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Production and Feeding of Silage

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Production and Feeding of Silage

L. J. Stadler, M. M. Jones, C. W. Turner, and P. M. Bernard

Abstract.—The advantages of silage are enumerated and the factors in its cost are taken into account. Several crops that may be used for silage are considered, and methods for growing and harvesting corn for silage are described. The practices essential to the economical filling of the silo and the production of good silage are set forth, and experimental evidence is included showing how silage may best be combined with other feeds in rations for various classes of livestock.

Although the first silo in America was erected less than fifty years ago, the feeding of silage has become a standard practice on American farms, particularly in the corn growing regions. The silo is now considered an essential in economical dairy feeding, and has taken an important place in the feeding of beef cattle and sheep. There are more than 15,000 silos in Missouri and the number is steadily increasing. The wide and growing use of silage is accounted for by its feeding value, its prevention of waste, and its convenience.

The feeding value of silage is due in large part to its succulence and palatability as well as to its actual content of food elements. Silage is used as a substitute for pasturage in winter and as a supplement to short pastures in summer. Because of its palatability it leads to increased consumption of feed and thus to larger production of meat or milk.

Prevention of waste is accomplished in several ways by the use of silage. Animals eat silage almost completely, though they would refuse a large proportion of the forage from which it is made, if it were given them in the dry condition. There is also less loss of food elements in ensiling than in field curing. Often forage may be saved from freezing, or frozen forage may be preserved for use by ensiling. Much of the plant material from which silage is made would not be used at all if it were not converted into silage.

And by its convenience silage feeding offers many advantages. The crop comes off the land early, in time for a fall-sown crop to follow if desirable. The ensiling process may be carried on under weather conditions which would make the curing of hay impossible. The feed is stored in a small space and in an easily accessible place. Some farmers consider the convenience of silage its greatest advantage.

But it is true that silos are sometimes recommended more highly and more generally than the facts warrant. Silage is almost indispensable for profitable milk production, but in other feeding operations the silo is

not always a profitable investment. Silage is not as cheap a feed as is generally supposed. The silo itself is an expensive item of equipment, and the machinery and labor necessary to fill it make the cost of silage per ton rather high in comparison to other roughages of equal feeding value. The actual cost in dollars and cents cannot be stated definitely, for it will vary widely under different conditions. The cost of producing silage is made up of (1) interest and depreciation on the silo and the harvesting and filling equipment, (2) the increased cost of labor in cutting, hauling and filling, as compared with husking, and (3) the market value of the grain included in the silage. Figured in this way, the cost of silage per ton on many Missouri farms has been found to be more than one-half the cost of producing a ton of clover or alfalfa hay. When this is true it is more profitable in many feeding operations to produce the hay rather than the silage.

Where silage fills a definite and important place in the feeding system, as in feeding dairy cattle; where a succulent feed is needed to supplement pasture in the summer; where the maximum number of animals must be kept per acre; where hay is relatively expensive and corn is cheap; where the number of animals fed is fairly high and fairly constant; where it is desirable to sow wheat or some other fall-sown crop after corn—these are some of the conditions under which the use of the silo may be advisable or necessary. Whether or not to erect a silo is an individual problem which can be properly solved only on the basis of the conditions of the individual farm.

CORN FOR SILAGE

Corn is the preeminent silage crop, because of its heavy yield of nutritious and palatable forage, because when it is ensiled it undergoes changes of the most desirable kind, and because it is a standard and adapted crop over a large part of the country.

Corn growing in general is discussed in Missouri Extension Circular 123. In the present bulletin only the special features applying to the growing of corn for silage will be considered. These are concerned chiefly with the choice of a variety, the rate and manner of planting, and the time and method of harvesting.

Corn Varieties for Silage.—Special varieties of corn for silage are often recommended. These special silage varieties are tall, rank-growing, late-maturing types which tend to produce a rather low yield of grain but a high total yield of plant matter. The best known of the special silage varieties is Eureka, but there are many others of similar type. Some of the late-maturing prolific varieties commonly grown in the South are also frequently sold as special silage varieties.

The ideal variety of corn for silage is one which will yield not only a large quantity of forage but also a good percentage of grain, for this is the most nutritious part of the feed. A pound of ear corn contains about 60 per cent more of digestible nutrients than a pound of stover of equal moisture content. The rank-growing silage varieties are at a disadvantage, not only because of their lower percentage of grain, but also because of their higher moisture content at harvest, resulting from their later maturity.

In tests at this Station, special silage varieties such as Eureka, Cocke Prolific, and Biggs Seven-Ear gave yields of silage approximately equal to that of Commercial White, but were decidedly inferior to Commercial White when yield of digestible nutrients or even of total dry matter was considered. Among the standard Missouri varieties, Commercial White was the outstanding leader in the production of silage, for it outyielded all other varieties in total yield of grain and also produced a higher proportion of stover than any other variety. These tests were made at Columbia, but observations on variety tests for grain in all sections of the State indicate that Commercial White would be the best silage variety in any section of Missouri.

Commercial White is not the best variety for grain production in Central or Northern Missouri, because of its lateness of maturity. It will mature well in Southern Missouri and fairly well in ordinary seasons in the remainder of the State. When the growing of silage is an important part of the farming system, it may be worth while to grow Commercial White in Northern and Central Missouri, and to produce an early maturing strain by field selection of seed from the early-maturing productive plants. If different varieties are to be grown for grain and for silage, no better silage variety than Commercial White can be found, for any section of Missouri.

