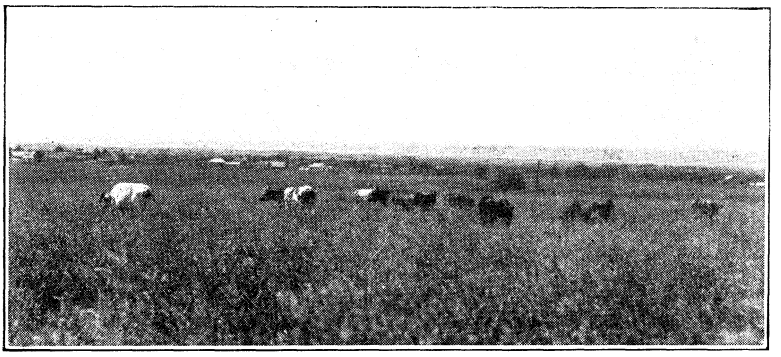

FIGURE 3

The test cows on sweet clover pasture. Photograph taken June 17, 1927

Sweet clover is the most valuable pasture crop that can be grown in many parts of the United States, since it provides a larger amount of digestible protein, and of mineral matter, as well as being an excellent succulent feed. It can be used as a member of a twelve-month pasture rotation in combination with winter cereal grains and Sudan grass in many parts of the South. The white biennial sweet clover yields more feed per acre than does the yellow biennial variety, and is to be preferred. Under Oklahoma conditions, biennial white sweet clover and Sudan grass are the two tame pasture crops which outyield all others. Cows do not take to sweet clover readily when first given access to it. In a short time they become accustomed to the taste of sweet clover, and prefer it to native grasses.

Although cattle seldom bloat on sweet clover, it is well to take the precautions to have the animals well filled with dry hay or other grasses when they are first turned onto the clover. Heavy dew and rain are factors that render alfalfa and other legume pastures more liable to cause bloat, especially when the cattle are turned onto such pastures hungry.

Grasses usually provide good pasture as long as they are fairly succulent. Old dry grass that has been leached by dew and rain, is unpalatable, and contains little digestible matter. Sudan and Johnson grass are especially useful pasture grasses. Sudan grass yields more feed per acre if not grazed shorter than 10 to 16 inches in height during the growing season. In drier sections Sudan grass is often drilled in rows, and cultivated to conserve moisture, giving good yields of pasture under these conditions.

When drouth, insect attack, plant diseases, or cold weather check the growth of any of the sorghums, there is danger of loss of animals grazing on them because of prussic acid poisoning. Cattle should be kept off of second growth cane, and from cane fields for several days after the first killing frost, since the prussic acid is liberated rapidly from frozen plants. Prussic acid usually is set free, and evaporates during the process of curing these crops into hay or silage.

Bermuda grass yields considerable pasture on moist lowlands. It becomes woody and less palatable at maturity. Considerable labor is required in planting the Bermuda roots. If grazed too closely in the fall, Bermuda grass may winter-kill in the northern section of Oklahoma. Bermuda grass

FIGURE 4
The dairy cows on native pasture. Photograph taken June 15, 1927

grows best in warm weather and so does not provide feed as early in the spring as sweet clover and native grasses. Lesperdeza is often seeded into Bermuda grass, improving the quality of the pasture.

Buffalo grass is a very important native grass in areas of uncertain rainfall, since it seldom is killed out by drouth. Though the yield is low, dry buffalo grass is approximately equal in feeding value to Sudan hay.

Root Crops and Silage:

Sunrise kafir and Japanese seeded ribbon cane are two of the heavy yielding silage crops in Oklahoma. Kansas Orange cane grows well in the northern parts of the state. Where corn can be grown successfully, it provides the highest quality of silage. Although kafir silage is only 90 to 95 per cent as valuable as corn silage yet it often yields more feed per acre, and is more profitable than corn on the uplands of western Oklahoma. Cane often yields a heavier tonnage of feed than kafir. A three-year comparison of cane and kafir silages with milk cows, at the Oklahoma experiment station showed them to be practically equal in feed value per pound.

Persons interested in the use of silage, should write the Oklahoma A. and M. College for Circular 60, "Silos and Silage."

