

## Silage Crops for Dairy and Beef Cattle<sup>1</sup>

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Silage and haylage are attractive to dairy and beef cattle producers because rainfall often hinders hay production, and silage can help reduce total feed costs. Additionally, when silage is grown on the dairy where it is fed, silage can serve as a means to recycle manure nutrients.

Many commonly grown forage crops can be harvested and stored as silage. Some of those that are grown or have been grown in Florida are listed below, either as high-energy or low-energy silages.

### 1. High-Energy Silages

- Corn
- Grain sorghum (Milo)

### • 2. Lower-Energy Silages

#### Perennial Grasses

- Bermudagrass and Stargrass
- Limpograss (*Hemarthria*)

- Other improved perennial grasses

#### Annual Grasses

- Forage Sorghum
- Sorghum-sudan hybrids, pearl millet
- Small grains and ryegrass

#### Legumes

- Alfalfa
- Red clover and other cool-season legumes
- Summer legumes (hairy indigo, alyceclover, aeschynomene, and rhizoma perennial peanut.

Other crops, such as sugarcane, and crop combinations, such as grain sorghum and soybeans or ryegrass and red or white clover, have also been ensiled.

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## Corn Silage

Production practices for growing corn silage are the same as for grain production. All of the cultural practices needed for high-grain yields should be followed. In North Central and Northwest Florida, corn can be grown without irrigation, but yields are usually relatively low compared to irrigated corn. Irrigation and adequate drainage are necessary when growing corn on the mineral and organic soils in South Florida.

A brief outline of essential production practices follows below. Additional information and experience may be needed to successfully grow a corn crop.

### Hybrid Selection

Corn hybrids can be divided into three maturity groups – full-season (120 plus days), mid-season (115 days), and early-season (110 days). The full-season hybrids silk from five to 10 days later than the early-season hybrids and require more time to fill the ear before reaching maturity.

The harvest period can be lengthened by planting an early-season hybrid first and a full-season hybrid last. The full-season hybrids generally produce larger plants and a higher tonnage of silage. Early-season hybrids may produce as much grain, but on smaller plants. As a result, therefore, total silage yield is usually lower, but percentage grain in the silage is higher in early-season hybrids.

The ideal silage types have high forage yields (more than nine dry tons per acre) and are high in neutral detergent fiber (NDF) and NDF digestibility (more than 60% NDF digestibility after 48 hours of digestion). Typically, hybrids recommended for grain are also suitable for silage, but these hybrids may produce lower tonnage than hybrids developed specifically for use as silage. Hybrids developed for use as silage are preferred because, in addition to producing greater tonnage, such hybrids often have stalks that are more digestible.

## Planting Dates

Plant during the planting season recommended for your area at times when temperature and soil moisture conditions are favorable for germination and growth.

**Table 1.** Recommended Planting Dates by Region

Region	Dates
South Florida	February 1 - March 15
Central Florida	February 1 - March 31
Northeastern Florida	February 15 - April 15
Northwestern Florida	February 15 - April 15

To reduce the chance of stand loss due to a late freeze, producers in North Florida planting no-till should wait until after March 1 to plant. Those planting on land without irrigation often delay planting so that tasseling and pollination occurs after the May drought.

Corn planted after the recommended dates is more likely to suffer from attack by foliage-feeding worms and diseases. Therefore, growers should switch to sorghum (tropical corn hybrids are no longer available) if additional silage acreage is needed after the recommended planting dates for corn have passed.

### Plant Population, Row Width and Planting Depth

With irrigation, 26,000 - 32,000 corn plants per acre are suggested. Without irrigation, plant population should be based on the ability of the soil to supply and retain moisture during the growing season. As the holding capacity for soil moisture decreases, so also should the plant population. Additionally, check the plant population recommended by the seed corn company for the particular hybrid being planted. Always plant 5 - 10% more seed than needed for expected final plant population. See your planter operator's manual for instructions on planter calibration.

Row width can vary from 15 - 40 inches, but most corn growers use rows that are 30 - 36 inches wide. This row width allows for side dressing nutrients and herbicide applications if needed. The average planting depth should be 2 inches.