Planting Corn for Silage.—When corn is planted especially for silage it is a common practice to plant at a heavy rate to increase the total yield of forage. The production of both grain and forage increases with increased rate of planting to a certain point, beyond which further increase in the rate of planting continues to increase the yield of forage, but does not increase the yield of grain. Still further increase in the rate of planting may decrease the yield of grain. For example, on medium-fertile soils in Central Missouri, corn planted at the rate of two stalks per hill will usually yield as much grain as corn planted at three stalks per hill, but the production of forage is considerably higher in the corn planted at the three-stalk rate. Under the same conditions corn planted at four stalks per hill would yield slightly more forage but less grain than that planted at the three-stalk rate. When the rate of planting is

very greatly increased for silage production, there is danger of losing more in the quality of the silage than is gained in the quantity of forage produced. The ideal rate of planting is that which will increase the production of forage as much as possible, without materially decreasing the yield of grain. This will be a rate about 35 to 50 per cent higher than the best rate for grain production. On soils of average fertility, the best rate for grain production would be two stalks per hill (or the equivalent rate in drilled corn) and the best rate for silage production about three stalks per hill. On the better upland soils and on bottom soils, the best rate for grain would usually be three stalks and the best rate for silage about four.

Corn planted for silage should usually be drilled rather than check-rowed. The yield of grain from drilled and checked corn is about equal, for equal rates of planting, but the yield of forage is somewhat greater when the corn is drilled, especially at the higher rates of planting. Drilled corn is also more easily cut with the binder.

Time of Harvesting Corn for Silage.—Corn for silage is often cut too green. As the grain ripens the feeding value of the plant increases rapidly. It is not well, however, to permit the corn to ripen fully because as the moisture content of the plants is decreased, it becomes more difficult to pack the silage thoroughly. Corn ensiled when too ripe is, therefore, likely to spoil in spots where air is not completely excluded. The best time of cutting for silage is when the kernels have glazed and the husks and a few of the lower leaves have turned yellow. The methods of harvesting corn and other crops for silage are described on pages 9 to 17 of this bulletin.

Shock Corn for Silage.—It is sometimes necessary to fill the silo with corn which has been previously cut and shocked. This may occur when the new silo has not been completed at the time when corn is harvested, or when it is desirable to refill the silo. It is possible to produce a fairly satisfactory silage from shock corn when a large quantity of water is added. Shock corn requires about a ton of water to each ton of fodder. The water should be sprinkled over the surface in the silo as the fodder is being put in. Some of the water may be added in the cutter but usually not more than one-third of the necessary amount can be added in this way. It is well to measure the amount of water that runs out of the pipes used in a given length of time and to determine from this how much is being added per ton of fodder. On most farms it is not practicable to add water in such large quantities, and under such conditions it will not be worth while to attempt to ensile shock corn.

Stover Silage.—Occasionally silage is made from corn stover, that is from the leaves and stalks of plants from which the ears have been

removed. A satisfactory silage may be made from this material, but it should be recognized that the feeding value is much less than that of silage in which the grain is included, and the silage produced may not be worth the cost of the ensiling process. When grain must be added in the feeding of silage there is no advantage in removing the ears before the corn is ensiled. A disadvantage is that the grain is not fully matured when the plants are in the best stage for ensiling. If the grain is allowed to ripen a large quantity of water will have to be added in ensiling the stover, as in the ensiling of shock corn.

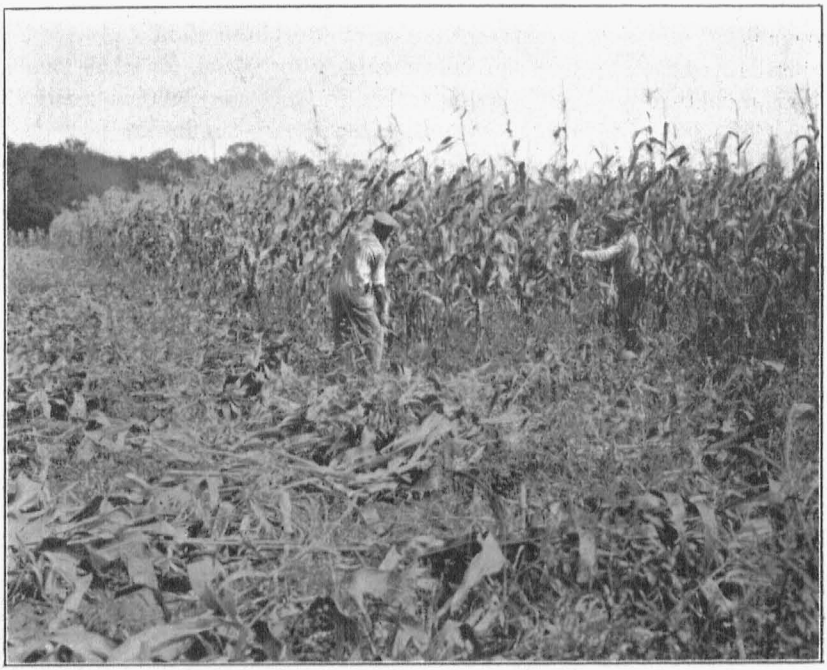

Fig. 2.—Cutting corn by hand is recommended only when the amount of corn to be cut is small, where labor is cheap and plentiful, or where corn is down and too badly tangled for a binder.

OTHER CROPS FOR SILAGE

Sorghum.—Sorghum ranks next to corn in importance as a silage plant. Over a large region where the rainfall is too low or the soil too poor for good corn production, sorghum is used as a standard silage crop. The silage produced from sorghum is much like that produced from corn in composition and feeding value, though it is usually considered to be not quite so palatable. The only portions of Missouri in which sorghum is to be preferred to corn are the Ozark section and the less fertile parts,

of Northeast Missouri. On the thin dry uplands of the Ozark section corn succeeds only in especially favorable seasons, while sorghum, because of its drought resistance and adaptation to poor soils, gives fair yields in ordinary seasons. The average yield of sorghum in both grain and forage is more than twice that of corn on typical Ozark uplands. On the poorer soils of the flat prairie region of Northeast Missouri, also, sorghum usually outyields corn.

