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THE MAKING AND FEEDING OF SILAGE.

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MAKING AND FEEDING SILAGE.

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SOME POINTS IN FAVOR OF SILAGE.

Within the last 30 years silage has come into general use throughout the United States, especially in those regions where the dairy industry has reached its greatest development. Silage is universally recognized as a good and cheap feed for farm stock, and particularly so for cattle and sheep. There are several reasons for the popularity of silage.

1. More feed can be stored in a given space in the form of silage than in the form of fodder or hay.
2. There is a smaller loss of food material when a crop is made into silage than when cured as fodder or hay.
3. Corn silage is a more efficient feed than corn fodder.
4. An acre of corn can be placed in the silo at less cost than the same area can be husked and shredded.
5. Crops can be put in the silo during weather that could not be utilized in making hay or curing fodder.
6. More stock can be kept on a given area of land when silage is the basis of the ration.
7. There is less waste in feeding silage than in feeding fodder. Good silage properly fed is all consumed.
8. Silage is very palatable.
9. Silage, like other succulent feeds, has a beneficial effect upon the digestive organs.
10. Silage is the cheapest and best form in which a succulent feed can be provided for winter use.

11. Silage can be used for supplementing pastures more economically than can soiling crops, because it requires less labor, and silage is more palatable.

12. Converting the corn crop into silage clears the land and leaves it ready for another crop.

SILAGE CROPS.

Almost any green crop can be successfully made into silage if sufficient care is taken to force out the air from the material. On account of the difficulty, however, of expelling air from plants with a hollow stem, such as timothy, oats, and barley, these crops are rarely put in the silo.

CORN.

In all parts of the United States where the silo has come into general use the principal silage crop is corn. One reason for this is that ordinarily corn will produce more food material to the acre than any other crop which can be grown. It is more easily harvested and put in the silo than any of the hay crops, such as clover, cowpeas, or alfalfa. These crops are much more difficult to handle after being cut. Furthermore, corn makes an excellent quality of silage. Sorghum makes a sour silage, and the legumes, such as clover and alfalfa, are liable to rot unless special care is taken to thoroughly pack the silage and force out the air. The fermentations which take place in leguminous silage are more extensive and in consequence the loss of food materials is greater than with corn.

The only objection which has been raised concerning corn silage is the fact that it contains insufficient protein to fully meet the requirements of animals to which it may be fed. Some persons have advised mixing clover, cowpeas, or alfalfa with the corn when it is being put into the silo in order to correct this deficiency of protein. Such a procedure is not to be advised, however, if it is at all possible to cure the clover or other crop into hay, and it usually is possible if hay caps are used. Since some dry forage should always be fed along with the silage, the leguminous hay would better be used in this way rather than by converting the crop into silage.

VARIETY TO PLANT.

The best variety of corn to plant is that which will mature and yield the largest amount of grain to the acre, since the grain is the most valuable part of the corn plant. The variety commonly grown in any particular locality for grain will also be the most satisfactory to grow for silage. As will be seen from the table below, taken from the First Annual Report of the Pennsylvania State College, 63 per cent of the digestible food materials present in the corn plant are found in the ears and 37 per cent in the stover.

Yield of digestible matter in corn.

Constituent.	Yield per acre.		
	Ears.	Stover.	Total crop.
Protein.....	<i>Pounds.</i> 244	<i>Pounds.</i> 83	<i>Pounds.</i> 327
Carbohydrates.....	2,301	1,473	3,774
Fat.....	125	22	147
Total.....	2,670	1,578	4,248

CULTIVATION AND YIELD.

Corn for silage may be planted and cultivated in the same manner as when grown for grain. Weeds should be kept out, else they will



FIG. 1.—A good field of corn.

be cut with the corn and may impair the quality of the silage. The yield of corn silage per acre will vary from 4 or 5 to 20 tons or more. A 50-bushel per acre crop of corn will yield about 8 to 12 tons of silage per acre, depending upon the amount of foliage and stalk that accompanies the ear. Southern varieties of corn as a rule carry a larger proportion of the plant in the form of stalk and leaves than do the northern-grown varieties. Figure 1 shows a good field of corn.

TIME TO HARVEST.

Corn should be harvested for the silo at about the same time that it is harvested for fodder—that is, when the grain has become glazed and the lower leaves of the stalk have turned brown. The following table taken from the Eighth Annual Report of the New York Experiment Station will furnish valuable information as to the proper time to cut corn for the silo:

Chemical changes during growth of corn plant.

Yield per acre.	Stage of growth.				
	Tasseled July 30.	Silked Aug. 9.	Milk Aug. 21.	Glazed Sept. 7.	Ripe Sept. 23.
Total yield.....	<i>Pounds.</i> 18,045	<i>Pounds.</i> 25,745	<i>Pounds.</i> 32,600	<i>Pounds.</i> 32,295	<i>Pounds.</i> 28,460
Water.....	16,426	22,666	27,957	25,093	20,542
Dry matter.....	1,619	3,078	4,643	7,202	7,918
Ash.....	138.91	201.30	232.15	302.48	364.23
Albuminoids.....	239.77	436.76	478.69	643.86	677.78
Crude fiber.....	514.19	872.93	1,261.97	1,755.85	1,734.04
Nitrogen-free extract.....	653.91	1,399.26	2,441.29	4,239.82	4,827.60
Fat.....	72.20	167.75	228.90	259.99	314.34

The table shows that there is a steady increase in the amount of dry matter and food ingredients in the corn plant up to the time it is ripe. Immature corn is a poor feed, whether fed fresh or as silage. The protein and carbohydrates especially undergo changes from the immature to the mature stage which increase their food value. Silage made from immature corn is not only less nutritious but also more acid than that made from more mature corn. The corn should not be allowed to become thoroughly ripe and dry, however, because the stalk and foliage are rendered more difficult to digest, and, besides, the corn can not be packed into the silo tightly enough to prevent "fire-fanging" without using excessive amounts of water. In case the corn is frozen before it is properly matured for cutting it should be harvested at once before it has had time to dry out to any great extent. Enough water should be added to replace that lost by evaporation through standing in the field after frosting.

