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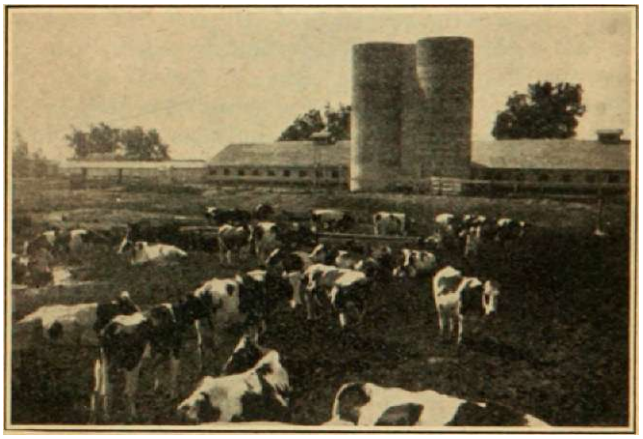
FEEDING DAIRY COWS IN COLORADO

By H. R. Lascelles and L. K. Crowe



Colorado Agricultural College
Extension Service

FORT COLLINS

PURPOSE OF THE BULLETIN AND HOW TO USE IT

In doing dairy extension work in Colorado, the authors have found a need for a bulletin, written in terms not necessarily scientific but clear, on the feeding of dairy cows particularly as applied to conditions existing in this State.

An effort has been made to confine this work to the fundamentals involved in the successful feeding of dairy cows, giving just enough of the theory behind the facts to lay a foundation for the statements made.

Groups of rations have been compiled which are typical for the feeds used, but are given only as guides, an eleven- hundred-pound cow producing 24 pounds of milk daily being taken as the standard for the compilation of these rations. Computations have been made from the Wolf-Lehmann Modified Feeding Standards.

Each feed is discussed briefly and references made by number to the groups of rations wherein these feeds are used. It would not be possible in this limited space to list all of the combinations of feeds that can be used as balanced rations, so only typical examples are given to guide the dairyman in his feeding.

Following the rations is a table that may be used as a guide in feeding operations, showing the cost of 100 pounds of digestible crude protein in our common Colorado feeds.

FEEDING DAIRY COWS IN COLORADO

By H. R. Lascelles and L. K. Crowe

In too many cases the Colorado dairyman feeds his cows the cheapest foods available without regard to their value for milk production. Repeatedly the statement is made "I'm just feeding hay this winter, as I can't afford to feed grain." If the truth were known he cannot afford not to feed grain, if he has the kind of cows that he should have, namely those that will return him a good profit. It is granted that sometimes balanced rations are higher priced than unbalanced ones, but generally the additional cost is more than made up by the additional returns.

A certain man in a cow testing association milked 20 cows. In November he received 11,920 pounds of milk while feeding an unbalanced grain ration that cost him $29.52 for the month. In this ration were 4,686 pounds of grain but the mixture was not in a balanced form. In December he used a balanced ration feeding 4,686 pounds of grain, (the same as the month before) but it was a different mixture. He received 14,060 pounds of milk in December or 2,140 pounds more than in November. His December grain bill was $42.17 or $12.65 more than in November but with his 2,140 pounds increase testing 3.9 per cent he got 83.5 pounds more fat which he sold for 45 cents a pound, netting him $37.58 more than in November. It. is true that his grain bill was $12.65 more but it is also true that his income was $37.58 more. It paid to feed the balanced ration.

Usually in the dry-land sections not enough ensilage is used in feeding cows. This food is important as a succulent during the winter and is a cheap food which often is not fully appreciated. In some cases, however, too much ensilage is fed and the ration is entirely unbalanced. Ensilage is a wonderful feed, but it must be used with other feeds high in protein, which ensilage lacks, if it is to be fed to the best advantage.

Another mistake frequently made is the feeding of every cow alike. The cow giving 40 pounds of milk a day must get more grain than the cow giving 20 pounds if she is to be expected to hold up on her milk, and likewise the cow giving 20 pounds requires less grain than the one giving 40 pounds. Feeding excessive amounts of grain to low-producing cows is wasteful and will soon bankrupt a man. It is the purpose of this bulletin to show the right feeds to use and the proportion in which these feeds should be given.

THE BASIS OF THE BALANCED RATION

In feeds there are three groups of substances which must be considered in formulating a balanced ration, or one which will secure the best results. These are known as proteins, carbohydrates, and fats.

Protein.—Proteins are the nitrogenous portions of feeds. The perfectly balanced ration is one which has the right proportion of protein to carbohydrates and fats just as the perfect combustion in an automobile engine is caused when there is just the right proportion of gas to air in the carburetor. The balanced ration is used by the cow to produce a maximum flow of milk at a minimum cost. Without adequate protein in the ration, the cow cannot produce at her best, as this material contributes to the formation of the proteins of the blood which in turn go to make the casein and albumin of the milk as well as other vital parts of the body structure.

Carbohydrates and Fat—Carbohydrates are the starches, sugars and crude fiber. The carbohydrates and fats are stored in the body as fat; are burned in the system for the production of heat and energy; or may form the fats and sugars in milk. A pound of fat is equivalent in feeding value to 2.25 pounds of carbohydrates. It is found that the best ratio of protein to carbohydrates and fat for milk production is from 1 to 4.5 to 1 to 6.5, depending upon the quantity and quality of milk produced, more protein being required for higher production.

DEFINITIONS AND RULES

A ration is that amount of feed given to an animal in 24 hours.

Generally speaking, feed hay at the rate of 1 to l 1/2 pounds to every one hundred pounds liveweight when fed with ensilage and grain.

When fed with grain alone, hay should be fed at the rate of about 2 1/2 pounds to every hundred pounds liveweight.

Feed ensilage at the rate of about three pounds to every 100 pounds liveweight with hay.

Feed grain at the rate of one pound to every four pounds of milk produced, unless the cow tends to fatten in which case the grain ration should be reduced.

Feed only what an animal will clean up readily. Feed left in the trough spoils the cow's appetite for the next meal and is worse than wasted.

Dry cows due to freshen within two months should be fed four pounds of grain daily, or more, according to the capacity of the cow. Grain fed to a cow while dry will insure a longer milking period with a heavier flow and larger profits during the next lactation. Many a dairyman makes his biggest mistake in not feeding grain to his dry cows.

Regularity in milking and feeding is essential to profitable dairying.

A good ration may not make a poor cow profitable, but may make a lot of difference in the returns from a good cow.

Begin on heavy rations gradually and be equally careful in making changes from one ration to another entirely different.

FEEDING VALUES AS RELATED TO THE DAIRY COW

The Concentrates

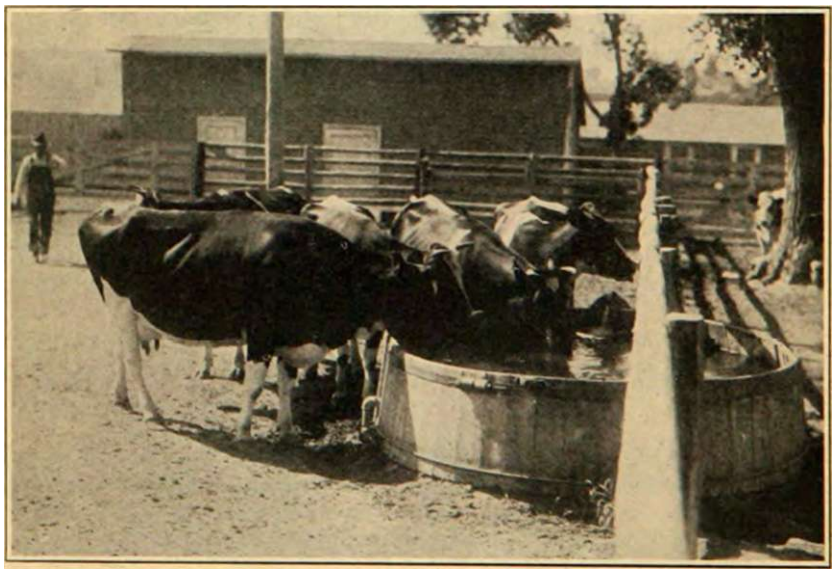
Barley—Ground barley, in combination with oats and other concentrates, makes a good feed for dairy cows. It has been found equal to ground corn when forming 60 per cent of the concentrate mixture for the feeding of dairy cows. From the composition of this grain we would judge it to be slightly lower in feeding value than corn, but it has been found to be of practically the same value. It, like all other grains, should be rolled, ground, or crushed before being fed, so as to make it more easily digested. (See rations under groups 1. 2, 5, 6, 7, 8, 9, 10, 11.)*

Beet Pulp (Dry).—Whenever corn silage is not available as a succulent feed, dried beet pulp can well be substituted, but is usually more expensive. It is similar to wet beet pulp, except that the water has been removed to make it keep. It should be soaked in water twelve hours before feeding, when fed as a succulent in place of ensilage; but occasionally it is economical to feed it dry as a part of the grain mixture. This is usually done when feeding with ensilage. Dried beet pulp is a highly carbonaceous feed, with a beneficial cooling and laxative effect. (See rations under groups 1, 5, 11.)