The sweet sorghums are generally preferred to the grain sorghums for silage. The best variety for the Ozark region is Honey and for Northeast Missouri is Orange. Sorghum should be planted a week or two later than corn. For silage it should be drilled in rows at the rate of 12-15 pounds per acre and cultivated like corn. Sorghum should always be allowed to become nearly ripe before cutting for silage, for silage made from immature sorghum is unpalatable and of poor keeping quality.

Sunflowers for Silage.—Within recent years sunflowers have become prominent as a silage crop, expecially in regions where corn and sorghum cannot be grown successfully. The chief advantage of sunflowers as a silage crop are their large yield of forage and their resistance to frost, drought, and insect pests. Sunflower silage is somewhat lower in feeding value and considerably less paltable than corn silage. Although sunflowers may be grown very successfully in Missouri, it is not likely that they will ever attain any great importance as a silage crop in this State, because of the greater value of corn and sorghum.

In growing sunflowers for silage, the land is prepared as for corn and the crop is planted at about corn planting time. The variety usually grown is the Mammoth Russian. The seed is planted in rows 24 to 30 inches apart, at the rate of 6 to 8 pounds per acre. The seeding may be done conveniently with a grain drill. The best silage is produced if the crop is harvested when about half the plants are in bloom. The equipment used for harvesting and for filling the silo is the same as for corn.

Legumes for Silage.—It is not usually an economical practice to ensile legume crops, because the labor required to handle the fresh-cut crop, with its high content of water, is much greater than that required to handle the cured hay. A ton of hay represents about three tons of green forage. But when unfavorable weather conditions make it impossible to cure legume hay, as is often the case with cowpeas and soybeans and with the first cutting of alfalfa, the possibility of making a satisfactory silage from legumes may become a practical problem.

It has long been thought that silage of good quality could not be made from legumes alone. When mixed with corn or sorghum, such legumes as cowpeas, soybeans, and alfalfa have commonly been used for silage and have given good results. When legumes alone are used the

silage produced is often bitter and unpalatable, with a disagreeable odor of decay. The loss of nutrients in the silo is also excessive.

Studies by Eckles at the Missouri Experiment Station have shown that the difficulties in ensiling legumes may be avoided entirely if the moisture content is sufficiently low when the material is ensiled. These crops are usually cut for silage at the same stage as for hay, when the moisture content is about 75 per cent. If allowed to become more mature the moisture content will be reduced, and a better quality of silage will result. The yield of dry matter will also be increased. Eckles was able

Fig. 3.—Many farmers prefer the sled cutter for cutting corn. It is a simple machine and its cost is not high.

to produce silage of excellent quality from soybeans, cowpeas, alfalfa, sweet clover, and peas and oats, when the moisture content of the material ensiled was between 50 and 70 per cent, though the quality of silage made from these crops was uniformly poor when the moisture content was much above 70 per cent. When forage was cut at about the hay stage and allowed to lie in the field for a few hours after cutting to reduce the moisture content, good silage was produced. In exceptionally dry seasons the plants cut at the usual hay stage may contain a low

enough percentage of water to permit ensiling without preliminary drying.

When legume crops are mixed with corn or sorghum in the silo there is little difficulty in preserving the material, and the moisture content need not be so carefully considered. A commonly used proportion for cowpeas or soybeans with corn or sorghum is one load of the legume to two loads of the non-legume. Sometimes the two crops are grown together, as corn and soybeans or corn and cowpeas. The yield of grain is reduced by this practice, but the total yield of forage is probably not much affected, and the feeding value of the silage may be increased somewhat by the addition of the legume. Soybeans give better results than cowpeas. The best rate of planting for silage is about 8 pounds of corn and 4 pounds of soybeans drilled together in the row.

FILLING THE SILO

Filling the silo is an expensive operation and one that requires much hard work, but both the expense and the hard work may be reduced to a minimum by the efficient use of time-saving and labor-saving machinery. Cutting corn by hand and loading it on wagons by hand is hard and disagreeable work, and when this method is used, it is sometimes difficult or impossible to keep labor during the silo-filling season. To make the best grade of silage, the crop often must be put into the silo within a very few days. With hand methods, this is not always possible.

Cutting by Hand.—Cutting corn in the field by hand is rather slow work and is to be recommended only where the total amount of corn cut is small and where labor is plentiful and cheap. In certain years, the corn may be blown down and so badly tangled that a corn binder or sled cutter can not be used to advantage. In such cases, the corn must be cut by hand.

It requires at least three men cutting in the field to keep a 12- or 14-inch ensilage cutter running at the silo. When hand cutting is used, the corn may be placed on the ground in piles, or it may be loaded directly on wagons and hauled to the silo filler.

The Corn Binder.—Generally a corn binder is to be recommended for cutting the corn, due to the saving in time and labor over other methods. One man with a 3-horse team and binder can generally cut more per day than 3 men can cut by hand. The amount that can be cut by a binder in a day varies considerably, but will average 6 to 7 acres. Under favorable conditions more may be cut, but if the corn is down and tangled, or the field is hilly, or the ground soft or muddy, or if there are delays due to machinery troubles, this figure may be reduced somewhat. Some farmers find that they can cut more corn by using four

horses instead of three, or by pulling the binder with a tractor, especially when the weather is hot.

The principal disadvantage of using a corn binder is that it does not work well if the corn is down or badly tangled. Another disadvantage, which is of minor importance, is that it knocks some ears off the stalks, and it is frequently necessary to have a man or boy go over the field and gather the ears that have been knocked off and also those on down stalks that were missed by the binder.