## Liming and Fertilization

Soil tests should be made well in advance of planting and used as a guide to nutrient management. Lime should be applied three to five months in advance of planting when possible. All the phosphorus ( $P_2O_5$ ), a third of the potassium ( $K_2O$ ), and about 30 lb/nitrogen (N) should be applied at planting. The remainder of the N and K may be applied in split applications, but should be completed by six to seven weeks after planting. A good schedule for applying the remaining N is a third at three, five, and seven weeks after emergence.

Calcium and magnesium are usually available in adequate amounts when the pH is corrected to 6.0 or higher with dolomitic limestone. Sulfur should be applied at the rate of 15 - 20 lb/A. Minor elements should be applied with the starter fertilizer as needed following recommendations from the soil-test report. Sandy soils usually need boron at 1 lb/A applied with later applications of nitrogen through the irrigation system. All nutrients should be applied according to soil-test values.

## Pest Control

Pest control recommendations change from year to year; the County Extension Office keeps updated references with the most current recommendations.

## Weeds

Cultivation and herbicides can be used to control weeds. For current herbicide recommendations, see EDIS Publication SS-AGR-02, *Weed Management in Corn*, available at County Extension Offices or online at <http://edis.ifas.ufl.edu/WG007>.

## Nematodes

These can be a problem in fields that are used to grow corn or other annual grass crops continuously. If nematodes are expected to be a problem in a particular field, a soil sample should be sent to the Florida Nematode Assay Laboratory to determine the kinds and numbers of plant nematodes in the soil. (See EDIS Publication ENY027, *Nematode Assay Laboratory*, <http://edis.ifas.ufl.edu/sr011>.) If nematodes are present in the soil, appropriate control measures can be taken. Contact your County

Extension Office on how to take samples and what nematicide to use. Use of nematicides and/or rotation with non-host crops will help to avoid nematode problems.

**Insects** - Foliage-feeding worms can cause serious damage, especially on late-planted corn. For recommended control measures for worms and other insects, see your county agricultural agent.

## When to Harvest

To optimize yield of dry matter and nutritive value, corn should be harvested for silage when the moisture concentration is about 65% (35% dry matter). Traditionally, the kernel milk line and black layer stages were used to predict the ideal maturity for harvest, but these indices should no longer be used. Instead, producers should determine the moisture concentration of the corn sample using the guidelines below:

- Harvesting when the moisture concentration is more than 70% can lead to effluent production and low yields, whereas harvesting when moisture concentration is less than 60% can reduce forage nutritive value and compromise packing in bunkers or bags.
- For considerable acreage, start harvesting when the forage is at 68 -70% moisture, such that the average DM of all the harvested forage will be about 65% moisture (35% DM).

## Sorghums and Pearl Millet

There are many types and varieties of sorghums. The primary types used for silage are forage sorghums, grain sorghums (milo), and sorghum-sudan crosses. The sorghum-sudan crosses and pearl millet are better suited for grazing or green chop than for silage.

Forage sorghums grow to heights of 5 - 10 feet. Silage yield of forage sorghums is equal to that of corn for the spring crop although nutritive value is somewhat lower. Thus, per-acre yield of total digestible nutrients (TDN) may be lower. When harvested for silage, forage sorghums will produce higher yields than other sorghum types and will

contain 20 - 25% grain although some varieties may contain less.

A problem with forage sorghum is that allowing the standing plant to dry down to the desired DM results in harvesting at the hard-dough stage, when the grain kernel is usually too hard to be easily digested by the cow. Such hard-dough sorghums should be processed with a forage chopper at the time of harvest.

Grain sorghums grow to a height of 3 - 5 feet. Silage yield of grain sorghums will range from a half to two thirds of the silage yield of forage sorghums. Grain content of silaged grain sorghums will average 50 - 60% of the total yield; thus, the nutritive value of grain-sorghum silage is only slightly lower than that of corn silage.

Pearl millet and the sorghum-sudan grass hybrids produce a leafy forage, grow from 3 - 7 feet tall, and are usually used as a grazing crop. Some varieties of sorghum-sudangrass will produce some grain, but on the average do not produce as much grain as forage-sorghum varieties.)

### Planting

Sorghums, sorghum-sudan hybrids and pearl millet may be planted in wide rows, drilled or broadcast. Row plantings allow for cultivation if necessary. Tall-growing forage sorghums should be planted in rows to facilitate harvest. Match row width of planter with row width of the forage-chopper head. Forage sorghums can be drilled or broadcast if the harvester has an all-crop harvest head. Circular cutters on the newer forage heads allow crops to be harvested in wide rows, whether seeds were drilled or broadcast.