Wet Beet Pulp.— (Discussed under roughages.)

Corn (Dent).—Corn can well supply a portion of the ration for dairy cows, when available. It supplies energy in a cheap form and

* The numbers following the discussion on each feed refer to the reference rations or groups in which the feeds are used, found on page 23 of this bulletin.



Fresh, pure water is essential—87 percent of average milk is water.

is palatable. Because of its comparatively low percentage of protein, it should not form the entire grain ration. It is rich in digestible carbohydrates and fats which are needed in liberal amounts to keep the cows in good condition and producing at a good rate. Cornmeal is a heavy feed and should be fed in combination with bulky feeds. It should also be fed with protein-rich feeds such as bran, ground oats or cottonseed meal. When fed with carbonaceous roughage such as corn fodder or native hay, it should only constitute a very small portion of the grain mixture; but when fed with alfalfa hay it can be used in more liberal amounts. A frequent mistake of Colorado farmers is to feed too much corn and not enough of our other grains that are frequently more desirable. (See rations under groups 1, 2, 3, 4, 5, 6, 8, 9, 10, 11.)

Corn and Cob Meal.—This product has the advantage of being more bulky than cornmeal and is frequently fed to dairy cows. It is of lower feeding value than cornmeal, but good results may be secured in feeding this concentrate, especially in the absence of other bulky grains. (See rations under groups 1, 2, 5, 9, 11.)

Cottonseed Meal.—This feed is highly nitrogenous, and heavy for dairy cows. It should be fed only in moderate amounts, not in excess of three pounds daily for mature cows, since it has been found that excessive amounts may cause inflammation of the udder and difficult breeding. It is constipating in effect, therefore should be fed with more laxative concentrates such as linseed meal, wheat bran, or with succulent feeds such as ensilage, roots, or beet pulp. Some feeders have found it advisable to use cottonseed meal and linseed meal in combination, to overcome any danger of constipation. Usually, we find cottonseed meal a cheaper source of protein than bran, and it is a very adaptable protein concentrate to use in the dry-land sections in connection with ensilage. (See rations under groups 1, 3, 4, 6, 7, 8, 9, 11.)

Flax Seed.—In the dry-land sections, where the greatest feed problem is to secure the necessary amount of protein at a low cost, and where flax seed can be grown, a few men have found it to be a practical feed for dairy cows, particularly in the grain form. On account of its high oil content, in the past it has not been frequently fed. It is very laxative in nature and for this reason should not comprise over half the grain ration and it is advisable not to feed over 3 pounds daily regardless of the amount, of other grain fed. In making gruel or mash from flax seed, it is advisable to use boiling water and keep the mass hot for an hour or two to destroy any prussic-acid- forming enzyme that might be in the seed. It has a nutritive ratio of 1 to 4.0. (See rations under groups 3, 4, 5, 9.)

Kafir Corn.—This crop is usually fed in the form of fodder, but the grain can be fed as a concentrate, and when so fed has been found to be 90 per cent as valuable as corn. It should not be used with highly carbonaceous feeds such as sorghum hay, corn fodder, or prairie hay, but can be profitably used with protein feeds such

as cottonseed or linseed meal, alfalfa hay, sweet clover hay, soy beans, etc. (See rations under groups 1, 2, 3, 4, 5, 9, 11.)

Linseed Meal.—This feed is valuable from the standpoint of its high protein content, conditioning qualities, and laxative effect. As mentioned under cottonseed meal, these protein-rich concentrates are often fed in conjunction with one another, the linseed meal overcoming the constipating effect of the cottonseed meal. As a source of protein, linseed meal is not ordinarily as cheap as cottonseed, but usually is somewhat cheaper than bran. It is somewhat more palatable than cottonseed and because of its laxative nature, is frequently fed in the dry-land sections in order to offset the constipating nature of the average dry-land roughages. (See rations under groups 1, 4, 5, 6, 7, 8, 9, 10, 11.)

Molasses (Beet).—This by-product of the sugar factory is a carbonaceous, laxative feed, used principally as an appetizer and usually fed on hay or ensilage. It is frequently of assistance in getting cows to eat an inferior grade of roughage. It is not practical to feed this product, except in the immediate vicinity of the sugar factory, since the cost of hauling is too great.

Molasses Beet Pulp (Dried).—Dried molasses pulp is somewhat more palatable and digestible than the ordinary dry pulp and is slightly higher in feeding value. It is highly carbonaceous and can be fed as in the case of dried beet pulp.

Oats.—Oats are one of our most valuable concentrates for feeding the dairy cow. This is contrary to statements made by eastern authorities but is a true assertion when applied to Colorado conditions. Eastern oats rarely weigh over 32 pounds to the bushel, frequently weighing as little as 28 and 30 pounds. We are exceedingly fortunate in Colorado as our oats invariably weigh 40 pounds to the bushel and it is not an unusual thing for whole fields to average 46 pounds and sometimes higher. This difference makes the Colorado oat a very superior feed to oats grown at lower altitudes. When ground or crushed, they form a very desirable, bulky, protein concentrate, which is exceedingly palatable. Frequently the price of this grain makes it necessary to substitute other feeds for it, but when oats are the same price, or cheaper than corn or barley, they should be fed in larger amounts, proportionately. (See rations under groups 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11.)

Rye.—Rye is less valuable than corn for feeding the dairy cow. It is low in palatability and should be fed only in small amounts in any concentrate mixture. Occasionally, rye grain contains some ergot, which is a fungus growth, called hard smut, replacing the grain. Rye with ergot in it should not be fed under any circumstances, since it results frequently in abortion and other complications. It is preferable to crush rye instead of grinding it for dairy cows, but like all grains it should under no circumstances be fed whole (See rations under groups 1, 2, 5, 6, 7, 8, 9, 11.)

Soybeans.—Soybeans can be grown in some dry-land sections and where this is practicable, the grain can be fed to dairy cows. They are an excellent source of protein, containing as much protein as cottonseed meal and are of a more digestible nature. They are a very valuable source of protein for the dry-land sections where they can be grown. (See rations under groups 3, 4, 8, 9.)

Wheat.—In feeding this concentrate, the price is usually the limiting factor. It may be substituted for corn in the dairy ration thereby furnishing a greater amount of protein. It is slightly higher in total feeding value than corn, and is a good feed for dairy cows from the standpoint of palatability. Wheat should not comprise more than one-third of the grain ration, due to the fact that it is a very heavy concentrate. Wheat should be fed ground, or preferably crushed, and when the farmer wishes to use wheat in his dairy ration, he may refer to the rations containing corn and may substitute wheat for corn, pound for pound, provided that in so doing he does not feed over one-third of the grain ration as wheat.