The majority of Oklahoma dairy herds are too small to advise a silo being built. Under these conditions, it is advisable to grow and feed mangel beets. Mangels contain less dry matter than silage, so it is necessary to feed about 50 pounds of mangels in place of 30 pounds of silage daily to a thousand pound cow, as noted in the Feeding Rules. Mangels contain little crude fiber, and so the dry matter in them is highly digestible. They should be more widely used with small dairy herds than at present.

Supplementary Mineral Feeds:

Many questions involved in mineral requirements of milk cows are yet unanswered. These problems are under investigation at several of the state experiment stations, and by the Bureau of Dairy Industry at Washington, D. C. It is known that even under the most extreme conditions of lack of mineral matter, the cow does not change the total amount of mineral in a pound of milk. Instead, she draws upon the reserve supply of mineral matter in her skeleton, and when this is low, decreases the amount of milk to equal the supply of mineral matter provided in the feeds. In the following year, if only a short dry period has been allowed, in which to replace this mineral matter, she is not as heavy a producer.

The best sources of mineral matter are the legume hays, the pasture grasses grown on soils rich in mineral matter, wheat bran, oats, and the milling by-products from the oil seeds. Under some conditions it is advisable to use a small amount of extra mineral matter in the feed, or separately in a box, just as common salt is provided. Only two minerals are definitely known to be needed in greater amounts than the feeds provide. These are lime and phosphorus. The cheapest and best forms to provide this extra mineral supplement are as very finely ground calcium limestone, and in by-products of animal bones. There are several forms of bone by-products only a part of which are adapted to feeding purposes. Very finely ground "feeding bonemeal" for cattle, is the by-product of gelatin manufacture, and has very little odor. Various packing houses label this grade of bonemeal as "raw" or as "steamed" bonemeal, but the product is the same. Fertilizer bonemeal is from the carcasses of condemned animals, and has an offensive odor similar to tankage or meat meal. The fertilizer bonemeal is never used in dairy rations, since it is unpalatable to milk cows. Spent boneblack, and bone ash, which are residues of the bone products used in clarifying sugar, are valuable but can be purchased less often on the market. One of the most common formulas for mineral mixtures, is 40 pounds of finely ground limestone, 40 pounds of finely ground feeding bonemeal, and 20 pounds of common salt.

In regions where livestock suffer from goiter, or swollen neck, the local veterinarian should be consulted as to the amount of iodine compound to be added to the ration, since an excess of this material is injurious to the animal.

"Open Formula" rations approved by the College Feed Conference Board are required to have one pound of finely ground calcium limestone, one pound of feeding bonemeal and one pound of common salt in each 100 pounds of mixed grain. Even with a good dairy ration including alfalfa hay, silage, and the wheat belt grain ration of bran, ground oats, cornmeal and cottonseed meal, cows on experiment at the Oklahoma station have eaten of their own free will, 2.3 pounds of common salt and almost nine-tenths of a pound of finely ground feeding bonemeal per cow per month.

PREPARATION OF FEEDS

During the past fifty years, many methods of preparing feeds for dairy cows have been studied. It has been found that in general, the cooking of feeds renders the protein less digestible. In fact, very starchy feeds such as potatoes appear to be the only feeds which are improved by cooking them.

The practice of steaming and cooking hay, fodder, straw and grains has long since been discarded as unprofitable.

Grains should be ground, except for young calves, and in silage. Even with silage crops, there is a question whether it might not be profitable to head the kafirs and sweet sorghums before putting the stalks into the silo. Under these conditions, the heads would be ground and added to the grain ration. If pigs or poultry have access to the manure, they will salvage the whole grain present. The losses of grain from corn silage are apparently very small.

Experimental work done at the Michigan, South Carolina and Oklahoma stations, studying the losses of grains fed whole to dairy cattle, have been summarized in Table III.

Table III. Losses of Whole Grain in Silage and Concentrates When Fed to Dairy Cattle

CLASS OF CATTLE	WHOLE GRAINS			WHOLE GRAIN IN SILAGES		
	Kafir %	Corn %	Oats %	Corn Silage %	Kafir Silage %	Sweet Sorghum Silage %
Mature cows	58.3	22.8	12.1	1.9	49.5	33.9
Yearling heifers		10.8	5.5	....	....	....
Calves		6.3	2.9	....	....	....

When the grain ration lacks bulky feeds as ground oats and wheat bran, it is advisable to grind ear corn, or make kafir head chop, or even to use a small amount of chaff or cottonseed hulls mixed with the grain to give it the desired bulk. These are the principal conditions under which there is any special advantage in using such products. Even here, it might be preferable to use alfalfa leaves or meal in place of the other coarse feeds that furnish little digestible matter.