SORGHUM.

Sorghum is readily made into silage. The only advantages which sorghum has over corn are that it will sometimes yield heavier on poor ground and that the operation of harvesting may extend over a greater period—that is, it stays in the right stage for harvesting longer than corn. Sorghum, however, makes a poorer quality of silage, being more acid, not so palatable, and less nutritious. Where corn yields well there is no advantage in growing sorghum.

CLOVER.

Clover is a successful silage crop yielding a palatable product high in protein. It does not pack so well as corn, so great care should be exercised in the tramping of the silage at the time of filling, and the depth of the silo should also receive particular attention. A shallow silo will not prove satisfactory. Clover should be chopped before siloing as a matter of convenience in feeding and also to secure more thorough packing, although it can be placed in the silo without chopping. Clover should be harvested at the same time as for making into hay—that is, when in full bloom and some of the first heads are dead. As stated elsewhere, it is usually inadvisable to make clover into silage if it can be made into hay, as is the case under most conditions. It is better practice to grow corn for silage and use the clover in the form of hay as a supplement to the silage.

COWPEAS, ALFALFA, AND SOY BEANS.

These crops can all be successfully made into silage by exercising the same precautions as with clover. They should be cut at the same time as for haymaking. However, it is ordinarily preferable, as with clover, to make them into hay rather than silage.

Other good silage materials are kafir corn, milo maize, teosinte, and beet pulp.

HARVESTING THE CROP AND FILLING THE SILO.**HARVESTING THE CORN.**

The corn is cut for the silo either by hand or by machine. Hand cutting is practiced on farms where the amount of corn to be harvested is so small as to make the expense of purchasing a corn harvester too great to justify its use. Hand cutting is also resorted to through necessity when the corn is down or lodged in such a manner as to prevent the use of the machine. This method of cutting, however, is slow and laborious and there are probably few localities now where the purchase of a harvester would not be a profitable investment. In case the expense is considered too great to be borne by a single individual two or more neighbors might well arrange to purchase a partnership machine.

In using the harvester it will be found a great advantage to make the bundles rather small. This will take more time, but the extra expense will be more than offset by the ease of handling the bundles and in feeding them into the silage cutter. Two or three horses, the latter preferable, and one man will be required to run the harvester, and they should be able to cut about 6 acres a day. The harvester should not get so far ahead of the haulers that the corn will dry out to any considerable extent. (See fig. 2.)

HAULING TO THE CUTTER.

This is ordinarily done with the common flat hay frames. An objection to their use is that it is necessary to lift the green corn fodder to a considerable height in loading, which is hard work. A low-wheeled wagon is preferable to a high-wheeled one. A low-down rack quite commonly used in some parts of the United States can be easily made. (See fig 3.) The following are the directions for making this rack, taken from Farmers' Bulletin 292:

The rack * * * consists of two 4 by 6 inch bed pieces, 18 or 20 feet in length, bolted together at one end to form a V. On top of these timbers is built a rack 6 feet



FIG. 2.—Corn harvester at work.

in width. The bottom of this rack is about 8 feet long. The end boards are 4 feet high, built flaring so they do not quite touch the wheels. The apex of the V is suspended below the front axle of an ordinary farm wagon by means of a long kingbolt. The other ends are attached below the hind axle by U-shaped clevises. The materials needed in its construction are 80 board feet of 4 by 6 inch plank, 96 feet of boards 1 by 12 inches, 22 feet of lumber 2 by 4 inches, 1 long kingbolt, 2 stirrup rods, and bolts and nails.

The load should be as large as possible, especially when the haul is for some distance. This is a matter which is rarely given sufficient attention by persons filling silos, and in consequence the expense of filling becomes unnecessarily high.

CUTTING THE SILAGE.

THE CUTTER.

There are several different makes of silage cutters on the market that will give satisfaction. The capacity of the machine to be purchased is an important consideration which should not be overlooked. Many persons make the mistake of getting a cutter which is too small, thus making the operation of filling the silo very slow and interfering with the continuous employment of the entire force of men. It is better to get a machine large enough so that every one will be able to keep busy all the time. Another matter to be considered is the fact that the larger cutters are equipped with a self-feeding device while the smaller sizes are not. Such a device saves a great deal of labor. Other factors to be taken into account in purchasing a cutter are the amount of work to be done and the power available. Of course, for the filling of a very small silo it would not be wise to buy

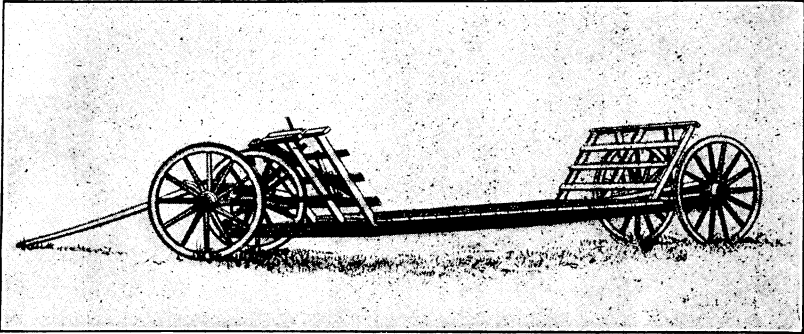


FIG. 3.—A low-down rack suitable for hauling corn to cutter.

a large machine. Neither would it be advisable to overload the engine or motor by using a cutter which is too large for the power available.

