CIRCULAR 550

Making and Feeding GRASS SILAGE

By W. P. GARRIGUS

UNIVERSITY OF KENTUCKY
Agricultural Extension Service

CONTENTS

	PAGE
Introduction	3
Reasons for Increased Popularity	4
Advantages Over Hay	4
Advantages Over Cultivated Silage Crops	8
Surplus Forage for Silage	8
Grass Silage for Drouth Emergency Feed Reserves	9
The Other Side of the Picture	10
How to Make Grass Silage	12
To Wilt or Not to Wilt	12
Feeding Grass Silage	19

(Photo: New Holland Machine Co.)

Cover illustration: Surplus pasture forage harvested for grass silage makes low-cost and nutritious feed for wintering livestock.

Grass Silage

By W. P. GARRIGUS

Grass silage has proved superior to and is more economical than most other harvested roughages. This is especially true where curing weather is unreliable, soil erosion is an acute problem, and when a high protein, carotene, and mineral content is important. Kentucky farmers who have tried grass silage are finding that 2 acres of forage properly ensiled are equivalent in feeding value to 3 acres of the same forage cured in the field. This circular points out some of the reasons why this is so, and also some of the precautions and rules that must be observed if success is to be had with grass silage.

During the past 20 years, farmers throughout the United States have found grass silage to be an economical and palatable feed for dairy cattle, beef cattle, sheep, poultry, and even hogs. Research at the Kentucky Agricultural Experiment Station and other stations has shown that good forage, properly made into grass silage, retains a higher percentage of its original feeding value than when preserved as field-cured hay. Bluegrass grown on fertile land and ensiled before bloom will make silage containing nearly three times as much digestible protein and slightly more total digestible nutrients than are found in the best corn silage per unit of weight.

The unreliable hay-making weather for which Kentucky and the Southeast are noted is an added reason for making grass silage inasmuch as only 1 to 4 hours of field wilting are required before the crop is ready to be put away. Nearly any farmer with the aid of weather reports can predict the weather that far in advance with a high degree of accuracy. If an unexpected shower does occur it does little damage since the forage is still too green to leach or spoil. Field forage harvesters encourage "direct cut" harvesting which completely eliminates the weather hazard.

Dairy farmers should be especially interested in grass silage, because it enables them to provide the benefits of an even supply of year-round pasture at a cost well below that of a grain-and-hay ration. Sheepmen are finding that it far surpasses, both in quality

and economy, hay or corn silage as winter roughages. Beef men have found grass silage to be an ideal roughage, especially for brood cows and stocker cattle.

American farmers have known about grass silage only since about 1937. During the war years, labor was scarce and the new field forage harvesters were not available. New silos could not be purchased at any price. Molasses and acid for preserving were available only in very limited quantities and then at a prohibitive price. Despite these handicaps, grass silage continued to grow in popularity. Once that labor-saving machinery, new silos, and molasses again became available, most commercial dairy farmers and many beef and sheep farmers began making grass silage. It has become a standard roughage on many Kentucky farms, especially those in rolling areas not suited to the growing of corn and sorghum.

REASONS FOR INCREASED POPULARITY

Advantages Over Hay

Some of the chief advantages of ensiling grass or legume crops rather than curing them as hay are the following:

Minimum harvesting losses.—Carefully conducted tests have shown that about 15 percent of the weight of various legume crops usually is lost in haymaking, even when weather is favorable and crops are well handled, and that with unfavorable weather and poor handling the loss frequently runs to 50 percent. This loss comes mostly from the shattering of leaves; based on per unit of weight, the leaves contain twice as much protein and four times as much vitamin A as the stems. The average loss in feeding value of legumes cured as hay in Kentucky, where the weather at haying time is often unfavorable is, therefore, tremendous. For the United States as a whole it has been estimated that in alfalfa haymaking alone, there is an annual loss of 1,326,000 tons of dry matter containing 257,000 tons of crude protein. On the other hand, harvesting these same crops for silage involves practically no loss. Further losses of nutrients after harvesting are about the same in the silo as in the haymow, ranging usually from 5 to 15 percent.

Superior feeding value.—In tests with fattening steers and pregnant ewes at the Kentucky Agricultural Experiment Station, alfalfa-molasses silage had a slightly higher feeding value per pound of dry matter than hay made from the same field. The feeding value of the silage of course depends on the quality of the crop from which it is made. Fair results, for example, were obtained from overripe bluegrass made into silage and used as winter feed for ewes. Much better results were obtained when the grass was in a more nutritious stage at the time the silage was made. In general, grass silage contains at least 9 times as much vitamin A and 10 to 20 percent more protein than hay made from identical herbage under favorable conditions. Dairy cows produce somewhat more milk, with nearly twice as much vitamin A in the butterfat, when they are fed alfalfa-molasses silage, as when they are fed alfalfa hay alone, for roughage. Grass silage, however, contains very little vitamin D, which is present in good sun-cured hay.