Sorghums and pearl millet are warm-weather crops and should not be planted until the soil is warm in the spring and all danger of frost is past. Time to start planting usually occurs around the first of March in South Florida and the last of March in North Florida. New plantings can be made into the summer until about 120 days prior to the end of the growing season or to the date of the first frost. Plantings made after mid-June will have lower yields than earlier plantings and will suffer more from diseases and

insects. Spring plantings, especially in South Florida, made without irrigation may suffer from drought stress. In such situations, sorghum may be the better crop choice compared to corn since sorghum is drought tolerant. Early-planted grain or silage sorghums may make a second or "ratoon" crop, but yields of such crops are often less than half of the original harvest.

Seeding rate for the sorghums, sorghum-sudan hybrids and pearl millet is 8 - 10 lb/A of seed when planted in rows of a 30-inch to 42-inch width. For broadcast or drilled plantings, the seeding rate should be increased by 25% or more for sorghums and more than doubled for sorghum-sudan grass (Table 2). Remember, when planted for silage, the forage sorghums should be planted in rows unless an all-crop harvest head is available on the silage harvester. Regardless of seeding method, seeds should be planted in moist soil at a depth of 1 - 2 inches and covered.

### Liming and Fertilization

Soils should be tested during the fall or winter to determine the kinds and amounts of lime and fertilizers needed. Sorghums perform best in soils with a pH of 5.5 - 6.5. If lime is needed, it should be broadcast and incorporated into the soil during the land-preparation process.

Apply all of the soil-test-recommended  $P_2O_5$ , 30% of the recommended  $K_2O$ , and 30 lb N/A in a preplant or at planting application. Topdress or sidedress the remaining 70% of the  $K_2O$  and N. Sidedress before plants are too tall to cultivate or approximately four weeks after planting.

If a second ("ratoon") crop is to be attempted, it should be refertilized at about half of the original rate. The fertilizer should be applied immediately after the first harvest.

## Pest Control

### Weeds

Weeds may be controlled with cultivation and by use of herbicides. For specific and up-to-date recommendations on the use of herbicides, see EDIS Publication SS-AGR-06, *Weed Management in Sorghum* <http://edis.ifas.ufl.edu/WG002>.

### Insects

Sorghum is attacked by many of the insects commonly associated with corn. Corn earworms, armyworms and aphids are very common in sorghum. Sorghum midge and sorghum webworm may also attack sorghum.

Corn earworms and armyworms may be present from the seedling stage through maturity. March plantings (first crop) may escape severe infestations, but summer crops can be subjected to heavy infestations that result in serious damage to the crop. Sorghum midge appears at flowering. An infestation of one larva per spikelet is sufficient to cause a loss of grain. Corn earworms, armyworms, and sorghum webworms also destroy the ripening grain.

For details on the use of insecticides to control insects in sorghum, contact your county extension agent.

### Harvesting for Silage

Grain-producing sorghums should be harvested at 65 - 70% moisture and typically at the the soft-dough stage of grain maturity. For highest yields of digestible dry matter, sorghum-sudangrass and pearl millet should be harvested in the boot to early-flower stage. Digestibility decreases very rapidly in the non-grain-producing types after flowering. Moisture content may be higher than desired to make good silage when harvested at the boot stage. Therefore, it may be desirable to add dried citrus pulp or some other material to absorb some of the excess juice. Wilting would be desirable, but the stems will probably be too long to be efficiently handled by windrow and pickup equipment, and too much sand may be picked up.

To produce a higher protein silage or haylage, sorghum-sudangrass and pearl millet can be harvested when they reach a height of about 3 feet. However, harvesting at this young stage of growth reduces overall yield. Also, in some instances, regrowth has been very poor when plants were harvested at a height of 3 feet, compared to regrowth following harvest at the boot or early-flower stage.

A stubble of 6 - 8 inches should be left if a second crop is planned. The cut should be made in such a way that shattering of the stubble is avoided and equipment does not run over the stubble.

### Sorghums Compared with Corn

The dry-matter yield of forage sorghum may equal or exceed that of corn. Forage sorghums also have the advantage of producing one or more ratoon crops. However, while the nutritive value of forage-sorghum silage is typically less than that of corn silage, the nutritive value of grain-sorghum silage is usually equal to that of corn silage. As a general rule, the lower the grain content, the lower the nutritive value.