THE ELEVATOR.

Two types of elevators are in use—the old-style chain carrier and the blower. (See fig. 4.) The chain carrier requires less power, but is harder to set up and there is more litter around when it is used, especially in windy weather. For these reasons the blower is now fast displacing the carrier.

The blower should be placed as nearly perpendicular as possible so as to reduce to the minimum the friction of the cut corn upon the inside of the pipe and reduce the danger of clogging. (See fig. 5.)

POWER REQUIRED.

The power necessary to operate the cutter will depend upon its size and whether the elevator is a chain carrier or a blower and

upon the rate of feeding. It is possible to feed slowly and to get along with less power than would be required with full feeding. As a rule, however, a person should have power sufficient to run the cutter at full capacity, and even a little surplus is advisable. The power required for a cutter and blower, if a gasoline engine is used, is about 1 horsepower for each 1-inch length in the cutting cylinder; that is, a 15-inch cutter will take a 15-horsepower engine, an 18-inch



FIG. 4.—Silage cutter with chain carrier.

cutter will require an 18-horsepower engine, and so on. If a steam engine is employed, the power should be at least two-thirds of that indicated for the gasoline engine.

LENGTH TO CUT.

The usual length of cutting varies from one-half to 1 inch. The latter is considered a little too long, since pieces of this length will neither pack so closely in the silo nor be so completely consumed

when fed as will the shorter lengths. On the other hand, the longer the pieces the more rapidly can the corn be run through the cutter.

PACKING THE SILAGE.

Ordinarily the blower or carrier empties the cut corn into the top of the silo and there are one or more men in the silo to distribute and tramp the material. Unless there is some one to do this the cut



FIG. 5.—Silage cutter with blower.

material will be thrown too much in one place and the leaves, stalks, and grain will not be uniformly distributed throughout the silo. The sides should be kept higher than the center and much of the tramping done close to the wall.

Various contrivances have been used for distributing the silage. The one most to be recommended for this purpose, however, is a metal pipe similar to the one in which the cut corn is elevated, but put together loosely in sections. The corn from the blower passes down this pipe into the silo, and being loosely put together it can be

swung so that the material can be placed anywhere in the silo. (See fig. 6.) With this contrivance no work with a fork is necessary and one man can do the work of two or three and do it easier. There is very little loose material flying about in the silo and the work is much cleaner. Another advantage is a lessening of the danger of being struck by some foreign object which has passed up the blower pipe. Heavy knives of the cutter have been known to pass through the blower and into the silo. As has been mentioned, this pipe is put together in sections, so that as the silage rises in the silo the sections can be readily detached as required.

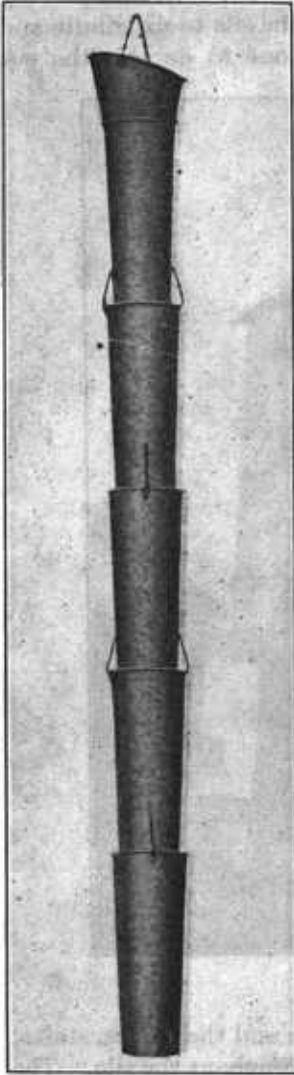


FIG. 6.—Jointed-pipe silage distributor.

the top layer from spoiling. At present when any provision at all is made for this purpose it consists usually in merely running in on top cornstalks from which the ears have been removed. By this method some of the corn grain is saved. The heavy green cornstalks pack

ADDING WATER.

In case the material has become too dry before it is put into the silo water should be added to supply the deficiency of moisture and so make the silage pack better. Unless it is well packed the silage will "fire-fang" or deteriorate through the growth of mold. Enough water should be added to restore the moisture content of the corn to what it would be if cut at the proper stage. The water may be added by running directly into the silo by means of a hose or by running through the blower. It is claimed that by running it into the blower the water is more thoroughly mixed with the cut corn.

It seems to be good practice, no matter what the condition of the corn, to thoroughly wet down the material at the top of the silo when through filling. This will help to pack the top layer and lessen the amount of spoiled silage on top.

COVERING THE SILAGE.

Several years ago it was a common practice to cover the silage with some material, such as dirt or cut straw, in order to prevent

much better than straw does and so exclude the air more effectually. The top is thoroughly tramped and then wet down. Sometimes oats are sown on the top before wetting. The heat generated by the fermenting mass will cause the oats to sprout quickly and form a dense sod which serves to shut off the air from the silage beneath, and in consequence only a very shallow layer spoils.