More protein is contained in most grass silages than in corn silage and a higher fattening value per pound of dry matter is found in some grass silages, such as excellent bluegrass-molasses

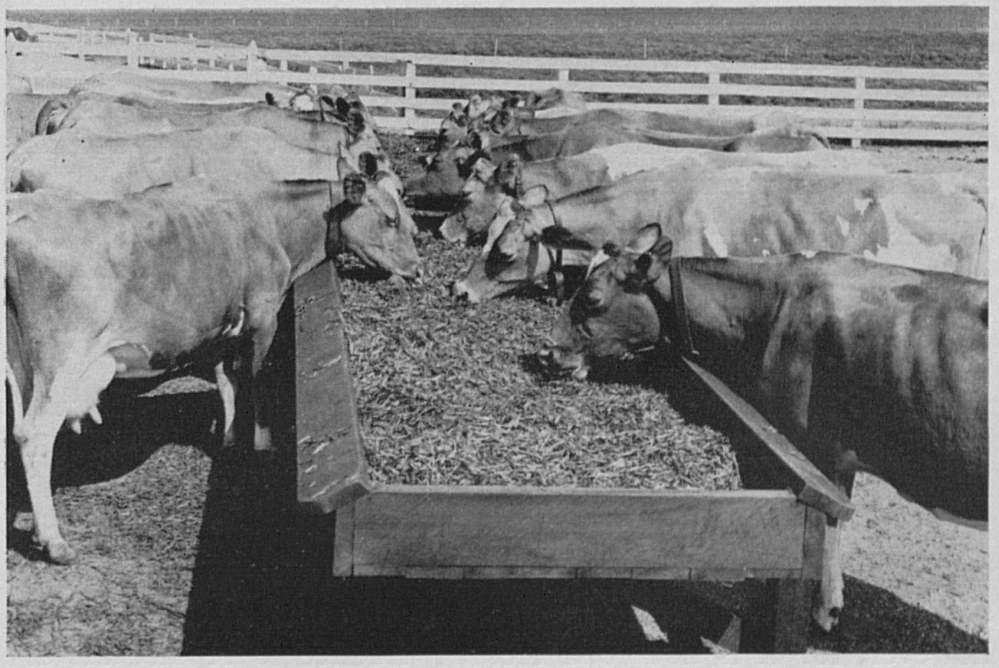

Fig. 1.— The high-protein, mineral and vitamin content of grass silage makes it an ideal roughage for dairy cows.

silage, than in corn silage. A series of digestion trials with feeder steers at the Kentucky Agricultural Experimental Station established the following nutritive values for bluegrass, alfalfa, Ladino, fescue, soybean, and corn silages (see Kentucky Agr. Exp. Sta. Bul. 573 for more details):

Average Digestible Nutrient Contents of Several Silages

(Dry Basis; divide by 3 to approximate contents of digestible nutrients in fresh silage)

Kind of silage and Quality	Dry matter	Crude protein	Ether extract	Crude fiber	N-free extract	Gross energy	Tot. dig. nutrients
	%	%	%	%	%	Cal/gm	%
Ladino clover-molasses — good	71.9	18.5	2.1	12.9	33.4	3.288	69.5
Soybean-molasses — very good	52.4	9.7	0.5	12.2	26.9	.....	49.9
Fescue-molasses — Fair	60.7	5.5	1.9	18.7	29.7	.....	58.2
Fescue-molasses — very good	67.0	10.3	2.7	20.4	28.6	3.074	65.3
Ky. bluegrass-molasses — poor	56.0	6.0	1.9	24.7	22.9	2.651	57.9
Ky. bluegrass-molasses — fair	66.8	11.7	3.8	21.8	25.7	3.281	67.8
Ky. bluegrass-molasses — very good	70.3	15.3	3.9	15.5	29.6	.....	69.2
Alfalfa-molasses — very good	59.2	12.8	2.6	14.8	24.9	2.648	58.4
Corn — excellent	67.3	4.9	2.8	13.7	44.6	2.895	69.5

Less feeding waste.—Livestock usually refuse a tenth to a half of the hay put before them, and there is always loss of shattered leaves in feeding whole hay. These losses are almost entirely avoided in feeding grass silage. When silage is of at least standard quality and is fed in proper amounts, livestock eat practically all of it, even weeds and stubble, for it is finely chopped and has a uniform odor and taste.

Less storage space.—About 3½ times as much storage space is required for loose hay and nearly twice as much for baled or chopped hay as for an equivalent amount of grass silage. Grass silage in the silo contains about 14 pounds of dry matter per cubic foot, loose hay in the mow about 4 pounds, and chopped or baled hay about 8 pounds per cubic foot. Corn silage contains about 12 pounds of dry matter per cubic foot. Silos and one-story stables can be built more cheaply than the common two-story barns of similar capacity. Some storage space for hay would still be needed, however, for it is not good feeding practice to replace all dry roughage by silage. (See page 20.)

Fig. 2.— A concrete-stave bunker-type silo on the University of Kentucky Mercer Farm. This silo requires no upkeep and is well suited to self-feeding operation. Bunker silos cost less to construct than upright silos. However, more spoilage of silage occurs in bunker silos.