When using a binder, it is well to cut a few acres of corn before the silo filler is started. This is to make sure that the silo filler will be kept

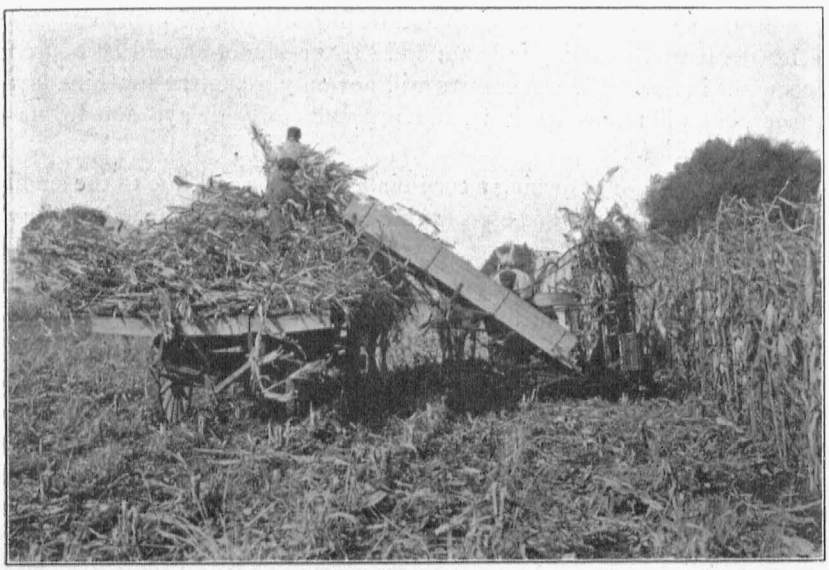

Fig. 4.—A bundle elevator will eliminate much hard work.

supplied with corn and that binder troubles will not delay the remainder of the crew. Corn should not be left on the ground too long, however, for much moisture would be lost and the corn would then make an inferior grade of silage. The binder should be set to make small bundles so as to facilitate loading the wagons and feeding the cutter.

Bundle Elevator for Binder.—Bundle elevators that will elevate the bundles directly from the binder to wagons drawn alongside, can be bought for most makes of corn binders. Such an elevator will not add greatly to the draft of the binder and will eliminate much hard work in loading the corn. One disadvantage in using a bundle elevator is that it

is difficult to so organize a crew that the binder will not lose some time occasionally in waiting for a wagon, and vice versa.

The machinery charge or cost on a corn binder is generally high because it is used only a few days during the year. This cost may be reduced considerably by proper care and repairing so as to make the binder last longer. The U. S. Department of Agriculture has found that in Western New York the average life of a corn binder is eleven years, but that during this period the binder does only about forty days of actual work. In order to lengthen the life of a binder and thus reduce the machinery charge, (1) the binder should be inspected for worn or broken parts before corn harvesting season, and the necessary repairs and adjustments made, (2) the working parts of the binder, especially the head and tying mechanism should be liberally coated with heavy oil after the season's cutting is done; and (3) the binder should be housed when not in use. These measures will not only make the machine last longer, but will reduce its draft, and prevent costly delays due to machinery troubles.

When the cost of owning a corn binder is too great, due to the small acreage to be cut, it may be profitable for two or three farmers to buy a binder in partnership.

The Sled Cutter.—Many farmers prefer to use a sled cutter or platform harvester for cutting the corn. Such a machine consists of a platform mounted on runners or wheels, the platform having knives near the ground for cutting the stalks. The most popular type of platform harvester is pulled by one horse and cuts two rows at a time. Two men are required to ride on the platform and catch the stalks as they are cut. The corn may be dropped on the ground in piles, but where possible it should be loaded directly on wagons to save time and labor. It has been estimated that it costs ten cents a ton to pick corn up off the ground and load it on wagons. Two men with a platform harvester can cut from 4 to 5 acres per day and load the corn on wagons. Generally, corn cannot be cut fast enough by this method to keep a very large silo filler running.

The platform harvester is a simple machine and its cost is not high. It ranks between the binder and hand cutting in time and labor required. Cutting with the platform harvester is cheaper than cutting with a binder and generally cheaper than cutting by hand. The platform harvester does not work well if the corn is down or tangled. Another disadvantage of the platform harvester is the hard work required to operate it.

Hauling.—Whenever the corn is placed on the ground in piles or bundles and must be picked up and loaded on wagons, two men should be employed to hand the corn up to the man on the wagon.

Wagons equipped with ordinary flat racks or frames are used most in hauling the corn to the cutter at the silo. Low wagons are preferred where the corn is loaded by hand. A special underslung low rack may be made and attached to the running gears of an ordinary farm wagon, if desired. The framework of such a rack consists essentially of two long heavy sills secured or bolted to the underside of the rear axle, and coming to a V-shaped point in front and attached to a long king bolt under the front axle.

The number of teams and wagons required to haul the corn to the ensilage cutter will vary considerably and will depend upon the distance the corn must be hauled, the size of loads, and the size of the ensilage cutter. Three teams and wagons are as few as are generally used for hauling. In long hauls the loads should be made as large as possible.

Ensilage Cutters.—The essential parts of an ensilage cutter are the feed table and feed rolls, the cutting head, and the elevator. The corn is placed on the feed table and is drawn into the cutting head by the feed rolls. The corn is cut into short lengths by the head and is then delivered to the blower or elevator which elevates the cut silage into the silo.

There are two types of ensilage cutters in common use, the cylinder or "lawn mower" type and the radial or "flywheel" type. The radial type of cutter is in more common use, although machines of both types give satisfactory service. Which is the better machine is more a matter of perfection of design than of type.

Ensilage cutters are available with two kinds of elevators, the blower type, which is the more common, and the endless chain or web carrier. The latter type has the advantage of requiring less power, but its capacity is less, and more time is required to set it up. It also requires more space around the silo, and more attention in operating.

The size of an ensilage cutter is designated by the width of the throat opening. This rating is nominal, however, and the actual size may vary slightly from the designated size. Two cutters with the same width of throat opening may vary considerably in capacity in tons per hour, because the depth of throat opening as well as the width affects the capacity of a cutter.

The power required to operate a cutter depends upon several factors, such as the condition of the corn, the sharpness of the knives, and the length of cut, the height of the silo, and the mechanical condition of the cutter. A very general statement of capacities and power requirements may be made as follows: The maximum capacity of an ensilage cutter in tons per hour is about the same as the width of throat in inches; and the horse power required is from one to one and a half times the capacity in tons per hour.