Wheat Bran.—Wheat bran furnishes an excellent dairy feed when used in the proper manner. It is bulky, high in mineral matter, and also laxative. Its popularity often makes it high in price and in such cases other nitrogenous feeds, such as linseed meal or cottonseed meal, may prove to be cheaper sources of protein, even though considerably higher in price. (See table in back of this bulletin.) When the price is not prohibitive, it may well be added to any ration for dairy cows. Wheat bran is especially valuable in the eastern sections of the United States, but in irrigated sections of Colorado alfalfa hay usually is a cheaper source of protein in the ration and often a more expensive protein than other concentrates when the percentage of digestible crude protein is compared. The writers have frequently seen alfalfa hay and bran fed together as the sole ration for dairy cows and wish to emphasize at this point, the in- advisability of feeding such a ration. Both alfalfa hay and bran have identically the same nutritive ratio, namely 1 to 3.9, so that a ration made up of these two feeds contains too much protein. With the bran at its usual high price, it would also be an expensive ration to use, especially since it does not serve the purpose for which a rightly balanced ration is intended. It is far better to use other grains that are not as high in protein, and which will balance the ration better and in a cheaper form. (See rations under groups 1, 3, 4, 5, 6, 7, 8, 9, 10, 11.)

Wheat Bran and Shorts, or Mill Bun.—This forms a slightly heavier feed than wheat bran and is somewhat higher in feeding value, contains a greater amount of digestible crude protein, but is less palatable. The notes given above on wheat bran hold true for bran and shorts mixed.

Wheat Shorts.—Wheat shorts is heavier and less palatable than either wheat bran or mill-run, but it contains a higher percentage of digestible crude protein than either of the other two. It, too,

is quite often a very expensive source of portein. It is not nearly so desirable a dairy feed as bran.

The Mineral Feeding of Dairy Cows

Much work is being done over the entire country on the mineral feeding of dairy cows and as yet comparatively little is known.

Professor C. I. Bray of the Colorado Agricultural College observes that once the milk cow gave as low as a thousand pounds of milk a year containing possibly ten pounds of mineral matter, whereas now she gives from six thousand to thirty thousand pounds annually containing from 40 to 80 pounds of mineral matter. This additional mineral matter has to come from the feed. The common feeds contained sufficient mineral matter to supply the unimproved cow with enough minerals, but the high-producing cow is not able to get all her mineral supply from these feeds and additional mineral feeds seem to be advisable. A correlation is apparent in many cases between the lack of ability of a cow to get with calf again after a year's heavy production, a possible reason being that all of the mineral matter has been taken for use in giving milk, leaving none for the building of a calf within the cow.

Cows lose a very large amount of mineral matter during a heavy lactation period and do not readily store calcium while milking. Dr. E. B. Forbes of the Pennsylvania Station, an authority on this subject, states that cows giving over 10 pounds of milk daily are not capable of storing calcium. Even on rations containing large amounts of mineral matter, he found that heavy milkers lost steadily in calcium. This makes a two months' rest essential so the cow may store up sufficient calcium for another milking period.

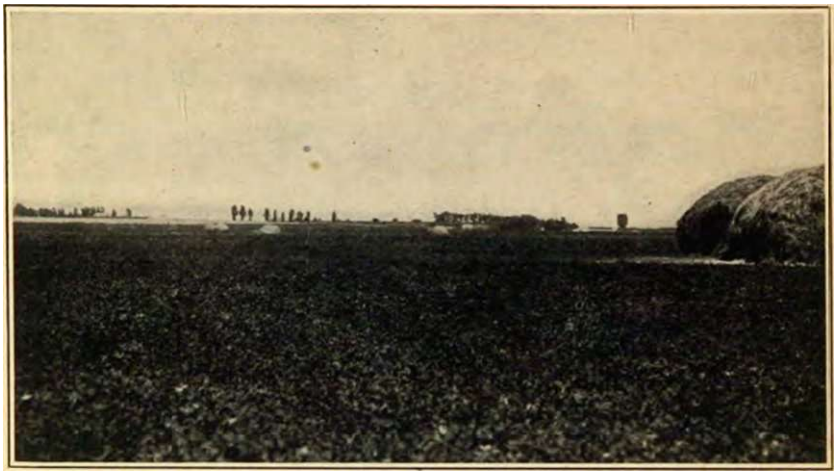
Hart and Steenbock of Wisconsin noted that cows fed entirely on oat straw and oat grains could not raise their calves, most of the calves being born prematurely, born dead, or dying a few hours after birth. The cows did not clean normally after calving. However, when either 2 pounds of calcium acetate or 2 pounds of wood ashes were mixed with each 100 pounds of grain feed, the same cows were able to deliver healthy calves at practically full time and almost invariably cleaned normally. The best results were obtained when a calcium-rich roughage such as alfalfa was fed.

A few feeders in Colorado are using commercial mineral mixtures and others are using a mixture of equal parts of crushed limestone, bone meal and salt, with very good results. Others are adding some wood ashes to this mixture.

All the evidence goes to show that it pays to feed a little mineral feed in addition to that already in the common feeds to keep the cows in the very best physical condition.

The Dry Roughages

Alfalfa Hay.—This roughage is usually placed at the top of the list **for** the dairy cow, because of its high protein content and its palatability. The large amount of protein in alfalfa reduces the



Alfalfa hay is the basis of a number of Colorado dairy-cow rations.

amount of high-priced protein concentrates it is necessary to use. This hay is also valuable because of its mineral content, being especially high in calcium. It is slightly laxative in effect, which is of value in keeping the heavy-producing cow in condition. Hay makes up a large part of the ration and is not as expensive a source of nutrients as grain, consequently every effort should be made to grow, cure, and store a supply that will be satisfactory. In general, leafy, fine-stemmed hay, cut before it is too ripe, is preferable for dairy cows. Third-cutting hay is usually preferred, with first cutting next in preference, but all cuttings will be more satisfactory if properly cared for. (See groups 1, 2, 5, 8, 9, 10, 11.)

Alfalfa Meal.—In view of the palatability of alfalfa hay for the dairy cow and its thorough mastication, the use of alfalfa meal is ordinarily not economical when good alfalfa hay is available. Low- grade hay may be made more palatable by grinding. Alfalfa meal may be of advantage when forced production is the object, and may also be fed when the comparative price with alfalfa hay makes it advisable. From time to time alfalfa meal sells at the same price or slightly higher than alfalfa hay. At such times its use can be advocated.

Alsike Hay.—This is a fine-stemmed hay and should be grown with timothy or some other supporting grass. It is eaten with but very little waste. It is not so high in total digestible nutrients as alfalfa hay and the yield is not nearly so large. It ordinarily has no place where good cuttings of alfalfa hay can be obtained but in the mountain sections of the State makes a very desirable hay. It is not usually grown alone for hay, both because it does better with timothy and because the tonnage to the acre is too light. (See group 6.)

Alsike and Timothy Hay.—This combination gives a much better yield than alsike alone and overcomes the lack of protein and

unpalatability of timothy hay alone. Timothy hay is too carbonaceous and not laxative enough for dairy cows. (See groups 7 and 8.)

Hubam Hay.—This is an annual clover which is fine stemmed and makes good hay, as well as excellent pasture. The big objection to hubam is that it has to be reseeded every year and when the biennial clovers and alfalfa are available, farmers hesitate to go to the trouble every year of sowing hubam when as good and better results are secured from other plants.

Red Clover Hay.—Hay from this clover, cut while in bloom, furnishes a very good feed for the dairy cow. It is slightly lower in protein content than alfalfa but furnishes slightly more net energy. As with alfalfa, the dairyman may cut down the amount of protein concentrates needed by feeding this hay. Red clover can be worked into a rotation of crops advantageously and is of special value as a soil builder.

Yellow-Blossom Sweet-Clover Hay.—This hay may be grown in sections where alfalfa or one of the other clovers cannot be grown. It is one of our leguminous hays which has only come into prominence in the last few years. It should be cut before it becomes too ripe, as the stems are apt to become woody and tough. It requires less moisture than the other clovers and is therefore adaptable to dry-land conditions. (See groups 1, 2, 5, 8, 9, 10, 11.)