Less fire hazard.—Properly prepared grass silage offers no possibility of spontaneous combustion nor of fire caused by lightning or the carelessness of smokers.

Low cost of production.—Grass silage can be produced at a cost 15 to 25 percent lower per unit of feed value than either corn silage or hay. Grass silages are especially helpful in reducing labor requirements during the summer rush period.

Reduced weather hazard.—In about 3 years out of 5, as most Kentucky farmers are all too well aware, the first cutting of legumes for hay is damaged or even ruined by rains. Moreover, the crops that are hard to cure, such as soybeans and cowpeas, nearly always suffer weather damage before they can be cured for hay. Losses sustained in these ways can be avoided by harvesting these forages for silage.

Fuller use of silo and cutter.—Grass silage may be made and fed out during the summer and early fall when most silos stand empty and silage cutters are idle. The same silo may then be used for corn silage later in the fall. If not all the grass silage is fed before time for making corn silage, the corn silage can be put on top of the grass silage without damage to either.

Better control of weeds and parasites.—The heat of the ensiling process kills all weed seeds and parasite eggs in the silage.

Much weedy or parasite-infested herbage which would be quite undesirable for pasture or for hay can be made into a safe and good-quality feed through proper ensiling. Even wild onion odors are dissipated in grass silage to the point where they do not noticeably affect the flavor of milk.

Advantage Over Cultivated Silage Crops

In addition to the 15 to 25 percent lower cost of production of grass silage than of corn silage (**see above**) and the smaller storage space required, grass silage offers a further advantage over corn silage, especially on farms where erosion losses on cultivated land are high. Because grass silage is obtained from crops grown without row cultivation, soil losses in connection with the production of it are low. Grass silage fits well, therefore, with a program of soil conservation.

Surplus Pasture Forage for Silage

Kentucky pastures, especially the bluegrass pastures of central Kentucky, generally produce a surplus of forage during May, above the immediate needs for pasture. During late July and August, however, there is usually a shortage of pasture forage. The use of this May surplus for the production of silage to be fed out during late July and August offers a new and practical way of

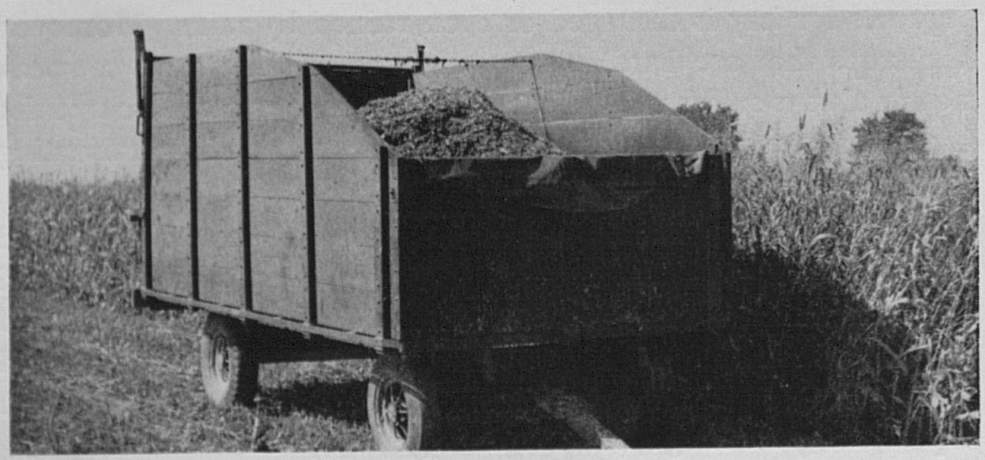

Fig. 3.— This mixture of soybeans, cane and sudan grass yielded over 20 tons of silage per acre which provided cheap feed for drouth emergency use.

evening up the forage supply, with more profitable livestock production and better pasture management as the result.

If silage is to be made from the surplus pastures, a fertile one-fourth to one-third of the pasture acreage, not too rough for harvesting machinery, should be left ungrazed during the spring months. Bluegrass forage will usually be 10 to 15 inches high and just heading out, but not yet in bloom, by late May. This is the right stage of growth for harvesting it for silage. On fertile land where there is a good stand of bluegrass intermixed with some white clover or other legumes, 1½ to 3 tons of silage per acre may usually be expected. Previous top-dressing with manure or nitrate will increase yields and lower harvesting costs. Other pasture mixtures will produce even greater yields of forage.

Silage can be made, of course, from the surplus forage on grazed pastures, but it is more economical to set off a portion of the pasture and keep it ungrazed until it is cut for silage. It takes more time and labor, and therefore costs more, to get from the entire grazed pasture the same amount of silage furnished by an ungrazed portion.