Cutting into Silage.—The cutter should be set in such a position that it will be accessible to the teams and wagons, and should be staked down rigidly. If a blower elevator is used, the blower pipe should be set as nearly vertical as possible. If the blower pipe leans to one side, the silage will settle to the low side and allow the blast to go by without carrying the silage up The blower will be easily choked under such conditions.

The engine should be carefully lined so that the belt will run in the center of both the engine and the cutter pulleys. It is essential that the proper size of pulley be used on the cutter to give the rated speed, if best results with the least power are to be obtained.

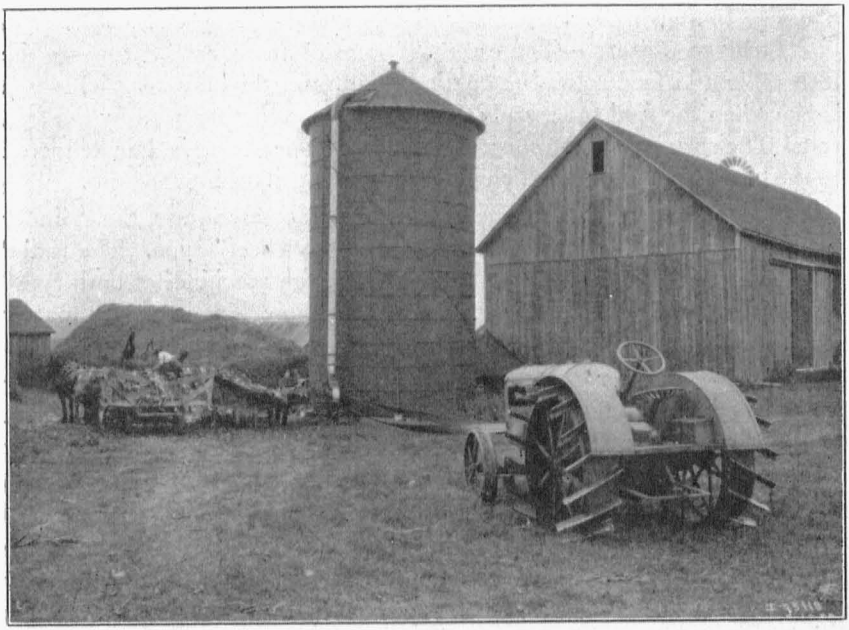

Fig. 5.—A good set-up. Notice the blower pipe is vertical and there is plenty of room for wagon and team around cutter and silo.

To determine the proper size of pulley to use is a simple matter. Multiply the diameter of the engine or motor pulley in inches by its speed in revolutions per minute, and divide by the speed the cutter is to run.

For example: An ensilage cutter is to run at 750 r. p. m. It is to be driven by a tractor with a 9½-inch belt pulley running at 1000 r. p. m. What size of pulley should be put on the cutter? $9\frac{1}{2} \times 1000 = 9500$. $9500 \div 750 = 12.6$ inches, the proper size of pulley for the cutter.

A 12-inch pulley lagged or covered with heavy belting would be satisfactory.

Most ensilage cutters may be set to cut the corn into various lengths ranging from ⅜ of an inch to 1 inch or more. A length of ½ inch is recommended for average conditions. Longer lengths increase the rate of cutting and filling, but the silage cannot be packed as well, nor can as much be put into a silo as when the corn is cut into shorter lengths. Also, stock generally eat the silage more cleanly when it is cut into shorter lengths.

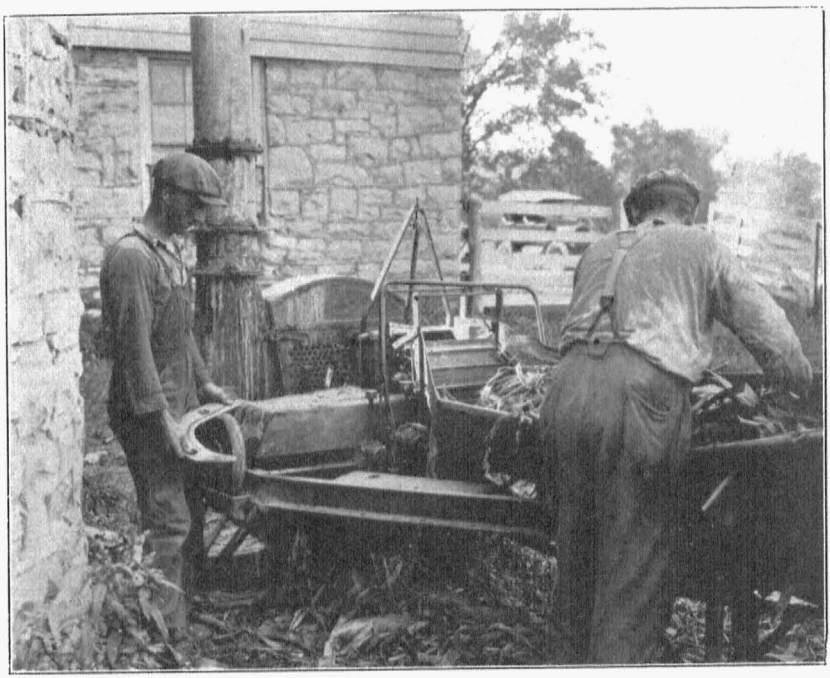

Fig. 6.—Sharpen the knives of the ensilage cutter at the end of every half-day's work. Sharp knives make better silage and require less power.

It is important that corn be fed steadily to the cutter. If there is enough power available, the bundles should be lapped about half-way. The butts are usually fed in first and a good practice is to put the bundles butt to band. By steady feeding, much more corn can be cut and with less wear and tear on both the engine and cutter.

One man is required to feed the cutter and at least one man to unload from the wagons. If a very large cutter is used, it is best to have two men unloading.