White-Blossom Sweet-Clover Hay.—This clover when sown for hay does best when sown closely. It then does not branch as much and makes a little better quality of hay. At best, it grows rank and coarse, lacking palatability but makes a greater volume for hay than the yellow-blossom variety. It also should be cut early.

Corn Stover.—This is a very unpalatable feed for the dairy cow. A big percentage of the crop is usually wasted in handling and feeding. It is a highly carbonaceous feed with a very low net energy value. It would be greatly preferable to cut this crop and put it in the silo, thus forming a succulent feed with less loss in feeding and greater palatability. However, corn stover constitutes one of the chief feeds on the dry-land under present conditions, and when used should always been supplemented with some high-protein concentrate such as linseed meal, soy beans, the clovers, alfalfa, etc., to more nearly balance the ration.

Millet Hay.—This hay is relished by dairy cows, and is more valuable than the hay from the grasses. It is an annual plant, having nearly half the protein content of alfalfa. However, millet hay cannot be used in the rations to supply protein in large amounts. (See groups 3, 4, 9.)

Oat Hay.—This hay is low in energy but more valuable as a dairy-cow feed than is timothy hay. When cut green it is fairly palatable but is not so high in feeding value as millet hay. (See groups 3, 4, 9.)

Red Top and Mixed Hay.—These hays become more valuable as they contain a larger percentage of the leguminous hays. These

hays alone are unsatisfactory for the dairy cow in that they are low in protein, unpalatable and have a constipating effect, rather than the beneficial laxative effect of the legume hays, but when fed in combination with ensilage and a protein grain ration, will form a balanced ration that can be recommended in places where the season is too short to grow alfalfa.

Corn Fodder.—This crop, although very inferior to ensilage, is often fed with moderate results. It forms a feed about equal to hay from the grasses. As with corn stover, it is unpalatable and a great loss is incurred in handling and feeding. This crop should be cut and placed in the silo to furnish the greatly needed succulent on most dairy farms.

Cow-Pea Hay.—This hay, when properly cured, provides a roughage that is equal to alfalfa as far as food value is concerned. It contains practically the same amount of protein and energy value and is very palatable. It is especially adaptable to dry-land sections where it can be grown, but in most sections of Colorado the season is too short for successful growth.

Field-Pea Hay.—This hay is grown extensively both under irrigated conditions and on the dry lands, although it is not used on the dry land to the extent that it should be. Field-pea hay is a valuable protein food containing more protein than alfalfa hay. It, however, is not quite as palatable as alfalfa. Field-pea hay should be cut while the peas are commencing to form. When cut this early it makes a much more palatable food for cows. The more-mature pea vine becomes too woody to make good cow feed. Oats are often sown with peas and make a very satisfactory combination. (See groups 1, 2, 5, 8, 9, 10, 11.)

Soybean Hay.—Soybean hay can be grown in almost every dry-land section of Colorado and should be used more where protein foods are lacking than it now is. It should be cut early to make a palatable feed. (See groups 1, 2, 5, 8, 9, 10, 11.)

Sorghum Hay.—Hay from the sorghums is best when cut while the seed is in the early dough stage. If cut prior to this time it is low in nutritive value and if cut later it is too woody to make a good feed. This feed is grown almost exclusively on dry lands, and when fed to dairy cows must be supplemented with feed high in protein, as the sorghums are of a low protein content and do not produce good results when fed alone or with other highly carbonaceous feeds. The dry-land dairyman will do well to cut down his acreage of sorghums and plant more soybeans, flax, yellow-blossom sweet clover and other feeds high in protein and more valuable as a dairy cow feed. Sorghum cane makes very good silage and can be fed more satisfactorily in this way than as hay. (See groups 3, 4, 9.)

Straws.—These feeds are low in net energy and are undesirable for the dairy cow except as a supplement to legume hay. If placed in a rack before the cows in the lot, they will often utilize small amounts of these feeds even when alfalfa hay is fed in abundance.

Sudan-Grass is a valuable feed in the plains area—it partially replaces permanent pasture and may be cut for hay.

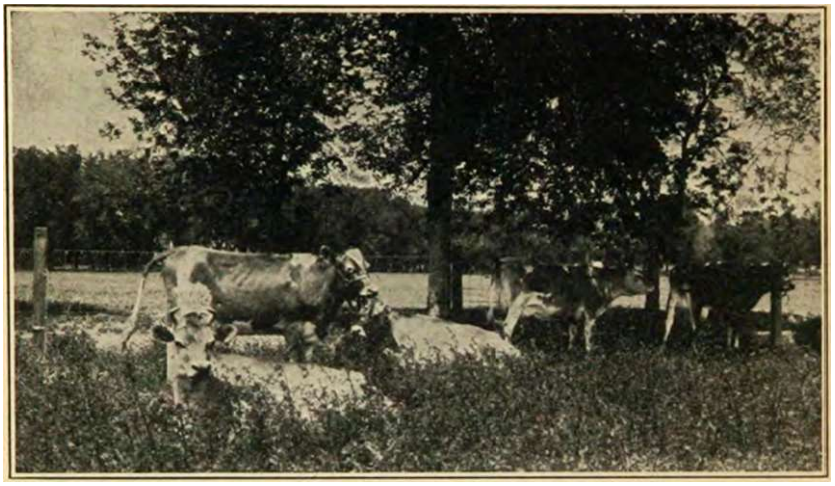
Oat straw is relished by cows much better than the straws of wheat, barley, etc. Straw should not be fed to take the place of any of the other roughages.

Sudan-Grass Hay.—Recent experiments at the Kansas Experiment Station show that sudan hay is a valuable feed for the dry-land farmer. When fed with ensilage and with a high-protein concentrate, sudan hay gives good results. It does best, however, when mixed with small amounts of alfalfa or other leguminous hay to bring up the protein content of the ration. (See groups 3, 4, 9.)

Timothy Hay.—Timothy hay is most unsatisfactory as a feed for dairy cows. It lacks protein, is not relished by cows because of its unpalatability, and is constipating in its effect upon cows. A comparison of timothy and alfalfa at the Illinois Station showed that alfalfa-fed cows produced 17.5 per cent more milk than those fed timothy. Moreover, the timothy-fed cows lost in weight and were often "off feed." When, of necessity, timothy must be used it should be supplemented by concentrates high in protein content.

Wild-Grass Hay.—This hay is unpalatable and constipating for the dairy cow, and should not be fed unless where more desirable hays are not available.

Wire-Grass Hay.—This is probably the least desirable of any of our hays from the grasses for the dairy cow, combining the poor qualities of all of them. When no other hays are available it may be fed the dairy cow, but should be combined with some high-protein concentrate and some succulent feed.



Good permanent pasture insures maximum production at minimum cost.

PASTURE GRASSES

Pasture is a good succulent, natural feed for dairy cows, and every owner of cows welcomes the time when the animals can be turned out to pasture. Not only is the labor and expense connected with winter feeding done away with but the herd may be expected to give the best results of the year during the first two months on pasture and in it we have a ration most conducive to high production. In changing from dry to green feed it is best to go somewhat slowly, especially with heavily milking cows. Early grass is mostly water, often containing not more than 10 per cent of dry substance—less than milk itself. Heavy milkers cannot eat enough of such food to supply the necessary nutrients, and production under such conditions will be made at the expense of the animal's body unless the pastures are supplemented with a grain ration. For heavily producing cows this grain supplement should be moderately high in protein.

A common mistake is to pasture too closely in the fall and too early in the spring. This injures the pasture materially and the cows do not get the amount of feed they require.

The amount of grain to be fed on pasture will depend upon various factors such as the production of the cow, amount of pasture available for each cow and the nature of the pasture.

There is no question that the cow will produce more if fed grain while on pasture, except in cases of low production. The cow that will not repay her owner for a small grain ration while on pasture is usually unprofitable.

A cow producing 35 pounds of milk daily requires about 30 pounds dry matter in her feed. Fresh pasture grass seldom contains

over 20 pounds dry matter per 100 pounds. That would mean that a moderately producing cow must eat close to 150 pounds grass daily. The physical exertion necessary to gather, masticate and digest this amount of grass is a hard day's work, requiring more energy than can be secured from the grass alone.