LABOR AND TEAMS REQUIRED.

The labor and teams to be used will of course depend upon the help available, the length of haul, and the efficiency of the machinery. With plenty of help, a short haul, and good machinery the following distribution of labor might well be used:

- 1 man and 3 horses to bind the corn.
- 2 men to load the corn.
- 3 men and 6 horses to haul.
- 1 man to help unload.
- 1 man to feed the cutter.
- 1 or 2 men to work in the silo.
- 1 man to tend the engine, if steam engine is used.
- Total, 10 or 11 men, 9 horses, and 3 wagons.

The least amount of help which it would be possible to work to advantage might be arranged as follows:

- 1 man and 3 horses to bind the corn.
- 1 man to help teamsters load.
- 3 men and 6 horses to haul and unload.
- 1 man to feed.
- 1 man in the silo.
- Total, 7 men, 9 horses, and 3 wagons.

A good manager is required to so arrange the help that each man and team can do the most efficient work. Without careful attention to this matter the operation of filling the silo becomes needlessly expensive.

COST OF HARVESTING AND FILLING.

It is not possible to set any definite figure as the cost of filling the silo because of the great variation in conditions in different parts of the country. But just in order to give some idea of the probable cost a few figures are taken from Farmers' Bulletin 292. The investigation reported in this bulletin included the work done upon 31 farms in Wisconsin and Michigan. The labor of each man was rated at 15 cents per hour and the same value placed upon each team of two horses. Engine hire was estimated at \$4.50 per day, including the engineer. Twine was rated at 11½ cents a pound, coal at \$5 a ton, and gasoline at 13 cents a gallon. The farmers owned their own cutters. In this investigation the cost per ton varied from 46 to 86 cents.

Investigations conducted by the Dairy Division during the past few years with 87 silos in various parts of the United States indicate the cost of filling to be an average of 87 cents per ton.

COOPERATION IN SILO FILLING.

The high cost of silo-filling machinery makes it oftentimes advisable for several farmers to cooperate in the purchase of a cutter and engine, or at least a cutter, since an engine is easier rented than a cutter. By varying the time of planting in the spring each man can get his silo filled when the corn is at the proper stage of maturity. Besides this the farmers can help one another in filling, so that there need be a very small cash outlay.

TOTAL COST OF SILAGE.

As with the cost of filling the silo, no definite figure can be set as to the cost of silage. This will depend upon the yield per acre, the cost of growing an acre, and the cost of filling. Several years ago the cost was variously estimated at from \$1 to \$1.50 per ton. At present this is much too low. The before-mentioned data collected by the Dairy Division on the filling of 87 silos in various parts of the country show the cost of growing the silage crop to average \$1.58 per ton. This added to the 87 cents, which represents the cost of filling, makes the total cost of the silage \$2.45 per ton. The cost of the silage for the individual farms varied from \$1.10 to \$5.42 per ton. In general, it may be stated that \$1.50 to \$3.50 per ton represents the limits between which most of the silage is produced.

LOSSES OF FOOD MATERIAL IN THE SILO.

When any crop is made into silage certain fermentation takes place, which results in the production of a considerable amount of heat and the consequent loss of food material. The extent of this fermentation is dependent upon the amount of air in the silo. The more air there is present the higher will be the temperature of fermentation and the greater the loss of food ingredients. Fermentation will continue until all the oxygen of the air has been used up or has been displaced by carbon dioxid. In the deep silos of the present time the pressure is so great that very little air is left in the silo, consequently the losses of food ingredients are reduced to a minimum. As before mentioned, on account of the difficulty of pressing out this air in crops with hollow stems they are seldom put in the silo.

There have been some experiments conducted at the Wisconsin station which show that the losses in the siloing of corn are not nearly so great as in the field curing of corn fodder. According to Prof. Woll, in modern, well-built, deep silos the loss should not exceed 10 per cent. More food material can be saved by putting the corn crop in the silo than by harvesting and storing it in any other way.

FEEDING VALUE OF SILAGE.

COMPOSITION.

The composition of silage will, of course, vary according to the crop from which it is made, the degree of maturity of the crop, and other factors. The following figures, taken from Henry's Feeds and Feeding, represent the digestible nutrients in 100 pounds of average silage:

Crop.	Total dry matter.	Digestible.		
		Protein.	Carbohydrates.	Fat.
	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>
Corn.....	26.4	1.4	14.2	0.7
Sorghum.....	24.9	.1	13.5	.2
Red clover.....	28.0	1.5	9.2	.5
Soy bean.....	25.8	2.7	9.6	1.3
Cowpeas.....	20.7	1.5	8.6	.9

It will be observed that about three-fourths of the total weight of silage consists of water. It will also be noticed that both corn and sorghum contain a large amount of carbohydrates in proportion to the protein. Silage is a bulky, succulent feed with a wide nutritive ratio, and for these reasons it will give the best results when fed along with some other feed richer in dry matter and in protein.

SUCCULENCE.

It is quite important in the feeding of cattle that the ration include some succulent material such as fresh grass, root crops, or silage. A feed containing a large amount of natural water is not only more easily digested but is also more palatable and, besides, serves the useful purpose of keeping the whole system of the animal in a state of healthy activity. A silage-fed animal is rarely troubled with constipation or other digestive disturbances, the coat is noticeably sleek and soft, and the skin is soft and pliable. It is a well-known fact that a cow usually reaches her maximum production when she has access to a good pasture. The cheapest and best substitute for fresh pasture grass during the fall and winter is silage.