### Prussic Acid Poisoning from Sorghum

Cattle grazing certain sorghum hybrids after frosts or droughts can suffer or die from prussic acid poisoning. Symptoms, causes, and preventative guidelines are available at the following Web sites: <http://beef.osu.edu/library/prussic.html> and [http://www.uaex.edu/Other\\_Areas/publications/PDF/FSA-3069.pdf](http://www.uaex.edu/Other_Areas/publications/PDF/FSA-3069.pdf).

### Small Grains

The small grains include oats, wheat, rye, and triticale. Oats are probably the most popular small grain used for silage. Oats and wheat produce comparable yields, and both make very palatable silage if correctly handled. Rye grows at lower temperatures than oats or wheat and may produce more forage than oats or wheat. However, because rye has more stems and fewer leaves than oats or wheat, rye is often less acceptable to cattle. Triticale, a cross between durum wheat and rye, produces very good silage and is similar in quality to common wheat.

## Planting and Fertilizing

Small-grain varieties that are recommended for grain production can also be used for silage. Planting dates and management of small-grain varieties should be the same as for other grain production. Planting dates range from November 15 to December 15. In North Florida and West Florida, small-grain crops should be planted during the early part of the planting season. In South Florida and Central Florida, plant these crops during the last part of the planting season. Early-maturing varieties of wheat should be planted in the later portion (Dec.) of this planting period. Mid-season or late varieties should be planted in the first half of the planting period. (See Table 2).

Plant about 100 lb/A of seed on a clean, tilled seedbed, where all the required fertilizer except nitrogen has been incorporated prior to planting. Apply 40 - 50 lb/A of nitrogen prior to planting with the complete fertilizer then topdress during the last week in January or the first week of February with an additional 60 - 70 lb/A of nitrogen.

Small grains can also serve as dual-purpose crops. These crops can be grazed during the fall and winter and then cattle can be removed in early spring to allow growth for silage production. To successfully do this the crop must be planted about one month earlier and an additional 50 lb/A nitrogen topdressing made, with the nitrogen going on in two topdressing applications.

## Harvesting

All of the small grains except rye can be harvested for silage from late-boot to early-dough maturity stages (Table 2). Dry matter yields will increase, and crude protein percentage will decrease as the plants mature. The moisture concentration will range from 80 - 85% at late-boot to about 70% at early-dough stage. When small grains reach the dough stage, the moisture content is satisfactory for direct chopping and ensiling. The optimum dough stage for ensiling may last for only four to six days. Once the plant turns yellow, quality drops rapidly, and the material becomes low in moisture and difficult to pack in the silo.

Harvest rye at the late-boot to early-head stage. If rye goes beyond this stage of maturity, quality decreases rapidly. Although yield is lower than with material cut at the dough stage, digestible dry matter and protein concentrations are higher. Harvesting at this earlier stage of growth and higher moisture content requires additional equipment because the crop must be cut, conditioned, windrowed, and wilted to at least 70% moisture content before being picked up, chopped, and packed in the silo.

## Grass Silage

Improved hay and pasture grasses can be successfully ensiled. Due to weather and storage problems often associated with hay production, higher yields and better-quality forage may be obtained when grasses are harvested as silage, rather than as hay.

With good management, it is possible to harvest 8 - 10 tons of dry matter per acre per year from improved forage grasses. An early-spring application of nitrogen (N), phosphorus (P), and potassium ( $K_2O$ ) recommended from soil-test results will get the grass off to a good start. A supplementary application of 80 lb/A of nitrogen plus 40 lb/A of  $K_2O$  will be needed after each harvest on mineral soils because large amounts of plant nutrients are removed from fields when hay or silage is harvested. Therefore, the nutrient status of the soil should be monitored closely by taking soil samples each fall after the last harvest or when regrowth has slowed due to cool weather.