Grass Silage for Drouth Emergency Feed Reserves

Grass silage makes an ideal forage to hold in reserve for use during drouth emergencies. It may be produced from surplus or weedy forage during rainy periods, and stored in inexpensive trench silos until needed. Every livestock farm needs such a reserve feed supply. It will permit heavier stocking of pastures and therefore more complete and more profitable forage utilization, since farmers having such a reserve will not continually understock their pastures with the idea that sooner or later they will be caught short of feed. Then, too, feed purchased during drouth periods is always costly. Trench silos for storing such feed reserves need not have concrete floors or sides since they will be emptied only once every 3 to 6 years and then usually during dry weather. The stored silage should be adequately covered with dirt, ground limestone, or durable paper or plastic and protected from surface drainage into the silo. Properly prepared silage so stored should retain most of its feeding value for periods up to 10 years. Enough drouth emergency roughage reserves should be on hand at all

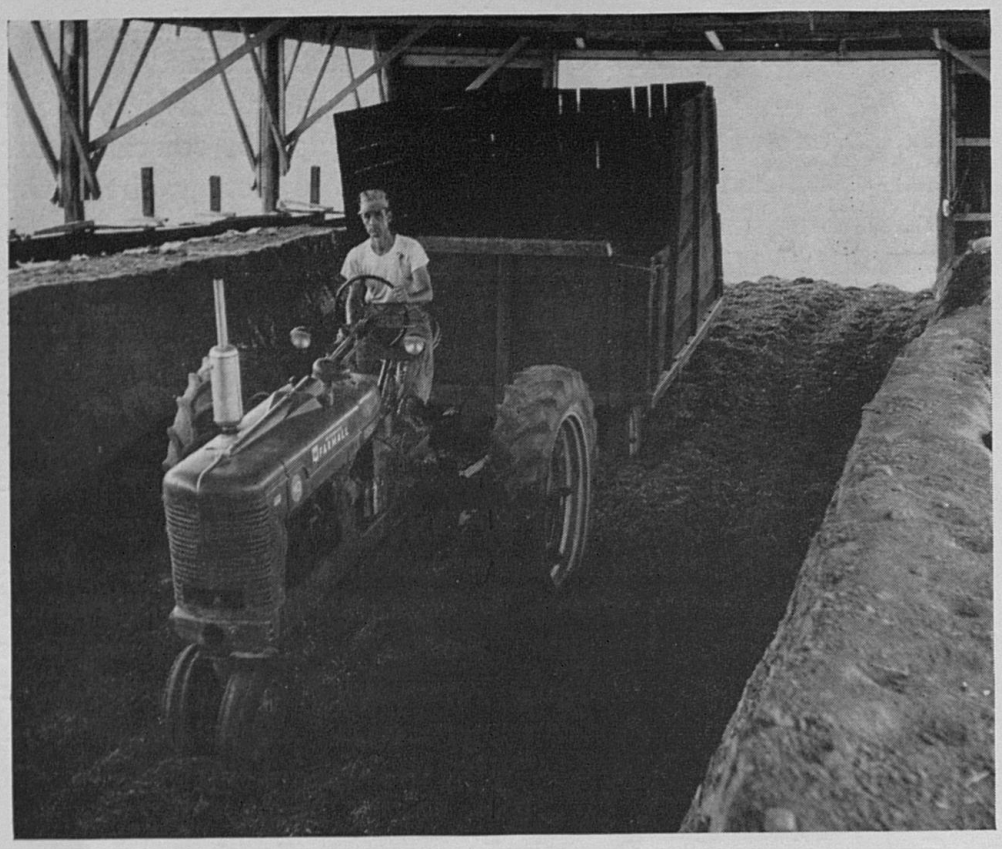

Fig. 4.— This trench silo is in a shed attached to a livestock barn. It provides low-cost and safe storage for grass silage.

times to carry the normal livestock inventory of the farm, on at least maintenance rations, for a period of 3 to 6 months.

THE OTHER SIDE OF THE PICTURE

No farmer who is thinking of putting up grass silage for the first time should fail to give full weight to the disadvantages involved. These disadvantages are for the most part dangers or risks to be avoided. If proper care and foresight are taken most of them will not prove troublesome. The more important of these disadvantages or risks are the following:

Stronger silos required.—Grass silage, especially when overly wet, produces more pressure on a silo than does corn silage. Before filling a silo with grass silage for the first time, therefore, be sure that the silo is strong enough to hold the grass silage. Silos

to be used for grass silage require double the amount of reinforcing steel used for corn silage, unless filled to no greater height than 15 or 20 feet. (See U. S. Dept. Agr. Farmers' Bulletin 1820, "Silos, Types and Construction," pages 10-12.)

Danger from asphyxiation.—Since all silage, and especially grass silage, settles considerably overnight and produces a large amount of carbon dioxide gas, workmen should not enter a partly filled silo in the morning until the blower has been in operation for a few minutes to clear out the carbon dioxide. Farmers should also watch out for a poisonous gas—nitrogen dioxide—that may form in fresh silage. This gas causes "silo-filler's disease," a recently discovered hazard to farmers and their families and to livestock. Its symptoms are severe coughing and burning or choking pains in the throat and chest. After awhile the pains disappear, leaving the exposed person free of discomfort for 5 to 12 hours. But then severe illness can strike, owing to lung irritation caused by the gas.