Shall roughages be ground? This question is being raised more frequently in the minds of many farm people. One needs to know how the feeds are digested in the cow's stomach in order to understand fully the answer to this question. In animals, the bones form the skeleton about which the organs and muscles are suspended. In plants, however, each cell is entirely surrounded by a skeleton of crude fiber. The cow's digestive system is built so that the crude fiber is digested in the paunch or first stomach. Coarse feeds remain in the first stomach from 12 to 24 hours, giving a chance for the crude fiber to be softened and digested by bacteria. These coarse

feeds come back to the cow's mouth to be rechewed as many times as may be necessary to grind them finely. As soon as these coarse feeds are finely ground, they are permitted to pass through the third stomach (called the many-plies) and on through the remainder of the digestive tract. If roughages are too finely ground, they do not remain long enough in the first stomach for the crude fiber to be softened and digested off from the outside of the plant cells. The finely ground roughages pass on through the digestive tract, and since the crude fiber was not digested off, some of the starch and protein inside of these cells is not exposed to the action of the digestive juices The Pennsylvania station found that finely ground roughages are not as valuable to the cow as the same quality of coarser feeds. The Wisconsin, South Carolina and other stations have found that although the cow may eat slightly more of the ground hays, that the benefit does not pay for the cost of grinding them. It is profitable sometimes to cut low grade hays coarsely, using a silage cutter, or to pour a small amount of dilute blackstrap molasses over low grade hays in order to render them more palatable. In this way the loss of refused feeds is lessened.

The statement is made that cows refuse much hay when it is fed whole, especially when the hay is stemmy. It is true that cows waste the coarser parts of the hay, more especially when rather larger amounts are offered, and also when the hay is placed in bunkers in the yards where some waste occurs through trampling under foot. When properly fed in the mangers, the refused stems seldom exceed ten percent of the total hay fed. The stems are low in feed value, as shown in Table IV.

Table IV. Composition of Various Parts of the Alfalfa Plant

Portion of Alfalfa Plant	Crude Fiber %	Total Protein %	Digestible Crude Protein %	Total Digestible Nutrients %
Alfalfa hay (Ave. analysis)	28.3	14.9	10.6	51.6
Alfalfa leaves	12.7	22.5	17.3	60.0
Alfalfa stems	54.4	6.3	1.8	49.6

(Taken from tables in Feeds and Feeding, 18th edition, by Henry and Morrison).

From the above statements, one may see that we do not consider it advisable to grind roughages for dairy cattle.

SUGGESTED DAIRY RATIONS

When legume hays and legume pastures are the only roughages, any of the following grain rations will prove satisfactory, when fed in the amounts as stated in the Feeding Rules.

Table V. Mixed Grain Rations Adapted for Use With Legume Hays

	Ration 1 Pounds	Ration 2 Pounds	Ration 3 Pounds
Corn-and-cob meal	100		
Barley, ground or rolled	100	100	
Oats, ground	100	100	200
Kafir-head chops		100	
Corn meal or chops			100
Darso, ground			100
The above rations contain:			
Total crude protein	10.8	11.2	11.4
Digestible crude protein	8.3	8.3	8.9
Total digestible nutrients	76.0	72.2	75.6
Crude fiber	7.8	7.3	6.8

If equal amounts by weight of a legume hay and of a grass hay (cane, Johnson, prairie or Sudan grass hay, or dry fodder), or if legume hay is fed with silage or mangels, the grain ration should provide about 16 percent of total crude protein, and less than 10 percent of crude fiber. The rations in Table VI are used widely with such roughages. When fed to very high producing cows, these rations may need an additional one-half pound or pound of a high protein concentrate (or two pounds more of wheat bran) in addition to the required amounts of one of these grain rations, as stated in the Feeding Rules.