A compilation from the Minnesota Cow Testing Associations is as follows:

	Pasture only	Grain and Pasture
Number of cows	700	300
Average fat yield (pounds)	238	302
Cost of feed	$41.87	$49.35

These figures indicate that by feeding grain worth $7.28 an addition of 64 pounds of butter fat was secured, which was worth $24.71 at 40 cents a pound.

It is a fact of common observation that cows fed grain on pasture give better results when the grazing season is over than those that have not had grain.

The best amount of grain to be fed on pasture has been found by Eckles of the Minnesota Experiment Station to be as follows:

Jersey or Guernsey Cow producing—	Holstein-Friesian, Shorthorn, Brown Swiss or Ayrshire Cow producing—
20 lbs. milk daily, 3 lbs. grain daily	25 lbs. milk daily, 3 lbs. grain daily
25 lbs. milk daily, 4 lbs. grain daily	30 lbs. milk daily, 4 lbs. grain daily
30 lbs. milk daily, 5 lbs. grain daily	35 lbs. milk daily, 5% lbs. grain daily
35 lbs. milk daily, 7 lbs. grain daily	40 lbs. milk daily, 7 lbs. grain daily
40 lbs. milk daily, 8 lbs. grain daily	50 lbs. milk daily, 9 lbs. grain daily

When less than five pounds of grain are fed daily, little attention need be paid to the protein content and common farm grains such as corn, oats, rye, and barley may be used, but when over five pounds are fed the protein content should be about the same as for winter feeding.

Grain is most essential during the months of July and August, when pastures become scanty. It is especially desirable to feed all the cows some grain at this time whether they are dry or producing milk.

Stock should be kept off pastures when they are wet because of the bad effects of tramping.

Awnless or Western Brome Grass.—This grass is one of the most palatable of our pasture grasses and endures heavy grazing due to its heavy-sod-forming habits. This grass is quite drought resistant, making it especially suitable for those sections lacking in rainfall or on land where irrigation water is not plentiful. It furnishes both early and late grass, staying green for a long season.

Hubam Clover Pasture.—This is an excellent fine-stemmed pasture plant but is objected to because it must be reseeded each year. When the biennial or the perennial grasses are available, labor will be saved by using them in preference.

Kentucky Blue Grass.—This is an excellent pasture grass but unless conditions are nearly ideal it fails to make a heavy yield and its carrying capacity is small. Blue grass is shallow rooted and requires a great deal of water. Unless the rainfall is good or it is irri-

gated it will turn brown and stop growing. Land that is irrigated frequently, as is necessary with a blue-grass pasture, is apt to become leached of plant-food materials.

Morton's Pasture Grass Mixture.—This mixture is an answer to the question, "Can we grow pasture profitably on high-priced land?" It comes after many years of experimenting with most of the pasture plants in this country and some of the grasses of foreign countries. It is a mixture adapted to Colorado conditions particularly.

MORTON'S PASTURE GRASS MIXTURE

Brome grass	15 pounds
Orchard grass	15 pounds
Meadow fescue	10 pounds
Timothy	6 pounds
Yellow-blossom sweet clover	4 pounds

This is a total seeding of 50 pounds to the acre, which may seem heavy, but eliminates any waste of soil, utilizing every available portion and insuring an early sod.

A heavy-yielding grass is necessary as a base, and this was found in orchard grass which is unsuited for planting alone because of its bunchy growth. To supply a compact sod, brome grass is added which in the later years of the pasture furnishes a very luxuriant growth. Timothy is put in the mixture to take the place of the brome before the brome becomes thoroughly set. The brome grass will later crowd out the timothy. The meadow fescue is a shallow-rooted plant and utilizes the upper layers of soil which are not used by the deep-rooted grasses. Then there must be a suitable legume and this is found in yellow-blossom sweet clover. It is non-

The experimental plots of irrigated pasture on the College farm always attract visitors. These plots carry six times as many head per acre as do the natural pastures and furnish the feed in a better balanced form.

bloating and while it is a biennial by nature, it will reseed itself due to its growing close to the ground. Even sheep do not graze close enough to destroy its lower-growing seed-bearing branches. Thus we have a well-balanced pasture, utilizing all the depths of the soil, giving abundant growth, and containing a legume.

To give the young roots opportunity to become firmly established, it is advisable not to turn stock on to newly sown pasture of this nature for the first two seasons, but to take a hay crop instead. This mixture makes a very heavy hay yield even when young.

For further information in regard to this pasture and its success in the State, write to the Animal Husbandry Department of the Colorado Agricultural College. Information will be gladly *given* as to the best method of planting, where to procure seed, etc.

Professor B. W. Fairbanks, during the summer of 1923, conducted an experiment at the Colorado Agricultural College which shows very well the cash value of an irrigated pasture. Eight cows were pastured on four acres for 74 days during the summer, which was considerably less than the full pasturage season. Some grain was fed to the cows on pasture. The cost of production may be tabulated as follows:

Grain cost	$64.24
Interest on 4 acres land at $150 per acre	42.00
Interest on $1500 equipment	18.75
Depreciation on $1500 equipment	15.62
Interest on value of cows	20.00
Labor	50.00
Labor for Irrigation	24.00
Total	$234.61

The returns were as follows: 2,046.08 gallons of milk sold at 20 cents, $409.22. Deducting the $234.61 or cost of production, we have a margin of $174.61 or $43.40 per acre which is a greater net income than most of our Colorado cash crops produce. Tables and water assessments were not included in the above calculations, as they vary considerably in different parts of the State.

Native Pasture.—Where a native pasture contains a good combination of grasses, it is advisable to let it alone, especially if the land is liable to wash away. Otherwise it might be difficult to get it reestablished.

If irrigation water is not available, the native pasture may produce more than a tame-grass mixture would. However, if the native pasture is growing on fairly level, irrigated land, it will not usually produce as abundant growth as a tame-grass pasture. A tame-grass pasture, however, cannot be planted the first year after the native grass has been broken, as a fine, well-divided seed bed is the first essential.

Rye Pasture.-—This cereal furnishes late-fall and early-spring pasture but must be sowed annually. Milk cows should be taken off rye pasture two or three hours before milking if an "off" flavor is noticed in the milk. Frequently rye pasture gives a bad flavor to milk, which can be avoided by not permitting the cows to pasture it right up to time of milking.

Sudan-Grass Pasture.—This makes a good early-fall and late- summer pasture, but has to be replanted every year. Despite this objection, it is being used with success in sections of the Arkansas Valley. It is also of value to the dry-land farmer as it is drought resistant, and furnishes a luxuriant growth.

Instances of prussic-acid poisoning are on record from this grass, but this usually occurs on second growth during frosty or damp weather.

Orchard Grass.—This yields much heavier than blue grass but is less palatable and, in a mixture with blue grass and brome grass, will probably be the last to be eaten. It grows in bunches and, therefore, will not stand tramping in a pasture. Orchard grass will grow on land too poor in lime or too deficient in fertility for either blue grass or brome grass.

White-Blossom Sweet Clover.—This clover forms a rank growth and because of its heavy stems it is not very palatable to any class of livestock. It is not recommended for pasture, where yellow-blossom sweet clover is obtainable, since this latter legume is much better for pasture purposes, and the white sweet clover does not readily reseed itself.

Yellow-Blossom Sweet Clover.—This is a much finer-stemmed plant and is, therefore, much more palatable. It is also a biennial but will reseed itself each year from the seeds borne on the low-growing stems. Occasional cases of bloat on this plant have been reported, but for all practical purposes it may be considered non-bloating. It does best when sown with other grasses and is well suited to any pasture-grass mixture. It is used alone as a pasture crop with success in dry-land sections.

Some trouble has been found with this plant causing bad taste in the milk but this can be remedied by removing the cows from pasture an hour and a half or two hours before milking.

Clover pastures will reseed themselves to quite an extent but the grower will be able to materially add to the value of this pasture if he will add about five pounds to the acre of seed each year.