These safety precautions should be observed in filling all tower silos:

1. Run the blower for 10 minutes before going into a partly filled silo. Always keep the blower running while you are inside.

2. Be alert to irritating odors. Nitrogen dioxide is heavier than air and collects near the surface of the silage. The gas tends to settle in the silo chute and around the base of the silo.

3. Watch for yellowish brown fumes—they signify nitrogen dioxide. If you can't see readily in the silo, use a flashlight.

4. Keep children and animals out of the silo and away from it during filling.

Strain on haying equipment.—Forage weighs almost three times as much per unit of volume when ready for ensiling as it does when cured for hay. Therefore, some farmers have broken side-delivery rakes, hayloader ropes, and wagons by trying to handle too much of this heavy material at one time. Either the green herbage should be handled at a slow, steady rate, or new heavy-duty equipment should be procured.

Hard on concrete.—All silage is somewhat acid and, therefore, gradually dissolves the lime from concrete silos or the mortar

joints in tile silos. Grass silage made from too-wet forage is slightly more acid than corn silage and is consequently more injurious on the silos. Good-quality grass silage made from forage containing the right amount of moisture and preserved with molasses is not appreciably more destructive of silos than corn silage. Various preparations are available for coating the inside of the silo to reduce this corrosion. (See U. S. D. A. Farmers' Bul. 1820, pages 15-17.)

Risk of spoilage.—Inexperience in making grass silage may sometimes prove costly, for if forage is ensiled when too wet it will usually produce strong, putrid silage, but if ensiled when it is too dry the silage will heat excessively and sometimes may char. In either case the feed value of the silage is greatly reduced. Thus it is essential that care be taken to have just the right amount of moisture in the forage if the maximum feeding value is to be retained.

HOW TO MAKE GRASS SILAGE

While we still don't know everything concerning the production of grass silage from the various crops, with or without one of numerous preservatives, some facts about its production are definitely established.

Crops to use.—Almost any crop that can be made into satisfactory hay can be made into an even more satisfactory livestock feed by ensiling. Legumes, cereals, and grasses all are equally well adapted to the production of good-quality silage. As a rule, first-cuttings and weedy crops are ensiled. It should be borne in mind, however, that the process of ensiling merely preserves in palatable form the nutrients contained in the forage when harvested. The better the forage is, the better the silage produced from it will be. Because of the high moisture content of silage, 2½ to 3 times as many tons will be produced per acre as would be expected of the crop if it were made into hay.

To Wilt or Not To Wilt?

The answer to the question of whether to wilt forage before ensiling depends to a large extent on the type of silo to be used for storing the silage.

For upright silos.—For the production of the best silage in upright silos the dry matter content of the forage should be from 30

to 35 percent. This percentage is usually obtained by cutting the crop at the hay-making stage or somewhat earlier and allowing it to wilt in the sunlight for 1 to 4 hours. Forage containing too much moisture usually produces slimy, putrid silage, and causes excessive leakage of juices from the silo. U. S. D. A. research shows that forages containing only 15 percent of dry matter when ensiled

Fig. 5.— Modern labor-saving equipment helps to make grass silage production an easy and efficient operation.

will lose up to 10 percent of their total dry matter in the juices that seep out of the silo for several weeks after filling. These are the soluble portions and therefore the more nutritious ones. This runoff from overly-wet silage can, by itself, result in feed losses up to 20 percent of the total at time of ensiling. On the other hand, crops that are too dry when ensiled do not settle well, and they undergo excessive fermentation and charring, except in tall silos (30 or more feet of silage) where there is enough pressure from the silage above to exclude most of the air. Crops are more often ensiled in upright silos when too wet than when too dry.

The time required to reduce the moisture content of a crop depends on air temperature, movement and humidity, and on the size of the stems. Drying is rapid on hot, dry days, and slower on sultry or cold days. Fine-stemmed crops such as bluegrass and Korean lespedeza dry rapidly, whereas coarse-stemmed crops such as soybeans, sweet clover, alfalfa, and red clover dry less rapidly and should not be windrowed for that reason .

Wilting may be impracticable when the weather is unsuitable or when field forage choppers are to be used, especially on stony land where the choppers will pick up loose stones in windrowed forage. Custom operators are, naturally, reluctant to wait for forage to wilt.

Where practical, wilting not only produces better silage but saves labor, since only two-thirds as much total weight will be hauled and blown into the silo when the forage contains 30 percent dry matter as when it contains only 20 percent. It has been shown that high-producing dairy cows will not consume as much dry matter from high-moisture silage as from silage containing 30 to 35 percent dry matter.

An alternative to wilting is the addition of ground ear corn, ground corn cobs, chopped hay or chopped straw to the forage at time of ensiling. These dry materials mixed with the overly-wet forage will soak up the excess moisture, thereby preventing costly runoff and improving the quality of silage produced. Three hundred pounds of such dry materials mixed with 1,700 pounds of 20-percent forage will bring the dry matter content of the mixture up to 30 percent, an ideal level.