Table VI. Grain Rations Adapted for Use With Such Roughages as a Mixed Legume and Grass, or Silage, or Mangels, in Amounts as Stated in the Feeding Rules

	Ration 4 Pounds	Ration 5 Pounds	Ration 6 Pounds	Ration 7 Pounds	Ration 8 Pounds
Wheat bran	400		200		
Oats, ground	300	300		300	300
Cornmeal, or chops	200	400	400	400	400
Cottonseed meal, (43 percent protein)	100	100	100	100	
Corn gluten feed				100	
Soybeans, ground					200
The above rations provide:					
Total crude protein	16.3	14.8	16.2	16.0	16.5
Digestible crude protein	13.0	11.8	12.9	12.9	13.8
Total digestible nutrients	69.6	77.0	75.3	77.4	80.7
Crude fiber	8.3	6.1	5.0	6.2	5.4

The grain rations in Table VII are adapted for use with lower grade legume hays, and although a little low in protein content for the purpose, are often used with grass hays where there is not a wide choice of high protein concentrates available locally. As stated in the Feeding Rules, slightly more grain is required with the lower grade roughages.

Table VII. Grain Rations Adapted for Use With Lower Grade Legume Hays, and the Best Grass Roughages

	Ration 9 Pounds	Ration 10 Pounds	Ration 11 Pounds	Ration 12 Pounds	Ration 13 Pounds	Ration 14 Pounds
Wheat Bran	400		200			300
Oats, ground	300	300		100	200	300
Cornmeal, or chops	200	300	400	100	200	
Cottonseed meal, (43 percent protein)	200	175	175		100	
Corn gluten feed		100				
Soybeans, ground				100	100	200
The above rations contain:						
Total crude protein	18.8	19.1	18.8	19.5	20.6	19.8
Digestible crude protein	15.2	15.7	15.3	16.7	17.3	16.6
Total digestible nutrients	70.4	77.0	75.5	82.1	78.1	72.8
Crude fiber	8.3	6.8	5.3	5.7	6.4	8.7

When other protein concentrates than cottonseed meal are available locally, the grain rations in Table VIII which provide approximately 24 percent of total protein and less than 10 percent of crude fiber, are adapted for use with the grass hays and other lower grade roughages. Note the amounts of grain required with such roughages, as given in the Feeding Rules.

Grain rations for use with grass roughages are improved by the addition of one pound of very finely ground calcium limestone and one pound of feeding bonemeal per 100 pounds of mixed grain.

Table VIII. Grain Rations Adapted for Use With Grass Hays and Other Low Grade Roughages.

	Ration 15 Pounds	Ration 16 Pounds	Ration 17 Pounds	Ration 18 Pounds
Wheat bran	100	200	200	300
Oats, ground	200	100	100	
Cornmeal, or chops				100
Cottonseed meal, (43 percent protein)	100	100	100	100
Corn gluten feed			100	
Linseed oilmeal		100		
Soybeans, ground	100			100
The above rations contain:				
Total crude protein	24.1	24.3	22.6	22.8
Digestible crude protein	20.4	20.3	18.6	19.1
Total digestible nutrients	74.8	69.7	70.2	72.6
Crude fiber	8.7	9.3	9.0	7.1

GROW FEEDS ADAPTED TO DAIRYING

One of the best-managed dairy farms in southern Oklahoma uses a crop rotation that is especially successful. The farm is divided into five fields. The rougher land is in permanent pasture. One field of bottom land has been set aside to grow alfalfa for a long period of years. On the remaining fields, a three-year rotation is used, as follows:

1. A silage crop, usually a sorghum, is grown, the field being plowed as soon as possible after the silage crop is cut.
2. Winter barley is sown in the fall of the first year, using only two-thirds the usual quantity of seed per acre. The barley is pastured with dairy cows in the fall, winter and late into the spring. The yield of barley is reduced by the late grazing, but more profit is realized from the pasture in this way. The barley is cut slightly early, so as not to take too much moisture away from the next crop.
3. Biennial white sweet clover seed is sown onto the winter barley in the late winter of the second year. The sweet clover attains sufficient growth to provide some pasture during the late summer and early fall. Care is taken that there is some growth to protect the roots during winter. This field is the principal pasture during the third spring and summer. As soon as the sweet clover matures and dies, manure is spread onto this field. It is plowed in the fall in preparation for the silage crop the next spring.

The crop rotation then consists of a sorghum crop, winter barley for pasture, grain and straw, followed by sweet clover pasture. Crop yields and fertility of this farm have improved under this system of farming. Little labor is spent in handling the manure, because the cows graze on each field a part of each year. The extra manure obtained while the cows are in the stable, is applied to the land just ahead of the silage crop.