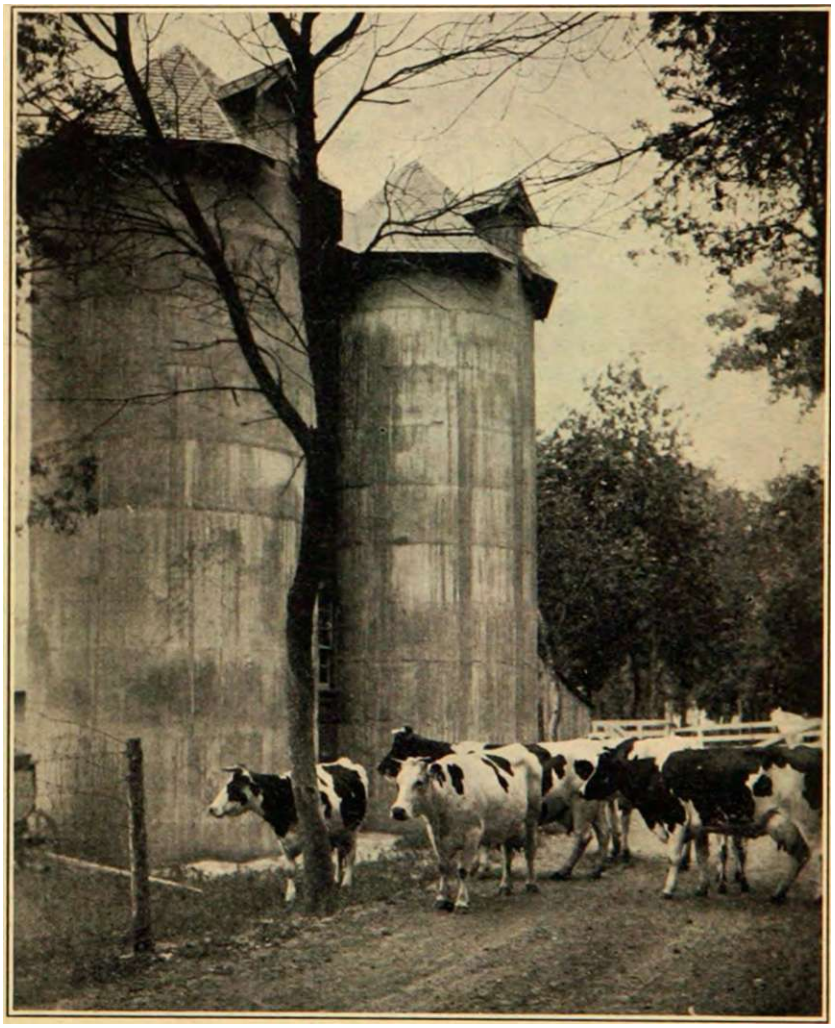
THE SUCCULENT ROUGHAGES

Silage or some succulence is an essential for economical and constant production during the winter months. The cow, to produce properly, must have something to take the place of the summer pasture, something that will have a stimulating, laxative effect and keep her organs working smoothly.

From any standpoint the dairyman cannot afford to be without a silo. The Ohio Experiment Station shows that cows receiving corn silage produced 15 per cent more milk at 41 per cent less cost than cows getting a dry ration of hay, stover and grain, when the silage was fed proportionately with mixed hays and a little grain.

Often the original cost of a silo appears prohibitive but in most cases it is not, after we figure a little. The following argument was

recently advanced by the Missouri State Dairy Commission. Suppose we erect a 100-ton silo. It will require ten acres to fill it with corn. The value of the silage approximates $5 a ton so we would have $500 worth of silage. The value of the dry fodder and grain can be figured by taking a yield of 40 bushels to the acre, or 400 bushels from the ten acres at, say 50 cents a bushel, which will be $200. Add to this the value of the stalks as pasture at $4.00 an acre, or $40.00 for the 10 acres, and we have $240. From this must be deducted $20.00 which represents the cost of husking and cribbing



The silo provides ensilage—an ideal winter succulent at a low cost.

the corn at five cents per bushel. This gives us $280, which, after subtracting interest, represents the net increase in the feeding value of the ensiled corn.

Now a 100-ton, upright silo will cost about $600 to construct, if contracted. If the money had to be borrowed to build it, the interest on the loan at 6 per cent would be $36.00, which, subtracted from the $280 leaves $244, which represents a handsome increase in the value of ensiled corn over dry fodder and grain.

In the dry-land sections it is seldom necessary to go to the expense of building an upright silo unless this type is preferred. Pit silos are a very serviceable means of preserving an excellent grade of ensilage wherever the water level is low enough to permit their construction. This type of silo can usually be constructed at a cost not to exceed $100, depending upon the size, and, while it is not quite as convenient to remove the ensilage, quite a saving is made in machinery as no elevator or blower is necessary.

Trench silos are also used successfully in almost every section of the State. Unless particular care is given to packing the ensilage in this type of silo, considerable loss will occur as it is much easier for air to penetrate a trench silo than one of an upright or pit type. The writers have seen excellent ensilage taken from trench silos, which has been retained in the silo several months, but only after heavy tramping was given while being filled.

Silos of the pit and trench type are serving many eastern Colorado dairymen and are saving them many dollars each year as this is a much more preferable way of feeding the corn plant than in the form of fodder.

Three pounds of ensilage fed to every 100 pounds of live weight makes a vast difference in the milk profits if fed in a balanced form with grain and hay.

Com Silage.—This is the most common and most valuable form of silage that we have. It is more economical to feed silage than corn fodder for in silage the entire plant is utilized and there is no waste when feeding. The corn should be ensiled when the grain has started to glaze. The silo must be of such size that at least a three-inch layer can be taken off every day to prevent spoiling. Moldy silage should not be fed. (See groups 1, 3, 6, 7, 8.)

Sunflower Silage.—This is a silage of only recent development and is about 15 per cent lower in feeding value than corn silage. It can be grown at a higher altitude than corn and is recommended for such places. If corn can be grown it is advisable to grow it for silage in preference to sunflowers, as sunflowers are only intended to serve as a substitute for corn at high altitudes. When corn silage can be secured it is preferable to sunflower silage at a price 15 per cent higher than sunflower silage. (See groups 1, 3, 6, 7, 8.)

Beet-Top Silage.—If not fed fresh from the field, the tops may be ensiled. As much soil as possible should be shaken from the tops. They may be ensiled in pits in alternate layers with straw, but frequently they are ensiled alone. When mixed with straw, they must be packed especially well and put in while quite fresh. When ensiled they are less purgative than when fed green. Salt added at the rate of five pounds per ton improves the quality. The silage can be fed with good results along with hay and other feeds to balance the ration. It is worth considerably less than good corn silage per ton, and to dairy cows should not be fed in excess of 30 pounds daily.

Wet Beet Pulp.—Wet beet pulp is fed extensively to dairy cows in sections which are close to sugar factories, and produces good milk when not fed excessively. Excessive feeding to the exclusion of other feeds frequently taints the milk and produces weak offspring due to the fact that this food is very low in lime content, vital to the production of healthy calves.

Three pounds of wet beet pulp is equal in feeding value to about one pound of ensilage or one and one-half pounds of sugar beets for dairy cows. Its very low protein content makes it necessary to have a leguminous hay in the ration or some high protein concentrate, such as cottonseed meal.

Wet beet pulp should not be fed in the barn because of its offensive odor and we advise feeding it soon after milking, taking the cows away from the pulp at least an hour before being milked. (See group 10.)

The Roots and Tubers

Roots are an excellent feed for dairy cows, furnishing succulence and bulk in a form much relished by them. The cost of raising roots is usually prohibitive and ensilage serves much the same purpose at a lower production cost. When roots are fed, they should always be sliced and under no circumstances fed whole. They may replace up to one-half the grain ration, experiments showing that from 8 to 12 pounds of roots are equal in feeding value to one pound of grain.

Where silage is not available, roots may be used as a substitute either wholly or partially as a succulent feed. Experience shows that cows will consume from two to nearly three times as much roots by weight as they will corn silage and large amounts of roots, especially stock beets, can be fed with safety. Many of the highest milk records are made largely with roots as one of the principal feeds, cows receiving as high as 100 pounds daily in some cases. The limiting factor is the cost of labor involved in growing roots.