For horizontal silos.—It is hard to get forage too wet for storage in trench, stack, or bunker silos, especially when it is ensiled without chopping. In such silos most forage should be ensiled without wilting since the depth of silage, and therefore the pressures, are such that little runoff may be expected. Then, too, the wetter silage will pack better and therefore have less spoilage.

When to cut.—The most favorable times at which to cut some of the crops commonly grown for silage are when the crops are in the stages of maturity stated in the following tabulation:

	Stage of Maturity	Approximate Dry-matter Content at Cutting	Hours of Sun-Wilting before Ensiling
		% %	
Alfalfa	¼ bloom	22 - 27	2 - 3
Red clover	½ to full bloom	23 - 28	2 - 3
Korean lespedeza	½ to full bloom	30 - 35	0 - 1
Soybeans	pods ¾ filled	23 - 28	2 - 3
Cowpeas	first pods filled	16 - 21	3 - 4
Sweet clover	½ to full bloom	20 - 25	3 - 4
Bluegrass	before bloom	25 - 30	0 - 1
Timothy or orchard grass	before bloom	25 - 30	1 - 2
Cereals	early milk stage	22 - 27	2 - 3

Letting the crops become more mature usually results in an increase in dry-matter content but a decrease in total feeding value. This fact is illustrated in the following data from the Kentucky Agricultural Experiment Station.

	Digestible Protein	Total Digestible Nutrients
	%	%
Kentucky Bluegrass, before bloom	5.1	25.1
Kentucky Bluegrass, early bloom	3.9	23.9
Kentucky Bluegrass, past bloom	2.0	19.5

Determining dry matter content.—A simple test to approximate the dry-matter content of the forage is especially helpful to those who are inexperienced in making grass silage. The day before one plans to ensile the crop, cut a sample of the forage (2 or 3 pounds), weigh it on fairly accurate scales, such as milk scales, and dry it for 3 to 6 hours in the oven of the kitchen stove held at approximately 220° to 250°F. If the oven has no vent the door should be left slightly ajar to permit the moisture to escape. After the drying, remove the sample from the oven and weigh it immediately, before it has time to absorb moisture from the air. Multiply the dry weight figure by 100 and divide the product by the wet weight, to arrive at the percentage of dry matter. Drying may be hastened by cutting the sample into short lengths. A patented device which will make an accurate dry-matter determination in 10 to 20 minutes is now on the market but its cost is so high that it should be purchased cooperatively by several farmers in a community.

Equipment needed.—Farmers who have a silo and silo filler need purchase little or no additional equipment in order to put up grass silage. However, a windrow attachment for the mower, a sturdy hayloader, and a silo filler designed to handle green forage crops are all considered very desirable by those who have used them. Some silo fillers have molasses pumps and automatically controlled feed valves which save time and give a more uniform mixture of forage and preservative. Field forage harvesters greatly reduce labor requirements but the cost of one is excessive unless it is to be used to put up at least 300 tons of forage per year. Wagons with unloading devices are also great savers of labor.

Preservatives to use.—When the forage is exactly in the right condition and the silo is properly filled, good silage can be produced from grasses or legumes without the aid of any preservative. But because conditions are not always ideal, most farmers have decided that a preservative is well worth the small extra cost and trouble, especially as a large part of the value of the feed-type preservatives is retained in the silage. About 75 per cent of the feed value of molasses or ground grain is usually retained.

Though many preservatives have been used successfully with grass silage, only three deserve recommendation for use in Kentucky. These are molasses, ground grain (or corn-and-cob meal) and sodium metabisulfite. Molasses is the cheapest and, up until recently, was the most popular.

Ground grain or corn-and-cob meal are easier to apply than molasses to field-chopped forage since they may be spread uniformly over the top of each load of chopped forage before it is unloaded into the blower. These preservatives produce top quality silage, add to the feed value of the silage, and also reduce the average moisture content of the silage. Where no grain is to be fed with the silage, the use of feed-type preservatives is especially recommended since their added carbohydrate helps rumen microorganisms to function properly and therefore brings about better utilization of the silage.

Sodium metabisulfite is a dry powder that combines with the forage juices to produce sulfur dioxide and, later, sulfurous acid. It therefore has the same action as sulfur dioxide gas which is more difficult to apply evenly and usually more costly to obtain. While sodium metabisulfite adds nothing to the feeding value of the silage, it does an excellent job of preserving the color, carotene, and nutritive values contained in the forage. Its use often results in the production of very palatable silages, but it cannot completely overcome the handicap of excessive moisture or excessive dryness in the ensiled forage. Preliminary research results indicate a slight improvement in the digestibility of silage due to the use of sodium metabisulfite as a preservative.