If the crop being ensiled is too dry, water should be added to obtain the proper moisture content and to make the silage pack well in the silo. Dry silage cannot be packed into the silo so as to exclude air, and it will mold. The water should be thoroughly mixed with the cut corn, and may be applied by running a steady stream into the blower or by forcing it up into the silo through a pipe or hose while the silo is being filled. If the silage is very dry, a large supply of water is necessary. The silage should always feel wet after it is put into the silo.

It is essential that the knives be kept sharp in order to reduce the power required to operate the cutter. Dull knives tend to shred and tear the corn considerably instead of cutting it clean. Knives should be ground after every half-day's running. It is well to have two sets of knives so that one set may be sharpened while the other is in use. Knife grinding attachments are available for most ensilage cutters. Such an attachment consists essentially of a grinding wheel driven by the machinery of the cutter.

When the knives are replaced on the cutting head, they must be carefully adjusted and then securely locked in place. The knives should not touch the shearing bar or plate. Most manufacturers of the flywheel type of ensilage cutters recommend that the knives clear the shearing plate by 1-64″ at the hub of the wheel and by 1-32″ at the outer end of the knife. On cylinder type cutters, the clearance should be about 1-64″ all along the knives.

Distributing and Tramping.—Two men are needed in the silo to distribute and tramp the silage. A jointed, flexible distributor pipe attached to the upper end of the blower pipe is best for delivering the silage into the silo. Unless a distributor is used, the grain and heavier parts of the silage will be blown to one side of the silo and the lighter parts will settle separately. This will cause uneven settling of the silage with resultant air spaces along the walls and spoiled silage. It is essential that the silage be well tramped to exclude the air, especially along the walls of the silo. It is best to keep the silage high around the walls and low in the center until the silo is nearly full, and then keep it higher in the center. The doors of the silo should be kept open to provide ventilation while filling, and to allow escape of the air which carries the silage up the blower pipe.

It is important to seal the doors of the silo thoroughly as the filling progresses, so as to exclude air and prevent spoilage around the doors. Many owners of silos put heavy building paper behind the doors. Probably a better method is to apply clay mud to the cracks around the doors. The moisture in the silage keeps the clay damp, and thus keeps the doors effectively sealed.

Goats or hogs are used occasionally for tramping silage. A mechanical silage packer driven by a small gasoline engine has been developed, but has not been widely used on account of the inconvenience of setting the machine up inside the silo and of taking it apart and removing it when the silo is filled.

There seems to be no very practical and effective way of sealing the top of the silo so that the top layer of silage will not spoil if feeding is

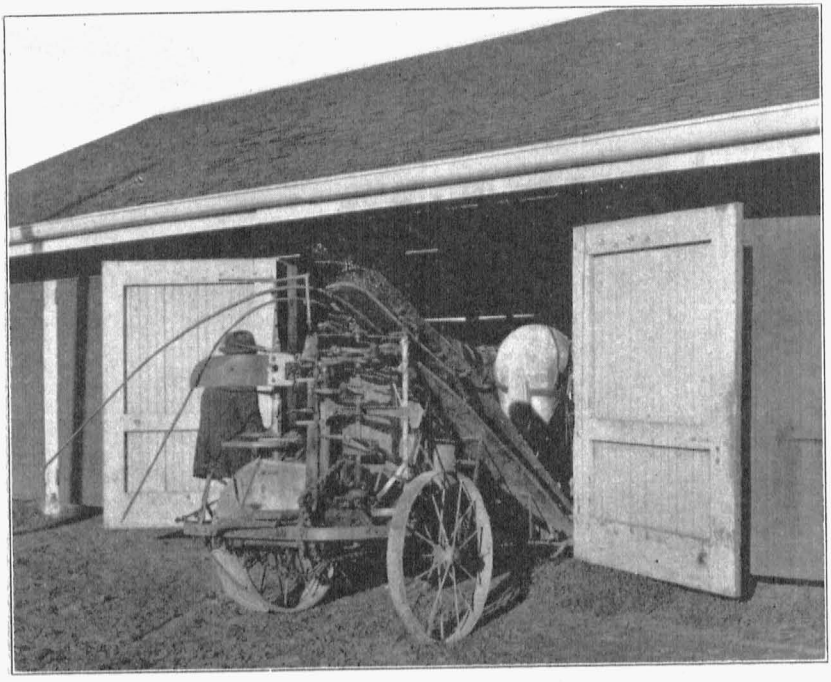

Fig. 7.—House the corn binder. By lengthening its working life the cost of silo filling can be reduced.

not begun at once. Probably the best method is to snap the ears off the last few loads of corn, so that the grain at least can be saved, and simply allow the top layer to spoil. Frequently 18 to 24-inches of silage will spoil on top, but this waste may generally be reduced to 6 or 8 inches, if the silage is thoroughly tramped, especially around the walls, twice a day for ten days after the silo is filled.

Cutting into Silage in the Field.—Within the last few years a new method of harvesting corn for silage has been developed. A combination machine or harvester cuts the standing corn in the field, cuts it into

silage, and delivers it into a wagon which is drawn alongside the harvester. One of the most popular types of this harvester is an attachment for a small tractor. The tractor pulls the harvester along and also drives the machinery of the harvester direct from the tractor engine.

The ensilage is then hauled to the silo and elevated into the silo by a blower elevator driven by a small engine or tractor. An old discarded ensilage cutter is sometimes remodeled to serve as a blower elevator.

This new method of filling silos has found favor among many farmers, especially where labor is scarce and high. This method reduces the hard labor of filling a silo to a minimum. One of these harvesters will cover about the same acreage in a day as a corn binder.

THE FEEDING OF SILAGE

Silage is a roughage; not a concentrate. The quantity of silage to be used therefore depends on whether a fattening, growing, or maintenance ration is desired. Silage is not a balanced feed. With fattening animals the best results will be obtained by feeding concentrates with the silage. In feeding young growing animals or in maintaining breeding animals, the addition of nitrogenous roughages or concentrates is desirable. Since silage is comparatively rich in carbohydrates and fats and deficient in protein and mineral matter, supplementary feeds comparatively rich in protein, such as legume hays or linseed or cottonseed meal, will give best results.