PALATABILITY.

No rough feed is more palatable than good corn silage. Sometimes, however, a cow will not eat silage readily until she has acquired a taste for it, which may require several days. But silage is not peculiar in this respect, for it has been observed that range horses or cattle shipped into the corn belt will refuse corn the first time it is offered to them. This quality of being palatable is a decided advantage for silage in that it induces a large consumption and promotes the secretion of digestive juices.

RELATIVE FEEDING VALUE.

The value of silage as a food may be best shown by comparing it with other feeds. The most accurate comparison which is available is found in Farmers' Bulletin 346. The figures given below are taken from this bulletin.

Energy value of various feeds in therms per 100 pounds of the feed.

Corn silage.....	16.56	Oats.....	66.27
Red clover hay.....	34.74	Linseed meal.....	78.92
Timothy hay.....	33.56	Cottonseed meal.....	84.20
Mangel-wurzels.....	4.62	Wheat bran.....	48.23
Corn.....	88.84		

These figures were obtained through experimentation with beef animals and are not claimed to be other than tentative and subject to correction later on. While they have not been prepared as a result of work with any kind of animals other than those for beef, it is thought that they are approximately correct when applied to sheep, horses, and dairy cows. At any rate they are the most reliable figures which we have at present.

From the table given it will be observed that clover hay is a little more than twice as valuable, pound for pound, as silage, that bran is three times as valuable, and that corn is more than five times as valuable. In other words, the feeding values of silage, clover hay, bran, and corn are in the approximate ratio of silage 1, clover hay 2, bran 3, and corn 5.

SILAGE FOR DAIRY CATTLE.

Silage has been found to be particularly well adapted to the dairy cow and as a consequence silos are more numerous upon farms devoted to dairying than upon any other kind of farms. In many sections silage has come to be the dairy farmer's main reliance for cow feed.

SUPPLEMENTARY FEEDS.

While silage is an excellent feed it is not a complete one for dairy stock. It is too bulky and watery and contains insufficient protein and mineral matter to fully meet the requirements of the dairy cow. It should be combined with some leguminous hay such as clover, cowpeas, or alfalfa. These will tend to correct the deficiencies of the silage in dry matter, protein, and mineral constituents. A ration of silage and, say, alfalfa hay alone is satisfactory, however, only for cows which are dry or giving only a small amount of milk and for heifers and bulls. Cows in full milk require some more concentrated feed than hay or silage, else they can not consume enough feed to meet the demands of the body. The result will be that the cows lose in flesh and in milk flow.

AMOUNT TO FEED.

The amount of silage to feed a cow will depend upon the capacity of the animal to take feed. She should be fed as much as she will clean up without waste when consumed along with her hay and grain. Raise or lower the amount until the proper quantity is ascertained. Generally speaking, a good cow should be fed just short of the limit of her appetite. If she refuses any of her feed it should be reduced at once. The small breeds will take 25 or 30 pounds per day; the large breeds about 40; and the medium-sized ones amounts varying between.

RATIONS.

Ironclad directions for feeding cows can not be given. In general, however, they should be supplied with all the roughage they will clean up with grain in proportion to butterfat produced. The hay will ordinarily range between 5 and 12 pounds per cow per day when fed in connection with silage. For Holsteins 1 pound of concentrates for each 4 pounds of milk produced will prove about right. For Jerseys 1 pound for each 3 pounds of milk or less will come nearer meeting the requirements. The grain for other breeds will vary between these two according to the quality of milk produced. A good rule is to feed seven times as much grain as there is butterfat produced.

The following rations will be found good:

For a 1,300-pound cow yielding 40 pounds of milk testing 3.5 per cent:

	Pounds.
Silage.....	40
Clover, cowpea, or alfalfa hay.....	10
Grain mixture.....	10

For the same cow yielding 20 pounds of 3.5 per cent milk:

Silage.....	40
Clover, cowpea, or alfalfa hay.....	5
Grain mixture.....	5

For a 900-pound cow yielding 30 pounds of 5 per cent milk:

Silage.....	30
Clover, cowpea, or alfalfa hay.....	10
Grain mixture.....	11

For the same cow yielding 15 pounds of 5 per cent milk:

Silage.....	30
Clover, cowpea, or alfalfa hay.....	8
Grain mixture.....	5

A good grain mixture to be used in a ration which includes silage and some sort of leguminous hay is composed of

	Parts.
Corn chop.....	4
Wheat bran.....	2
Linseed-oil meal or cottonseed meal.....	1

In case the hay used is not of this kind some of the corn chop may be replaced by linseed or cottonseed meal. In many instances dried brewers' grains or crushed oats may be profitably substituted for the bran.

TIME TO FEED.

The time to feed silage is directly after milking or at least several hours before milking. If fed immediately before milking the silage odors may pass through the cow's body into the milk. Besides, the milk may receive some taints directly from the stable air. On the other hand, if feeding is done subsequent to milking the volatile silage odors will have been thrown off before the next milking hour. Silage is usually fed twice a day.

Many objections have been made to the feeding of silage; some condenseries even refusing to let their patrons use it. These objections are becoming less common, since milk from cows fed silage in a proper manner is in no way impaired; besides which there is nothing about silage that will injure in any way the health of the animals.

FEEDING FROZEN SILAGE.

Frozen silage must first be thawed before feeding. If it is then given immediately to the cows before decomposition sets in no harm will result from feeding this kind of silage; neither is the nutritive value known to be changed in any way.