The amounts of preservative needed per ton of silage are given in the following tabulation:

	Any one of the following preservatives—			
	Molasses	Ground Grain	Corn-and-Cob Meal	Sodium Metabisulfite
	lb	lb	lb	lb
Cereals in milk stage) Grasses in bloom)	40	100	125	8
Grasses before bloom) Grass-and-legume mix)	50	125	155	8
Legumes in early bloom	60	150	190	10
Legumes before bloom	80	200	250	10

Filling the silo.—The silo filler should be set for a quarter-inch cut so that the silage will be fine and will pack well. The knives should be sharp and closely adjusted since most forages used for grass silage are harder to cut than corn. If the silo filler has no molasses pump, good results may be obtained by placing a barrel or drum above the cutter and threading in a faucet at the bottom. A mixture that is half molasses and half water may be readily run from the barrel through a short piece of hose into the blower near the shaft. In either case the flow of molasses must be regulated by trial. When the molasses come in wooden barrels and a suction pump is used, much time will be saved if a strainer of ¼″ mesh hardware cloth is placed over the end of the suction hose to prevent chips from entering. A better device for this purpose is a ¾″ pipe, 30 inches long, with one end inserted into the suction hose, the other threaded and covered with a cap having 10 to 12 ¼″ holes drilled in it. The molasses pump should be cleaned thoroughly and then flushed with lubricating oil after the silo is filled. If this is not done the pump will rust badly and will probably have to be torn down and cleaned before it can be used again. When cornmeal is used as a preservative, sprinkle it on the forage as it enters the cutter, or above the feeding rolls rig a hopper so that the flow of meal may be regulated by opening or closing a gate made in its bottom. With field-chopped forage, spread the ground grain or sodium metabisulfite on the load before it is unloaded into the blower.

Self-unloading wagons are almost a necessity for the efficient handling of field-chopped forage. These may be home-made affairs or excellent ready-made ones may be purchased.

If only one truck is available for hauling the forage to the silo, time may be saved by placing a length of woven wire on the bed and up the front before loading, and then rolling the load off at

Fig. 6.— A home-made unloading device saves much labor in making grass silage.

the cutter by roping the front end of the wire to a post at the rear and driving ahead. The truck can then be sent to the field for another load while this load is being run into the silo. If some of the forage to be ensiled is more mature than the rest, the drier, more mature forage should be run in first so that it will be near the bottom of the silo and the younger, wetter forage will be nearer the top. The silo walls should be smooth to insure uniform settling, and the doors should close airtight. When doors are old or poorly fitted, cracks may be caulked with wet clay or caulking compound, or tarpaper may be placed on the inside as the silo is filled. To exclude the air, which causes spoilage, the top should be tramped thoroughly, especially at the edges, every day for the first week after filling. If a layer of tarpaper is placed on top of the silage and covered with a load of forage, weeds, ground limestone or sawdust the amount of spoilage will be reduced even more.

Silage losses will vary somewhat, depending on type of storage provided. At 30-percent dry matter content, an ideal level, total losses have been estimated at 14 percent of the dry matter in upright silos, 23 percent in trench silos, and 35 percent in stack silos.

Losses will greatly exceed these if the silage is improperly prepared or stored.

FEEDING GRASS SILAGE

Grass silage, as fed, should be moderately green to greenish brown and moist but not wringing wet. It should have a pleasing faintly-acid aroma free from the characteristic rancid-butter odor of butyric acid. Grass silage is especially high in protein, minerals and Vitamin A as is shown in the following tabulation of the chemical composition of nine silages.

Average Chemical Composition of the Several Silages

(Dry Basis; divide by 3 to approximate fresh silage)

Kind of silage Quality	Dry matter	Crude protein	Ether extract	Crude fiber	N-free extract	Total ash	Gross energy	Vit. A*
	%	%	%	%	%	%	Cal/gm	
Ladino clover-molasses — good	100.0	25.6	3.6	20.0	40.4	10.4	4.629	75,000
Soybean-molasses — very good	100.0	17.2	2.1	30.0	41.4	9.2	.....	50,000
Fescue-molasses — fair	100.0	10.2	3.7	28.1	46.4	11.6	.....	40,000
Fescue-molasses — very good	100.0	15.5	3.5	28.9	42.1	10.1	4.569	60,000
Ky. bluegrass-molasses — poor	100.0	11.0	3.5	36.1	41.2	8.2	4.579	20,000
Ky. bluegrass-molasses — fair	100.0	16.6	5.8	29.3	40.8	7.5	4.927	40,000
Ky. bluegrass-molasses — very good	100.0	22.1	5.2	22.0	40.4	10.4	4.514	60,000
Alfalfa — very good	100.0	18.6	4.0	29.8	37.3	10.4	4.485	40,000
Corn — excellent	100.0	8.6	3.3	23.4	59.9	14.6	4.470	15,000

* Estimated vitamin A values per pound of dry forage.

The high protein, vitamin A, and mineral content of grass silage make it especially valuable for feeding to growing, pregnant or lactating animals. Since this silage contains practically no vitamin D, animals receiving it should also receive some sun-cured hay in their ration or spend a good part of each day outside of the barn where they will be exposed to sunshine.

Grass silage made without a preservative and, to a lesser extent, that made with sodium metabisulfite should be fed with some grain or other source of carbohydrate. Otherwise the ration will be deficient in readily available carbohydrate which is needed by the rumen microorganisms for proper breakdown or utilization of roughages.