What Occurs when Corn is Ensiled.—When corn or other forage crops are cut up and packed into silos certain changes take place. The most obvious of these changes connected with silage formation are the rise in temperature of the material, changes in color and odor, and the development of an acid taste. There is also a considerable evolution of carbonic acid gas.

It has been found at this Station that the best silage is produced when the temperature of the silage does not exceed 100 degrees Fahrenheit. When the temperature goes much above 100 degrees it generally indicates that the silage was not properly packed.

The production of acid is one of the most characteristic reactions. A considerable amount of the soluble sugars are converted into lactic and acetic acid. The production of these acids aids in the preservation of the silage.

In order to increase the development of lactic acid to the exclusion of other kinds of acid, it has been suggested that a pure culture of lactic acid bacteria be used to inoculate the freshly cut silage. Trials have

shown, however, that with corn there is no advantage in the use of such cultures.

Losses in the Silo.—During the normal process of silage formation certain changes take place with a resulting loss of nutrients. In the past it was believed by many that these losses were very large, but recent work has shown that the losses are relatively small. There are two kinds of losses in the silo, the unavoidable losses necessary for the formation of silage, and the avoidable losses which are due to the decomposition of the nutrients caused by the imperfect construction of the silo, surface spoilage, and losses of soluble nutrients from the bottom of the silo. It has been found in a careful study of 54 silos at this Station, that the unavoidable loss of nutrients during the formation of silage amounted to 7.59% of the dry matter. Compared to these losses in the silo it was found that during the field curing of corn, covering four different seasons, the average loss of dry matter was 15.12 per cent. In other words, the loss of dry matter in the field curing of corn is shown to be approximately twice as great as the unavoidable loss of nutrients in the silo.

Moldy Silage.—Moldy silage results when the air is not excluded from the silo, when the corn is not cut and ensiled at the proper stage, when the silage is improperly packed, and when there are cracks in the silo. Undoubtedly the most common cause of moldy silage is the ensiling of corn when it is too dry. While it is possible to add water, it is very difficult to do a thorough job unless a good supply of water is available. It is better to ensile the corn at an earlier stage of development.

It has been commonly thought that moldy silage was dangerous to cattle and great care has been taken to exclude all mold in silage. Recent experiments indicate that moldy silage is not necessarily injurious to cattle. Large amounts of moldy silage were fed to dairy cattle for an extended period with no ill effects. From this it is not recommended that moldy silage be fed extensively, but it indicates that it is not injurious to cattle if silage contains a limited amount of mold. In the feeding of other classes of stock moldy silage is likely to be injurious.

Silage for Dairy Cattle.—For maximum milk production succulent roughages in some form are almost indispensable. The dairy cow seems to need laxative succulent feeds in order to keep the digestive tract in good condition and to consume a maximum amount of roughage. Being palatable the succulent feeds will be consumed when other roughages are refused. Because of the large acre-yield of digestible nutrients corn silage is, therefore, both an economical and profitable addition to the dairy ration.

While corn silage is an excellent feed for dairy cattle it is not complete in itself, but must be used in connection with other roughages and

concentrates. Because corn silage is low in protein and mineral matter the leguminous hays are especially adapted to supplement the deficiency of corn silage. Clover, alfalfa, or soybean hay stand high in protein and calcium which are essential for large milk production. In addition to the roughages for maximum production suitable grain mixtures should be fed in proportion to the quality and amount of milk produced. The following grain mixtures are well suited to supplement these roughages:

1

400 lbs. ground corn
200 lbs. wheat bran
100 lbs. cottonseed meal

2

400 lbs. ground corn
200 lbs. wheat bran
200 lbs. ground oats
100 lbs. cottonseed meal
100 lbs. linseed oil meal

For most economical production it is generally best to feed all the roughage which the cows will clean up. This will usually be about three pounds of silage per 100 pounds of live weight. In addition about one pound of hay per 100 pounds live weight would also be consumed. A 1000-pound cow would require approximately 30 pounds of silage and 10 pounds of hay. The grain ration is fed in proportion to the milk produced. One pound of grain will ordinarily be fed for each 3 to 3½ pounds of Jersey or Guernsey milk while 1 pound of grain for each 3½ to 4 pounds of Holstein or Ayrshire milk will be sufficient.

In addition to being almost indispensable in furnishing a succulent winter feed silage is rapidly filling a place in supplementing the pasture during the late summer months. During parts of July and August the flow of milk generally decreases because of the poor pastures. Cows falling off in milk at this time cannot be brought back to their normal production later. Silage or soiling crops are extremely valuable at this time. Silage has been found by many experiments to be a cheaper, more uniform feed than soiling crops because of the labor involved and the difficulty of having a succession of crops available at the right time.

Though calves when a few weeks old will eat some silage, it is not fed to any considerable extent to young stock until they are about six months old. In connection with a good legume hay silage can then be fed to them in amounts gradually increasing up to their capacity. In

addition to silage and legume hay for animals less than ten months old it is well to feed 2 pounds of corn or other cereal grain. This amount of grain can be increased after the heifer has been bred so that by the time she is within three months of the date of calving she will be consuming about 5 pounds of grain daily.