Stock Carrots.—Stock carrots are relished by the cow and are as valuable as any of our root feeds. They produce a heavier yield per acre than do sugar beets but the tops are not relished by stock to much extent so that consequently they are not grown in as large amounts as mangels, beets, etc. They are good appetizers, making the cow relish her other feeds and improve the color of the butterfat.

The labor cost of growing carrots in large enough quantities for dairy cows usually makes them unprofitable. (See groups 1, 3, 6, 7, 8, 11.)

Mangels.—From Danish experiments it has been found that one pound of dry matter in roots is equal to one pound of dry matter in Indian corn, or to one pound dry matter in a mixture of barley, oats and rye. At the Minnesota Experiment Station, Haecker found that eleven pounds of mangels or nine pounds rutabagas have the same value as one pound of grain but cannot at any time replace more than one-half of the grain ration. Mangels will keep better than sugar beets. (See groups 1, 3, 6, 7, 8, 11.)

Potatoes.—Due to large production and low prices, a great many potatoes have been fed during the last few years and with good results. When potatoes will bring 35 cents to 40 cents per cwt. on the market, they cannot economically be fed to stock, although culls may be utilized at all times. The price at which potatoes can be profitably fed depends largely on the existing price of grain. Potatoes have about one-fifth the total feed nutrients of the common grains such as corn, oats and barley. Potatoes fed to cows in large amounts will cause salvy butter. To avoid trouble in feeding potatoes, care must be exercised in the following ways: Chop potatoes when fed in an ordinary manger. Feed no sprouted or rotten potatoes. The sprouts or stored potatoes frequently contain considerable quantities of solanin which is a poisonous compound. The sprouts should, therefore, be removed or the potatoes not fed at all. Potatoes that have become green should not be fed for the same reason. Potatoes should not be fed in amounts over 25 pounds daily, as they are very laxative and when fed in large quantities often cause bloat. (See group 5.)

Stock Beets.—These half-sugar beets combine the qualities of high feeding value and high production. From the standpoint of economical production, they are possibly the best roots available for cows, serving the same purpose as other roots, but being a cheaper root to raise because of the greater yield to the acre. (See groups 1, 3, 6, 7, 8, 11.)

Sugar Beets.—These roots furnish a good feed but are usually worth too much to feed. They are worth slightly more than mangels. Because of their high sugar content, they may cause scours if fed in excess.

The Nebraska Experiment Station made some comparisons on the production secured from a like amount of sugar beets fed with a like amount of ensilage and obtained the following results:

30 pounds corn silage
10 pounds alfalfa hay } yielded 17.4 pounds milk; .84 pounds fat

30 pounds sugar beets
10 pounds alfalfa hay } yielded 16.1 pounds milk; .78 pounds fat

But it should be borne in mind that a cow can consume from two to nearly three times as much roots by weight as she can ensilage, the limiting factor being the excessive labor cost involved in growing the roots, ensilage being almost always a much cheaper succulent. (See groups 1, 3, 6, 7, 8, 11.)

Shade in the farm lot lends contentment and comfort to the cows, naturally increasing production.

Turnips.—These roots do not give a particularly high yield and are not relished as much as some of our other roots by the dairy cow. Quite often they will cause milk with a bad flavor. They are more watery than rutabagas and do not keep as well. In general they cannot be recommended for feeding cows, as other roots are much more satisfactory.

COLORADO RATIONS FOR DAIRY COWS

Feed all the hay and silage the cows will eat up clean, preferably from one to one and a half pounds daily of hay and three pounds daily of ensilage to every 100 pounds live weight. Grain should be fed at the rate of one pound to every four pounds of milk produced. Amounts of roughage given in the following rations refer to the daily needs of the cow:

GROUP 1

10 to 15 pounds of alfalfa hay, soybean hay, field-pea hay, or yellow-blossom sweet clover.

30 to 40 pounds of either corn or sunflower silage, or 40 to 50 pounds of stock beets, mangels, sugar beets, rutabagas or carrots.

Grain mixtures to use with above are:—

No. 1	**No. 3**	**No. 5**
250 pounds ground oats 100 pounds ground barley 100 pounds corn chop	225 pounds corn chop 200 pounds ground oats 150 pounds dried beet pulp 25 pounds cottonseed meal	100 pounds kafir corn 100 pounds corn and cob meal 150 pounds ground oats 50 pounds linseed meal
No. 2	**No. 4**	**No. 6**
175 pounds ground oats 100 pounds ground barley	100 pounds corn chop 100 pounds ground barley 100 pounds bran	100 pounds corn chop 200 pounds crushed rye 300 pounds ground barley 50 pounds linseed meal

Note: 10 pounds of potatoes may be substituted in this group for a like amount of ensilage, but should not be fed in larger quantities in this group.

GROUP 2

22 to 30 pounds of alfalfa hay, soybean hay, field-pea hay, or yellow-blossom sweet-clover hay.

No succulence.

Grain mixtures to use with above are: —

No. 1	No. 2	No. 3
100 pounds ground oats		100 pounds kafir corn
100 pounds ground barley	100 pounds ground oats	100 pounds corn and cob meal
100 pounds corn chop	100 pounds ground barley	100 pounds ground barley

or any other suitable farm grains such as corn, oats, barley, wheat, rye, kafir and the sorghums.

GROUP 3

10 to 15 pounds of millet hay, sorghum hay, milo hay, sudan hay, kafir hay, or oat hay.

30 to 40 pounds of either corn or sunflower silage, or 40 to 50 pounds of stock beets, mangels, sugar beets, rutabagas, or carrots.

Grain mixtures to use with above are:—

No. 1	No. 3
100 pounds flaxseed	400 pounds ground soybeans
100 pounds cottonseed meal	100 pounds bran
100 pounds kafir corn or corn chop	100 pounds kafir corn
No. 2	**No. 4**
300 pounds cottonseed meal	400 pounds ground soybeans
200 pounds bran	100 pounds bran
100 pounds ground oats	100 pounds corn chop

GROUP 4

22 to 30 pounds of millet hay, sorghum hay, milo hay, kafir hay, sudan hay or oat hay.

No succulence.

Grain mixtures to use with above are:—

No. 1	No. 2	No. 3
300 pounds linseed meal	100 pounds flaxseed	300 pounds ground soy beans
100 pounds cottonseed meal	300 pounds cottonseed meal	100 pounds kafir corn or corn chop
100 pounds bran	125 pounds bran	200 pounds linseed meal
100 pounds ground oats		

GROUP 5

18 to 24 pounds alfalfa hay, soybean hay, field-pea hay, or yellow-blossom sweet-clover hay.

20 pounds of potatoes or 4 pounds of dried beet pulp, weighed dry, soaked in water 12 hours prior to feeding.

Grain mixtures to use with above are:—

Same as used in Group 1.

GROUP 6

10 to 15 pounds alsike-clover hay.

30 to 40 pounds of either corn or sunflower silage, or 40 to 50 pounds of stock beets, mangels, sugar beets, rutabagas, or carrots.

Grain mixtures to use with above are:—

No. 1	No. 2	No. 3
300 pounds ground oats	400 pounds bran	125 pounds linseed meal
200 pounds ground barley	100 pounds corn chop	275 pounds ground barley
100 pounds cottonseed meal	100 pounds ground oats	100 pounds bran
		100 pounds crushed rye

GROUP 7

10 to 15 pounds of timothy and alsike hay.

30 to 40 pounds of either corn or sunflower silage, or 40 to 50 pounds of stock beets, mangels, sugar beets, rutabagas, or carrots.

Grain mixtures to use with above are:—

No. 1	No. 2	No. 3
200 pounds cottonseed meal	100 pounds cottonseed meal	260 pounds cottonseed meal
150 pounds linseed meal	100 pounds bran	100 pounds crushed rye
250 pounds ground oats	100 pounds ground barley	140 pounds ground barley
	100 pounds ground oats	100 pounds linseed meal
	100 pounds linseed meal	

GROUP 8

5 to 8 pounds of timothy and alsike with 5 to 8 pounds of alfalfa hay, soybean hay, field-pea hay or yellow-blossom sweet-clover hay.