Very acid silage (especially that containing acid preservatives or made from too-wet forage) can be made somewhat more palatable by sprinkling fine-ground limestone over it at the rate of 10 ounces per 100 pounds of silage. To be on the safe side when feeding silage, provide salt, ground limestone and steamed bonemeal in separate containers at all times. If a fairly liberal grain ration is being fed, the bonemeal may be omitted.

Generally speaking, 2½ to 3 pounds of grass silage will replace one pound of hay made from the same crop. Three pounds of grass silage has a feeding value equal to approximately 2¼ pounds of good corn silage plus ¼ pound of protein supplement. While grass silage may be used as the sole roughage in a ration, the stock will eat more roughage and therefore usually thrive better if some dry roughage also is fed.

When pastures are short and dry, grass silage will be found to be a very satisfactory source of roughage. In this capacity, grass silage not only helps in providing a uniform supply of roughage for the livestock but also permits resting of pasture at this critical period.

To prevent spoilage of the silage after the silo has been opened for feeding, a layer of silage at least three inches in thickness should be removed each day during warm weather and a somewhat thinner layer during the winter. The top of the silage should be kept firm and level at all times. (See U. S. D. A. Farmers' Bulletin 1820, pages 3-6 for sizes and capacities of silos and rates of feeding.)

CAUTION: Sweet-clover silage, properly ensiled, is excellent feed; but if it becomes even slightly moldy it is dangerous, often deadly, to the animals that eat it. This same difficulty is found with sweet-clover hay, but very rarely with the other legumes, either as hay or as silage. Properly cured ensilage made from sorghum, sudan grass or Johnson grass is safe to feed even though its prussic acid content at time of ensiling may have been at a highly toxic level. The ensiling process renders the HCN harmless.

Dairy cattle.—Grass silage is especially beneficial in the rations of dairy cattle. When fed high-quality grass silage, dairy cows produce somewhat more milk containing over 50 percent more vitamin A than they do on the ordinary dairy ration. If legume silage

is used to replace most of the corn silage or grass hay in a dairy ration, the crude protein content of the grain mixture may be reduced about 2 percent. Although dairy cows have been known to eat as much as 125 pounds of grass silage per day, for best results it should be fed at the rate of from 3 to 5 pounds daily per 100 pounds live weight of the animals, and dry roughage up to 1 pound per 100 pounds live weight. Difficulty will be experienced in getting dairy cows to consume more than 1.25 pounds of dry matter from overly wet (20% D. M.) silage per 100 pounds live weight per day. Drier silage (30 to 35% D. M.) will be consumed at rates that will provide twice as much dry matter. This will mean a saving on the amounts required of other, usually more costly, items in the ration. Tests show that milk from cows fed silage containing an average infestation of wild onions is not noticeably tainted.

Beef cows and heifers.—Beef cows need a ration that enables them to give birth to strong, healthy calves and to produce a large flow of milk for these calves. Up to 30 or 40 pounds daily of good grass silage would improve the winter ration for beef cows and heifers on most farms, especially where poor-quality hay or corn stover has formed the bulk of the roughage fed. A small amount of grain or molasses will aid in the efficient utilization of the silage.

Steers.—Growing and fattening steers relish and make good use of grass silage. Two-year-old steers being fattened in drylot will eat a full feed of shelled corn and up to 30 pounds of grass silage per day. (See Ky. Agr. Expt. Sta. Bul. 579.) Somewhat less silage in combination with some dry roughage has produced still better results. Stocker steers fed mostly grass silage need some corn (3-5 pounds per day) in order to adequately utilize the grass silage.

Ewes and lambs.—Pregnant ewes receiving no pasture or other roughage will eat 8 to 12 pounds of grass silage daily. Better results usually are obtained, however, if 3 pounds of the silage is replaced by 1 pound of good grass or legume hay. Also feed ½ pound of shelled corn per ewe per day before lambing and 1 pound after lambing. No moldy or frozen silage should be fed to pregnant ewes, for they are especially susceptible to digestive upsets while carrying their young. Late lambs being barn-fed after

weaning will use 2 to 4 pounds of grass silage, each, to good advantage, as part of their daily roughage ration.

Hogs.—Hogs, especially pregnant sows, not having access to fresh, green pasture, relish and will benefit from 3 to 6 pounds of grass silage daily. Although pigs can use to advantage only a small amount of any roughage, those being fattened without access to pasture may benefit from a small amount of high-quality grass silage unless thoroughly adequate rations are already provided.

Horses and mules.—Moldy or frosted silage is definitely injurious to both horses and mules. It is inadvisable therefore to feed any kind of silage to these animals.

Poultry.—One hundred hens will consume approximately 8 pounds of grass silage per day. Grass silage can effectively replace alfalfa products in laying and breeder rations. Egg quality and flavor are unaffected by the feeding of grass silage except that, in general, a darker egg yolk is produced when hens receive silage. Improved hatchability frequently results from supplementation of the regular mash with silage.