The important part of the cropping system on Primrose Farm, as described above, is that every crop contributes its part to make a profitable dairy ration, largely home-grown. In general livestock farming, it is possible also to plan the crops so as to have the amounts of feeds needed for the dairy cows, work horses, hogs and poultry, as well as providing a garden for the farm family. The quantities of feeds required vary with the numbers and kinds of livestock that are maintained. Good cows require somewhat more grain than poor cows, and pay a profit accordingly, when fed a good ration in proper amounts.

FEED PRODUCTION PLANS

"Home grown feeds help to make dairying profitable" is a well known slogan. A definite plan helps to provide the necessary feeds needed in a satisfactory dairy ration. It is not possible to lay out a plan that will offset weather conditions and other variable factors, but it is possible to outline

a general guide which is practical, and can be applied to average climatic conditions over the state.

The quantity of grain needed to feed a cow during the year varies with the production of the cow, and with the kinds of roughages fed. In general, a thousand pound cow eats about 4,500 pounds of dry hay during the year, or about 2,200 pounds of dry hay and 5,500 to 6,500 pounds of silage, in addition to the pasture. When mangel beets replace silage, four to five tons of mangels are needed per cow. If the roughage portion of the cow's ration consists solely of legume hay, she will need about 1,600 pounds of grain to provide for a yearly production of 250 pounds of butterfat. With grass hays, the same cow would need 1,850 pounds of grain in order to make the same butterfat yield. With lower grade roughages such as straw, hulls, or stalk fields that have been leached by rains, this cow would require at least 2,400 pounds of grain in order to produce 250 pounds of butterfat, and keep from losing flesh. Higher producing cows cannot use more roughage, but do need more grain in the ration. The amounts and kinds of the different grains may be estimated by applying the above figures to any of the grain rations suggested on previous pages.

It is possible to suggest a tentative crop plan that will provide the larger part of the feeds for a five-cow dairy herd, suitable to eastern Oklahoma. One should understand that the plan is based on average climatic, soil and tillage conditions. This plan may be used as a guide from which to make variations in the plantings suited to a particular farm or locality.

Table IX. Suggested Cropping System to Provide Home-Grown Feeds for a Five-Cow Dairy in Eastern Oklahoma.

Feed Crop	Variety	Amount Needed	Acreage	Time of Planting	Rate of Seeding Per Acre	Average Yield Per Acre
Soybean hay	Virginia	5 tons	3	Late April to May 15	15-25 lbs.	1½-3 tons
or	Laredo					
Sudan hay		5 tons	2½	May 15 to June 15	30 lbs.	2-4 tons
Mangels	Mammoth Long Red	25 tons	2	Early April	10-15 lbs.	10-15 tons
or	Bloody Butcher					
Silage corn	Strawberry	15 tons	2	Late March	6-10 lbs.	7 tons
or	June corn			or April		
Winter pasture	Wheat or barley		10	Fly-free date	100 lbs.	?
Oats	Fulghum	15 bu.	½	February	64-80 lbs.	30 bu.
	Kanota					
Corn	Midland Yellow Dent	6 bu.	¼	Late March	6-10 lbs.	25 bu.
	Silver Mine			or April		
	Pride of Saline					
Pastures:						
Sweet clover	Biennial White		5	September, March or early April	15 lbs., hulled	
Native grass			5			
Sudan grass			5	May	30 lbs.	

Climatic conditions in western Oklahoma require different crops in part. On the uplands, corn is replaced by darso or kafir. It is sometimes more difficult to establish a stand of sweet clover than of Sudan grass, giving the latter a slight advantage. Soybeans may be grown, even though cowpeas are recommended in the cropping system. A larger acreage of native grass is required in order to yield the same quantity of forage for cows on pasture. It is frequently advisable to plant Sudan grass in rows, so that moisture may be conserved by cultivation.

Table X. Suggested Cropping System to Provide Home-Grown Feeds for a Five-Cow Dairy in Western Oklahoma.

Feed Crop	Variety	Amount Needed	Acreage	Time of Planting	Rate of Seeding Per Acre	Average Yield Per Acre
Cowpeas	Whippoorwill	5 tons	3	May 15 to June 13	20 lbs.	1½-3 tons
or						
Sudan hay		5 tons	2½	May 15	5 lbs. in rows	2-3 tons
Kafir silage	Sunrise	15 tons	4	May	7 lbs.	3-6 tons
or						
Winter pasture	Wheat or barley		10	Fly-free date	100 lbs.	?
Oats	Fulghum Kanota	15 bu.	½	February	64-80 lbs.	30 bu.
Kafir	Blackhull Darso	6 bu.	¼	May	7 lbs.	20-30 bu.
Pastures:						
Sudan grass			5	May 15	10 lbs.	
Sweet clover	Biennial White		5	March or Early April	15 lbs., hulled	
Native grass			25-50			

Credit is given the Agronomy Department for assisting in the arrangement of Tables IX and X.