30 to 40 pounds of either corn or sunflower silage, or 40 to 50 pounds of stock beets, mangels, sugar beets, rutabagas, or carrots.

Grain mixtures to use with above are:—

No. 1	No. 2	No. 3
300 pounds ground oats	200 pounds ground soy beans	225 pounds linseed meal
200 pounds cottonseed meal	150 pounds bran	225 pounds crushed rye
100 pounds ground barley	200 pounds barley	100 pounds bran
	50 pounds cottonseed	50 pounds corn chop

GROUP 9

11 to 15 pounds of either or any of the following: Millet hay, sorghum hay, milo hay, kafir hay, sudan hay, bean straw, or oat hay WITH 11 to 15 pounds of any of the following: Alfalfa hay, soybean hay, field-pea hay, or yellow-blossom sweet-clover hay.

No succulent.

Grain mixtures to use with above are:—

No. 1

200 pounds flaxseed
200 pounds ground oats
100 pounds cottonseed meal
100 pounds corn and cob meal

No. 2

200 pounds flaxseed
100 pounds ground oats
100 pounds bran
100 pounds corn and cob meal
50 pounds cottonseed meal

No. 3

200 pounds ground soy beans
100 pounds bran
100 pounds corn and cob meal
100 pounds ground barley
100 pounds kafir corn

No. 4

200 pounds linseed meal
250 pounds crushed rye
100 pounds corn chop
50 pounds bran

GROUP 10

10 to 15 pounds alfalfa hay, soybean hay, field-pea hay, or yellow-blossom sweet-clover hay.

50 to 60 pounds wet beet pulp.

Grain mixtures are:—

No. 1	No. 2
	300 pounds corn chop
400 pounds ground oats	200 pounds barley
100 pounds bran	50 pounds linseed meal
100 pounds barley	50 pounds bran

GROUP 11

10 to 15 pounds alfalfa hay, soybean hay, field-pea hay, or yellow-blossom sweet-clover hay.

20 pounds beet-top silage.

30 pounds stock beets, mangels, sugar beets, rutabagas or carrots. Use same grain mixtures as in Group 1.

COST OF 100 POUNDS OF DIGESTIBLE PROTEIN.

Price per Ton	Price per 100 lbs.	Alfalfa	Barley (ground)	Beet Pulp (dried)	Bran (wheat)	Corn Meal or Chop	Corn-and-Cob Meal	Cotton-seed Meal (choice)	Cow-peas.	Linseed Meal (O.P.)	Linseed Meal (N.P.)	Middlings (wheat)	Oats (ground)	Rye Chop	Sorghum Grain	Soybean Meal
$10.00		$ 4.71														
12.00		5.66														
14.00		6.60														
16.00		7.54														
18.00		8 96														
20.00	$1.00	9.43	$11.11	$21.74	$ 8.00	$14.49	$16.39	$ 2.70	$ 5.15	$ 3.31	$ 3.15	$ 7.46	$10.64	$10.87	$13.33	$ 3.26
21.00	1.05	10.37	11.67	22.83	8.40	15.22	17,21	2.84	5.41	3.48	3.31	7.84	11.17	11.41	14.00	3.42
22.00	1.10	11.32	12.22	23.91	8.80	15.94	18.03	2.97	5.67	3.64	3.47	8.21	11.70	11.96	14.67	3.58
23.00	1.15	12.21	12.78	25.00	9.20	16.67	18.85	3.11	5.93	3.81	3.63	8.58	12.23	12.50	15,33	3.75
24.00	1.20	13.20	13.33	26.09	9.60	17.39	19.67	3.24	6.19	3.97	3.79	8.96	12.77	13.04	16.00	3.91
25.00	1.25		13.89	27.17	10.00	18.12	20.49	3.38	6.44	4,14	3.94	9.33	13.30	13.59	16.67	4.07
26.00	1.30		14.44	28.26	10.40	18.84	21.31	3.51	6.70	4.30	4.10	9.70	13.83	14.13	17.33	4.23
27.00	1.35		15.00	29.35	10.80	19.57	22.13	3.65	6.96	4.47	4.26	10.07	14.36	14.67	18.00	4.40
2S.00	1.40		15.56	30.43	11.20	20.29	22.95	3.78	7.22	4.64	4.42	10.45	14.89	15.22	18.67	4.56
29.00	1.45		16.11	31.52	11.60	21.01	23.77	3.92	7.47	4.80	4.57	10.82	15.43	15.76	19.33	4.72
30.00	1.50		16.67	32.61	12.00	21.74	24.59	4.05	7.73	4.97	4.73	11.19	15.96	16.30	20.00	4.89
31.00	1.55		17.22	33.70	12.40	22.46	25.41	4.19	7.99	5.13	4.S9	11.57	16.49	16.85	20.67	5.05
32.00	1.60		17.78	34.78	12.80	23.19	26.23	4.32	8.25	5.30	5.05	11.94	17.02	17.39	21.33	5.21
33.00	1.65		18.33	35.87	13.20	23.91	27.05	4.46	8.51	5.46	5.21	12.31	17.55	17.93	22.00	5.37
34.00	1.70		18.89	36.96	13.60	24.64	27.87	4.59	8.76	5.63	5.36	12.69	18.09	18.48	22.67	5,54
35.00	1.75		19.44	38.04	14.00	25.36	28.69	4.73	9.02	5.79	5.52	13.06	18.62	19.02	23.33	5.70
36.00	1.80		20.00	39.13	14.40	26.09	29.51	4.S6	9.28	5.96	5.68	13.43	19.15	19.57	24.00	5.86
37.00	1.85		20.56	40.22	14.80	26.81	30.33	5.00	9.54	6.13	5.84	13.81	19.68	20.11	24.67	6.03
38.00	1.90		21.11	41.30	15.20	27.54	31.15	5.14	9.79	6.29	5.99	14.18	20.21	20.65	25.33	6.19
39.00	1.95		21.67	42.39	15.60	28.26	31.97	5.27	10.05	6.46	6.15	14.55	20.74	21.20	26,00	6.35
40.00	2.00		22.22	43.48	16.00	28.99	32.79	5.41	10.31	6.62	6.31	14.93	21.28	21.74	26.67	6.51
41.00	2.05		22.78	44.57	16.40	29.71	33.61	5.54	10.57	6.79	6.47	15.30	21.81	22.28	27.33	6.68
42.00	2.10		23.33	45.65	16.80	30.43	34.43	5.68	10.82	6.95	6.62	15.67	22.34	22.83	28.00	6.84
43.00	2.15		23.89	46.74	17.20	31.16	35.25	5.81	11.08	7.12	6.78	16.05	22.87	23.37	28.67	7.00
44.00	2.20		24.44	47.83	17.60	31.88	36.07	5.95	11.34	7.28	6.94	16.42	23.40	23.91	29.33	7.17
45.00	2.25		25.00	48.91	18.00	32.61	36.89	6.08	11.60	7.45	7.10	16.79	23.94	24.46	30.00	7.33
46.00	2.30		25.56	50.00	18.40	33.33	37.70	6.22	11.85	7.62	7.26	17.16	24.47	25.00	30.67	7.49
47.00	2.35		26.11	51.09	18.80	34.06	38.52	6.35	12.11	7.78	7.41	17.54	25.00	25.54	31.33	7.65
48.00	2.40		26.67	52.17	19.20	34.78	39.34	6.49	12.37	7.95	7.57	17.91	25.53	26.09	32.00	7.82
49.00	2.45		27.22	53.26	19.60	35.51	40.16	6.62	12.63	8.11	7.73	18.28	26.06	26.63	32.67	7.98
50.00	2.50		27.78	54.35	20.00	36.24	40.98	6.76	12.89	8.28	7.89	18.66	26.60	27.17	33.33	8.14

MEMORANDA

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