SILAGE FOR CALVES, BULLS, AND DRY COWS.

Calves may be fed silage with safety when they are about 3 or 4 months old. It is perhaps of greater importance that the silage be free from mold or decay when given to calves than when given to mature stock. After the calves are weaned they may be given all the silage they will eat up clean. Yearling calves will consume about one-half as much as mature stock, that is, from 15 to 20 pounds a day. When supplemented with some good leguminous hay little, if any, grain will be required to keep the calves in a thrifty, growing condition.

There is a decided opinion among some breeders of dairy stock that a large allowance of silage is detrimental to the breeding qualities of the bull. Whether there is any scientific foundation for this opinion remains to be determined. Pending further investigations, however, it is advisable to limit the allowance to about 15 pounds of silage a day for each 1,000 pounds of live weight. When fed in this amount silage is thought to be a good, cheap, and safe feed for bulls. It should of course be supplemented with hay, and with a small allowance of grain also in the case of bulls doing active service or growing rapidly.

Cows when dry will consume almost as much roughage as when milking. Silage may well form the principal ingredient of the ration, in fact, with 25 to 40 pounds of silage and a small supplementary feed

of clover, cowpea, or alfalfa hay, say 5 or 6 pounds a day, the cows will keep in good flesh and even make some gain. Cows in thin flesh should receive in addition a small amount of grain. Silage will tend to keep the whole system in a state of healthy activity and in this way lessen the troubles incident to parturition.

SILAGE FOR SUMMER FEEDING.

One of the most trying seasons of the year for the dairy cow is the latter part of summer and early fall. At this season the pastures are often short or dried up, and in such cases it is a common mistake of dairymen to let their cows drop off in flow of milk through lack of feed. Later they find it impossible to restore the milk flow no matter how the cows are fed. Good dairy practice demands that the milk flow be maintained at a high point all the time from parturition to drying off. It becomes necessary, therefore, to supply some feed to take the place of the grass. The easiest way to do this is by means of silage. Silage is cheaper and decidedly more convenient to use than soiling crops.

The amounts to feed will depend upon the condition of the pastures, varying all the way from 10 pounds to a full winter feed of 40 pounds. It should be remembered in this connection that silage contains a low percentage of protein, so that the greater the amount of silage fed the greater must be the amount of protein in the supplementary feeds to properly balance the ration.

SILAGE FOR HORSES.

By GEORGE M. ROMMEL, *Chief of the Animal Husbandry Division.*

Silage has not been generally fed to horses, partly on account of a certain amount of danger which attends its use for this purpose, but still more, perhaps, on account of prejudice. In many cases horses have been killed by eating moldy silage, and the careless person who fed it at once blamed the silage itself, rather than his own carelessness and the mold which really was the cause of the trouble. Horses are peculiarly susceptible to the effects of molds, and under certain conditions certain molds grow on silage which are deadly poisons to both horses and mules. Molds must have air to grow and therefore silage which is packed air-tight and fed out rapidly will not become moldy. If the feeder watches the silage carefully as the weather warms up he can soon detect the presence of mold. When mold appears, feeding to horses or mules should stop immediately.

It is also unsafe to feed horses frozen silage on account of the danger of colic. This is practically impossible to avoid in very cold weather, especially in solid-wall silos. By taking the day's feed from the unfrozen center of the silo and chopping away the frozen silage from the edges and piling the frozen pieces in the center the mass will usually thaw out in time for the next feed.

Corn to be made into silage for horses should not be cut too green, as sour silage will result and may cause colic when fed. The corn should be well matured and cut when the grain is beginning to glaze. The silo should be filled rapidly and the corn should be vigorously tramped and packed while filling. At least three men should be inside the silo, moving constantly, two around the edges and the third across and around the center. This is by far the most important point in connection with feeding silage to horses, and the lives of the horses fed on silage may depend on the thoroughness with which the tramping is done. If properly done no danger is likely to result; if not properly done air pockets may form and cause the accumulation of a small mass of mold which the feeder may overlook but which might be sufficient to kill one or more horses.

The value of silage for horses is greatest as a means to carry them through the winter season cheaply or to supplement pasture during drought. As the danger of mold is greater in summer than in winter, silage should not be fed to horses in that season unless a large number of animals are getting it and the daily consumption is so large as to preclude the formation of mold on the surface.

To cheapen the ration of brood mares in winter no feed has more value than good corn silage. If the grain goes into the silo with the stover no additional grain is needed for brood mares, hay being the only supplementary feed necessary. If there is little grain on the corn the silage should be supplemented with 1 pound of old-process linseed-oil meal or cottonseed meal daily per 1,000 pounds live weight, sprinkled over the silage.

Horses to be wintered on a silage and hay ration should be started on about 5 pounds of silage daily per 1,000 pounds live weight, the grain and hay ration being gradually decreased as the silage is increased until the ration is 20 pounds silage and 10 pounds of hay daily per 1,000 pounds live weight. It will require about a month to reach the full feed of silage, but the period may be decreased somewhat, depending on the judgment and skill of the feeder.

Mares fed in this manner will be in splendid condition for foaling, and, so far as the writer's experience goes, the foals will be fully as vigorous, with just as much size and bone, as if the mares were fed the conventional grain and hay ration.

Work horses when idle can be wintered satisfactorily in this manner, but much silage is not recommended for horses at heavy work for the same reason that a driving horse can not do his best while on watery grass pasture.

The writer knows of cases where stallions receive a ration of silage, but has had no experience in feeding them in this manner. There seems no reason why silage should not be a valuable feed for stallions during the idle season.