When corn silage is on hand but no legume hay is available a satisfactory ration for dairy heifers is silage fed at will with some dry feed such as hay or fodder. Two or three pounds of a grain mixture should be fed daily. At least one-half of the grain mixture should consist of high

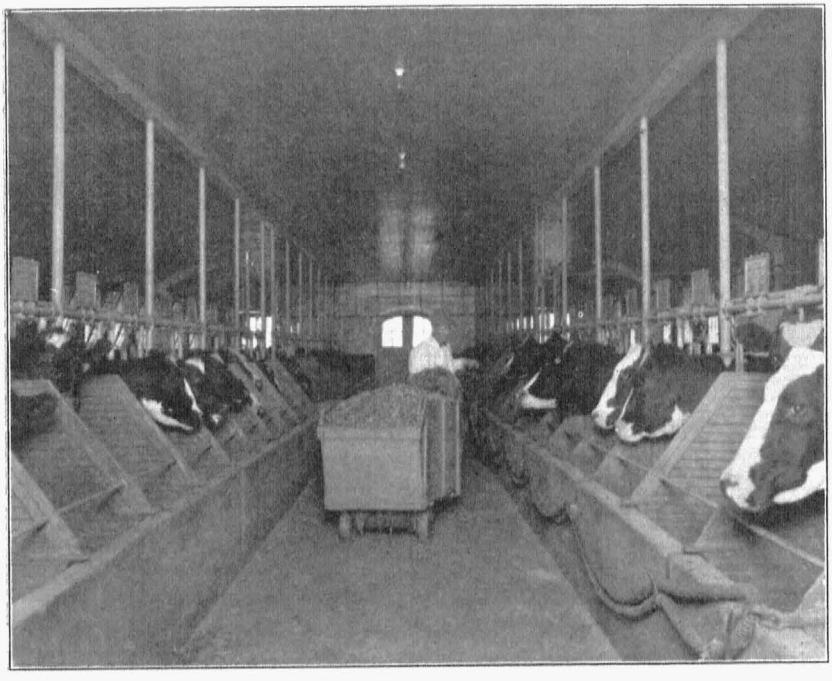

Fig. 8.—Feeding silage to dairy cattle at the Missouri College of Agriculture. Silage is almost indispensable for profitable milk production.

protein feeds such as gluten feed, linseed meal or cottonseed meal. The remaining half may consist of corn, oats, or bran.

The dairy sire should be fed silage only in limited amounts. Fifteen to twenty pounds is all that is recommended for a sire during the breeding season. Some breeders even go so far as to withhold silage entirely. However, it has not definitely been shown that there are any ill effects on the breeding ability of the sire from feeding silage in limited amounts.

Silage for Beef Cattle.—Corn silage is used advantageously in the maintenance, growth and fattening of beef cattle under a wide variety

of circumstances, frequently forming the most economical portion of a ration. Its economy depends largely upon the price of corn and the conditions under which the silage must be put up. It has two features of advantage; namely, the large yield per acre and the reliability of supply.

The amount of silage which calves, yearlings, or two-year-old steers will consume, varies from 10 to 50 pounds per day, depending on the amount of grain and other roughage being fed. At the Missouri Experiment Station during the years when corn was highest in price, as much as 50 pounds of silage per day per steer was fed profitably when little or no corn, was fed. On the other hand, where more shelled corn was fed, steers in the same experiment ate only 16 pounds of silage per day.

Experimental evidence shows that when conditions are such that the extensive use of corn silage is indicated in the ration for fattening cattle, the most satisfactory results are obtained when it is fed in conjunction with such high protein concentrates as linseed or cottonseed meal.

When the cost of silage is such as to indicate its use in rations for fattening cattle it is economy to feed all the silage they will clean up twice a day, rather than to limit the amount fed. Mature steers, yearlings and two-year-olds will eat from 20 to 40 pounds per day during the first 30 to 60 days, and gradually less as the feeding period advances and the supply of grain is increased.

When cattle are to be fed for more than 90 days, the addition of clover, alfalfa or other legume hay usually proves highly advantageous, especially during the latter part of the feeding period.

Silage is best fed in bunks which are used for grain feeding. The feeder should always keep in mind that with cattle, as well as other stock, the quality of silage is an important factor, and should guard against the feeding of silage that is soured or decayed.

Cattle which are expected to make maximum gains on grass during the following summer should not be in high condition of flesh in the spring. In case their winter ration contains silage, the amount fed should be governed by the condition of the cattle, for if they are fed all they will consume they take on considerable flesh.

Stock cattle can be maintained cheaply on a limited amount of silage and either legume hay, stover, linseed meal, or cottonseed meal.

Corn silage is also a valuable feed for breeding beef cattle, since it is nutritious and provides succulence at a time when it is greatly needed. Breeding cattle can be satisfactorily wintered on a ration containing what silage they will clean up and a limited quantity of legume hay or

nitrogenous concentrate. Where the cost of silage is such as to indicate its use in this connection, it may safely constitute a large portion of the ration.

Silage for other Classes of Stock.—Although corn silage has been used as a horse feed only in recent years, it is now fed quite liberally to horses and mules in certain sections.

Horses at hard work should not be fed very much silage, because of its bulky nature. It is best suited to idle horses, brood mares, and growing colts.

The quality of silage should be watched closely in feeding to horses, as moldy silage may cause poisoning. It should be fed with great care, and horses should be accustomed to silage gradually. From 10 to 15 pounds of silage daily to mature mares or work horses is sufficient.

At the Missouri Experiment Station idle brood mares have been wintered economically with silage as a part of the roughage.

In feeding silage to sheep and lambs, the greatest advantage lies in the saving of grain and hay. In most experimental trials no more daily gain was made by adding silage, but less grain and hay were consumed.

Corn silage of good quality can be fed to sheep in amounts varying from 1 to 3 pounds daily per head, depending upon the age of sheep and the amount of grain being fed. Greater care is necessary in feeding silage to sheep than to cattle; since digestive disturbances seem more easily induced in sheep and silage is frequently charged with causing them.

Silage is as valuable for the breeding flock as for fattening sheep. Two to three pounds daily for ewes of 150 pounds weight is probably the best amount to feed. Silage for sheep of any kind should be made from well-matured corn.

As silage is very bulky and coarse, it is not adapted to swine feeding, and little or no silage is thus fed. The hog requires concentrated feeds, and the roughage needed can be supplied best by the use of legume hays.