A SUCCESSION OF PASTURE CROPS

Since milk and butterfat are produced at low feed cost when cows are on pasture, considerable attention needs to be given to the problem of providing a succession of pasture crops that will yield succulent green feeds over a large part of the year. Native pastures can seldom be depended upon to furnish continuous grazing, since their growth is checked by heat and dry weather, or by maturing seed early during the summer months. If there is a sufficient supply of moisture during the late summer, some native grasses have a second growing period in the fall.

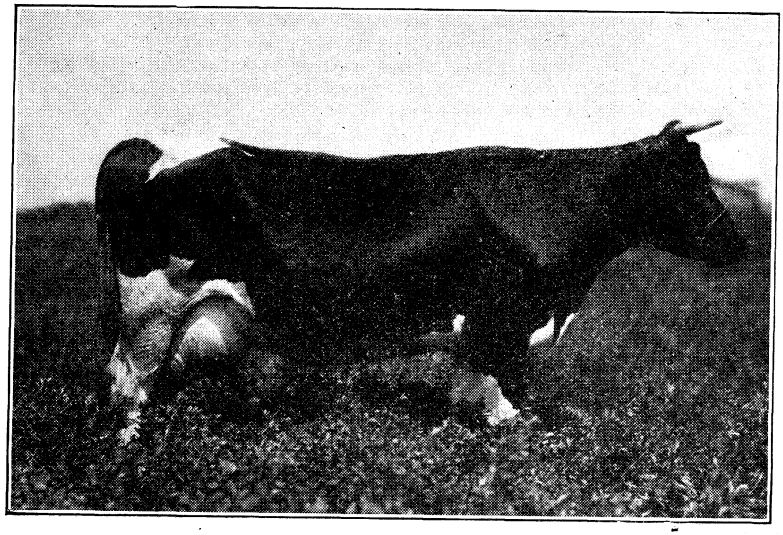

FIGURE 5

The height of sweet clover when it is ready to be grazed. Photograph taken April 25, 1927.

Sweet clover and Sudan grass are the most widely used of all the planted pasture crops in Oklahoma. They root more deeply, and hence are less affected by drouth than most native pasture crops.

Sweet clover planted in the early spring, is ready to graze during the late summer and fall. The following spring it furnishes pasture earlier than any other crop. On fair soil, and with a good stand, an acre of it will provide sufficient pasture for one cow. Several days are required for cows to become accustomed to the taste of sweet clover. It has a bitter taste, due to a compound called cumarin present in the joints of the plant. After cows become accustomed to it, they prefer sweet clover to native grasses. Sweet clover is less subject to insect attack than are the grasses.

Being a legume, sweet clover provides a larger amount of digestible protein and mineral matter than do the pasture grasses. On this account, it has a greater feed value in a dairy cow's ration than any of the grasses. Sweet clover is a soil builder, as well as being the best pasture crop for dairy purposes.

Sudan grass has an especial advantage as a pasture, in that it can be planted in May, and is ready to graze in five to six weeks. It has a carrying capacity of approximately one cow per acre. Sudan grass seed cannot be planted until all danger of frost has passed. The plant is killed by the first light frost in the fall. It is especially drouth resistant, but is subject to attack by insects such as chinch bugs and grasshoppers. Sudan grass fits into a pasture succession during mid-summer, after the sweet clover has gone to seed and matured in its second year. A spring planting of sweet clover can be used in turn, after the Sudan has been killed by frost in the fall.

There is slight danger of prussic acid poisoning on Sudan grass, especially when its growth has been severely checked by drouth, insect attack, rust or cold weather. Immediately following the first killing frost there is considerable danger in grazing the recently-frozen plants.

In the region north of the Arkansas river, orchard grass, bluegrass, lesperdeza and even alsike clover are used as pasture crops. Other grasses are adapted south of the Arkansas river where somewhat different climatic conditions exist. Bermuda grass grows well on some of the moist lowlands, but is not available until in the late spring. It withstands some drouth, but is less palatable than Sudan and sweet clover.