Silage should also be useful for young horses, especially drafters, but here again the writer can not quote his own experience and experimental data are meager.

To summarize, silage is safe to feed to horses and mules only when it is made from fairly mature corn, properly stored in the silo. When it is properly stored and is not allowed to mold, no feed exceeds it as a cheap winter ration. It is most valuable for horses and mules which are not at heavy work, such as brood mares and work horses during the slack season. With plenty of grain on the cornstalks, horses will keep in good condition on a ration of 20 pounds of silage and 10 pounds of hay for each 1,000 pounds of live weight.

SILAGE FOR BEEF CATTLE.

By W. F. WARD, *Animal Husbandman in Beef Cattle Investigations.*

There is no roughage which is of more importance to the producer of beef cattle than silage. The value of silage to the beef producer varies considerably and is dependent upon a large number of other factors. If rough fodders are scarce or are high priced, if the grain is high priced, or if the grain is so near a good market that much of it can be readily sold, silage will have a greater value than if the opposite conditions exist. It is a great saver of grain regardless of whether it is to be fed to stock cattle or fattening cattle. It will lessen the grain feeding by practically the same amount as is contained in the silage. The value will also depend somewhat upon the kind of cattle to which it is to be fed. If there is an abundance of rough fodders which can not be marketed, silage will not be so valuable. But in a case of this kind the silage would prove more valuable if used for the calves and pregnant cows and the coarse fodders used for the other stock.

SILAGE FOR THE BREEDING HERD.

For wintering the entire breeding herd there is no roughage better than silage. All of the animals will relish a ration containing it and it will create a good appetite for all other feeds. Cows that are fed all of the silage they will consume along with clover hay will go through the winter in fine shape and make small gains. If the amount of silage is limited, a more economical method of wintering them will be to reduce the silage to a half ration, letting them have the run of a straw stack and feeding about 2 pounds of cottonseed meal or oil meal per day. Some dry coarse fodder or straw should always be kept before animals getting silage, as it reduces the amount of silage consumed and prevents the bowels from becoming too loose. The succulent feed will cause the breeding cows to give a good flow of milk even though the calf be born in midwinter, and a thrifty calf

will result. If the silage is free from mold or rotten spots there will be no danger in feeding it to breeding cows.

Silage is especially beneficial for calves which have just been weaned. They take to this ration quicker than to dry feed and there is usually little loss in weight from the weaning. The silage should be supplemented with some good leguminous hay, as alfalfa, cowpea, or clover, and the calves should be given a small amount of grain. A mixture of one-half corn chop and one-half cottonseed meal is excellent.

SILAGE FOR STOCKERS.

Each farmer will have to plan the rations for his cattle according to the amount of the various feeds he has on hand. Stockers can be wintered on silage and some good hay, fodder, or straw, but this may not always be the most profitable. When hay is high priced and grain is reasonably cheap or plenty of silage is available, it may be more economical to omit the hay altogether. A ration of corn silage alone has often been profitable for thin cattle. Stockers which have been fed liberally all winter and made to put on good gains usually do not make as large daily gains when put on grass as do steers which have not been quite so well fed. The time the cattle are to be finished for market and the degree of fatness to be attained should govern to a large extent the method to be followed during the winter. When beeves are expected to sell high in the early summer and the steers are to be finished for market at that time, a heavy roughage ration with a small amount of grain should be fed during the winter months.

SILAGE FOR FATTENING ANIMALS.

Silage stands first in rank of all the roughages for finishing cattle. Formerly, during the era of cheap corn and other concentrates little attention was given to the roughage, as it was usually considered merely a "filler" and of very little economic value in feeding. No especial care was taken in selecting any particular kind, nor was the quality of it seriously considered. As the prices of the concentrated feedstuffs advanced, the feeder looked about for methods of cheapening the cost of producing beef and soon found this could be accomplished by using judgment in selecting his roughage with respect to the grain fed. This has continued until at the present time the roughage receives as much attention as the concentrated feed, and has been made to take the place of a large amount of the latter. The feeding of silage came into general use with the advent of expensive grain and is becoming more popular each year. With the present prices of feedstuffs there is hardly a ration used for feeding cattle which can not be cheapened by the use of this succulent feed. By combining it with other feeds the efficiency of the ration is increased to such an extent that the amount of the daily

gains is invariably greater and the cost of producing a pound of gain is lessened. The heaviest daily gains are usually made during the first stage of the feeding period, and silage can then be used to advantage in large quantities with a small amount of grain, but as the feeding progresses the amount of silage should be lessened and the grain increased. In some places the price of hay and stover is so high that the greater the proportion of silage used in the ration the more profitable is the feeding.

Conditions in general are such that any given ration will not suit a large number of farmers, nor will it be so profitable for some as it will for others, so each farmer must determine for himself just what combination of feeds will be most profitable for his use. However, to give a general idea of some of the rations adapted to different localities and which may prove satisfactory for a 1,000-pound steer, some examples are given below:

RATIONS.

FOR THE CORN BELT.		Pounds.
(a) Corn silage.....		25
Corn stover.....		6
Cottonseed meal or oil meal.....		3
Shelled corn.....		14
(b) Corn silage.....		25
Clover hay.....		7
Shelled corn.....		15

FOR THE EASTERN STATES WHERE HAY IS VERY HIGH AND CORN IS RELATIVELY HIGH.