It is advisable to use some native pasture on practically every farm. Because of the growth habits of native grasses, they can seldom be depended upon to provide pasture for longer than two to three months, unless deferred grazing is practiced. Where a large acreage of pasture is properly fenced, the cows could graze on a part of the pasture while the remainder has an uninterrupted growth. Changing the cows to the new pasture permits the old pasture to regain its growth. Even where deferred grazing is practiced, Sudan grass pasture is needed during the summer in average years.

Winter wheat and rye, where grown, are used to provide some succulent feed during open winter weather over a large part of the state. Winter barley and oats are frequently grazed in the southern counties. Barley often furnishes more green feed than does wheat. The yield of grain is reduced considerably when grazed late in the spring. Data from the Woodward Field Station (U. S. Department of Agriculture) show that these winter cereals cannot be relied upon for winter feed. When grazed as late as May twentieth the feed value of the pasture obtained from winter rye and wheat varied from $3.13 to $13.61 per acre, the average for three years being $7.83 per acre. Due to lack of moisture, pasture was not available until March fourteenth in one of these years, showing that one should not depend on these crops as a source of winter feed.

RELATION BETWEEN NUMBER OF COWS AND SIZE OF SILO

Many silos in Oklahoma are unused today because they were built too large in diameter in proportion to the number of cattle to be fed from them. With the smaller breeds, more cows are required in order to allow of a silo being used, than with the large breeds. An even layer of silage must be removed from the entire surface of the silo daily to prevent spoilage by molds. During very cold weather removal of as little as a one-inch layer daily may suffice, but in summer weather even as much as a 2½ to 3 inch layer must be fed off daily to avoid surface spoilage. Silage is often used to advantage during periods of dry weather or shortage of pasture in the summer and fall, as well as during the winter months.

In building an upright silo, it is economical to dig a 5 to 6 foot pit lining it with a concrete wall, on top of which the tile or concrete of the above-ground porton of the structure is erected.

Silage settles considerably during the first week after filling, the amount varying from five to eight feet in an average silo. The data in Table XI are based on weights of settled corn and kafir silage as observed at the Kansas and Missouri experiment stations.

It is better policy to construct two silos, a larger one for winter use, and one of smaller diameter to be used during the summer. The size of silo needed in relation to the number of cows, is shown in Table XI.

Table XI. Relation of Diameter and Capacity of Silo to Size of Dairy Herd.

Diameter of Silo Feet	Depth of Settled Silage Feet	Capacity (settled silage) Tons	Average Weight of a one-inch Layer Pounds	MINIMUM HERD NEEDED			
				Winter		Summer	
				Jersey	Holstein	Jersey	Holstein
10	26	39.2					
	28	42.5					
	30	45.9	236	14	10	24	16
12	26	56.4					
	28	61.2					
	30	66.0	339	20	14	34	24
14	26	76.8					
	28	83.4					
	30	90.0	462	28	19	46	32
16	26	100.3					
	28	108.9					
	30	117.5	603	36	25	60	42

The above table is based on a cubic foot of silage weighing 36 pounds. The daily allowance of silage is estimated at 25 pounds for a Jersey, or 36 pounds for a Holstein cow. Large cows of these breeds will consume slightly greater amounts of silage per day.

USEFUL FARMERS' BULLETINS RELATED TO DAIRYING AND PREPARED BY THE UNITED STATES DEPARTMENT OF AGRICULTURE

A limited number of these may be secured in the offices of many county agents, or by writing direct to your United States senator or representative at Washington, D. C.

United States Department of Agriculture Farmers' Bulletins:

578 Making and feeding silage.
602 Production of clean milk.
797 Growing sweet clover.
814 Bermuda grass.
825 Pit silos.
876 Making butter on the farm.
972 How to use sorghum grain.
1097 Stable flies.
1126 Sudan grass.
1153 Cowpea utilization.
1179 Feeding cottonseed products to livestock.
1336 Feeding and management of dairy calves.
1342 Dairy barn construction.
1359 Milk and its uses in the home.
1412 Care and management of dairy bulls.
1422 Udder diseases of dairy cows.
1443 Dairy cattle breeds.
1446 Cow testing associations.
1470 Care and management of dairy cows.
1473 Sterilizing milk utensils.
1520 Soybeans, culture and varieties.
1532 Dairy herd improvement.
1536 Infectious abortion of cattle.