	Pounds.
Corn silage.....	30
Corn stover.....	6
Cottonseed meal or oil meal.....	4
Shelled corn.....	10

FOR THE SOUTH WHERE COTTONSEED MEAL IS OF MODERATE PRICE AND COWPEA HAY IS RAISED ON THE FARM.

	Pounds.
(a) Corn silage.....	35
Cowpea hay.....	8
Cottonseed meal or oil meal.....	7
(b) Corn silage.....	30
Cottonseed hulls.....	12
Cottonseed meal.....	7

FOR THE WEST WHERE CORN CAN NOT BE RAISED.

	Pounds.
(a) Kafir-corn silage.....	30
Prairie hay.....	3
Cottonseed meal.....	3
Kafir-corn meal.....	10
(b) Kafir-corn silage.....	25
Alfalfa.....	7
Kafir corn.....	15

It should be understood that the above rations are not necessarily to be fed in the exact quantities given above, but should be modified to suit local conditions or the actual conditions on each farm. They are given to show approximately the average amounts and character of feed that would be consumed daily by a 1,000-pound steer during the feeding period.

It is well to feed as near a balanced ration as possible without materially increasing its cost. Sometimes the prices of available feeds are such that a farmer is justified in deviating from the standard. Such conditions are illustrated by the use of some of the rations given above. The second ration shown for the South is an example, as that ration is very narrow, but in certain localities it is more profitable than one which is balanced by the use of high-priced carbohydrate feeds.

Two rations are shown for the West where kafir-corn silage is used. With some farmers it would undoubtedly be more profitable to use alfalfa hay as a substitute for cottonseed meal, while with others the purchase of the cottonseed meal would be more economical.

MISCELLANEOUS CONSIDERATIONS.

Silage is a quick finishing roughage in that it produces large daily gains and produces a glossy coat and a soft, pliable skin. Moreover, it can be used to advantage at times for carrying cattle for a longer time so as to pass over a period of depression in the market, or to carry the cattle along in thrifty condition so they can be finished at a later period.

For many years the belief was general that cattle which received silage as a major portion of the roughage would have to be kept in warm barns and not be exposed to the cold. While they do need protection from the cold winds and rains and need a dry place to lie down, it has been clearly demonstrated that warm barns are not only unnecessary but that fattened cattle make both larger and cheaper gains when fed in the open sheds than when confined in barns. Stocker or thin cattle receiving silage will of course need more protection than animals which are being fattened.

Silage can be profitably used to supplement the pastures for steers during a time of drought, when they are being finished for market, but it is still an open question whether it can always be used profitably for feeding to breeding cattle during such times.

The theory that silage-fed cattle shrink very heavily in shipping to market is erroneous. While the actual shrinkage during transit is sometimes greater, the fill taken at market is usually good, and if good judgment is used in preparing them for shipping the net shrinkage is no greater than for cattle which have been fed on dry feeds. For 36 hours previous to shipping nice bright hay and stover should be substituted for the silage in the ration.

The general impression that choice or prime carcasses can not be made by the use of succulent feed is equally untrue, as the silage-fed cattle usually make more desirable carcasses than cattle fed a similar ration, except that silage was replaced by one of the coarse fodders. There is no appreciable difference in the percentage of marketable meat that steers will dress out which have been finished on a silage ration and a dry ration. The meat seems equally bright and the fat as well intermixed with the lean.

If silage makes up the bulk of the roughage it will be necessary to haul large amounts of bedding into the sheds to keep the animals dry, as there is no waste in silage, or else make a cement floor and cover with bedding to absorb the urine and prevent the animals from slipping and to give them a warm place to lie down. When the enormous saving in the quality and amount of the feed is considered, this disadvantage does not seem so hard to overcome by the stockman who has the capital to put up the silo and pave his feed sheds or feed lots.

SILAGE FOR SHEEP.

By E. L. SHAW, *Animal Husbandman in Sheep and Goat Investigations.*

The use of this succulent feed for sheep has attracted the attention of most farmers only during the past few years. Although a few sheepmen fed silage many years ago with good results, most flockmasters have been slow in giving it a trial. Owing to the wonderful increase in the use of silos on farms, and owing to the cheapness of silage as compared with other succulent feeds, such as roots, farmers are constantly raising the question regarding the feeding of silage to sheep. A great deal has been said of its bad effects upon sheep, but these have arisen either because an inferior quality of silage was fed or on account of carelessness on the part of the feeder in not feeding it properly.

A good quality of silage is extremely palatable and can be fed to all classes of sheep with good results. It must be borne in mind, however, that silage which is either very sour, moldy, or frozen should not be fed.

The amount of silage reported in feeding trials varies from 1 to 5 pounds per head per day. The amount to feed depends upon the class of sheep and the character of the other feeds comprising the ration. As a general rule from 2 to 4 pounds per head per day is considered as much as should be fed.

Lamb feeders have found silage a very satisfactory feed, and the amount fed ranges from 1 to 3 pounds per day. Where lambs are on full feed of grain, such as corn, and are receiving a fair allowance of hay, they will, as a rule, only consume from 1 to 2 pounds per head per day.

In feeding breeding ewes before lambing a daily allowance of from 2 to 3 pounds should be considered a maximum quantity. After lambing the amount can be slightly increased.

In feeding silage or any other succulent feeds it must be borne in mind that the value of such feeds to a large extent is to act as an appetizer and to keep the digestive system in good condition. Under ordinary conditions where silage is fed it should not constitute more than one-half of the entire ration, and it should be fed with other feeds that will properly balance the ration for the purpose intended.