The first harvest can be taken when 14 - 16 inches of growth accumulates in the spring, with subsequent harvests about every four weeks. The harvest period for Floralta or Bigalta limpograss (*Hemarthria*) should be lengthened to five or six weeks, which will result in higher yields and only a moderate decrease in quality. A taller stubble height should be left in the field for limpograss (more than 4 inches), as compared to other grasses, which may be cut at a stubble height of 2 - 3 inches. Frequent harvests at a low stubble height may hurt the stand of limpograss. Bermudagrasses, stargrasses, bahiagrass, digitgrasses, and rhodesgrass decrease rapidly in quality when allowed to grow more than four to five

weeks. Good-quality silage can be made by cutting at four weeks and wilting to 60 - 70% moisture. If the grass is cut directly without wilting, use a silage additive to enhance fermentation.

## Legume Silage

Alfalfa, red clover, and other hay-type, cool-season legumes – either alone or in combination with grass – have some potential as silage crops. When harvested at the optimum stage of growth, these crops are high in protein and buffering capacity but low in sugar. Therefore, these crops need to be wilted to 60 % moisture to concentrate the sugars. In addition, a silage aid that improves lactic-acid formation such as ground corn, molasses or a lactic-acid bacteria inoculant should be added.

Summer-annual legumes such as aescynomene, hairy indigo, and alyceclover can be ensiled although these legumes are not particularly well suited as silage crops. The first harvest should be taken when the plants are 18 - 24 inches tall. The second harvest should be taken just prior to or at the early-bloom stage. When these plants are allowed to mature, they become woody and make low-quality feed. Wilting is important, and the use of a silage additive may be desirable.

Perennial peanut, annual peanut, cowpea, pigeonpea and forage soybean can also be ensiled. These forages should be wilted to 60 % moisture and stored after application of a silage aid that improves lactic-acid formation, such as ground corn, molasses or a lactic-acid bacteria inoculant.

## Moisture Determination of Silage Crops

### The Squeeze Test

The "squeeze test" for moisture may be used as a crude field test to determine when to start analyzing the moisture content of forages destined for silage production. After the grass has been in the swath for two to four hours under good drying conditions, run a small amount through the chopper. If a squeezed fistful forces free juice into your hand, and the ball holds its shape when pressure is first released, the forage is too wet.

When the forage reaches 60 - 70% moisture, the ball will momentarily hold its shape after squeezing and then gradually expand. There should be no free juice on your hand. This is the right moisture for chopping into silage. When the forage gets too dry, the ball will spring open and quickly fall apart when released.

The squeeze test is a crude guide for determining the optimal maturity for harvesting. This field test should be followed by more precise methods, such as oven drying. These tests involve weighing a forage sample, drying it in a traditional or microwave oven, reweighing the sample and using the weight difference to calculate percent moisture. See the guidelines below for details on this procedure. Alternatively, moisture content can be determined with a Koster moisture tester <http://www.kostercroptester.net>.

### Moisture Determination with an Oven

#### The Procedure with a Drying/Roasting Oven

It is necessary to determine the moisture content of a silage crop in order to know whether the crop is ready to be harvested and stored as silage.

Two pieces of equipment are needed - an oven and a small scale that weighs to 0.1 grams, such as a postage or kitchen scale.

Select one or more representative samples of the forage to be tested. Samples that have passed through the chopper are preferred. If whole plants are used, cut these into pieces 2 - 3 inches in length.

1. Set the oven to 135°F.
2. Record the weight of a suitable, oven-proof pan.
3. Accurately weigh 10g of forage into the pan and record the weight of the pan and the forage. This total is the wet weight.
4. Spread the forage into a thin layer in the pan to promote even drying.

5. Leave the forage sample to dry for eight hours or overnight.
6. Remove the pan containing the dried forage and reweigh. This weight is the dry weight.
7. Calculate moisture concentration using the equation below:

$$\% \text{ moisture} = \frac{(\text{wet weight} - \text{pan weight}) - (\text{dry weight} - \text{pan weight})}{(\text{wet weight} - \text{pan weight})} \times 100$$

### **The Procedure with a Microwave Oven**

For an explanation of this procedure, see EDIS Publication DS23, *Microwave Drying for Measurement of Forage Moisture*, <http://edis.ifas.ufl.edu/DS158>.



Table 2. Summary of Recommendations for Silage Crops in Florida

Crop	Planting dates <sup>2</sup>	Seeding rates (lb/A)	When to cut <sup>3</sup>	% Moisture as cut
Corn	S, Feb. 1 - Mar. 15 N, Feb. 15 - Apr. 15	As needed to provide more than 20,000 plants/A	Take samples to determine moisture content. When the kernel milk line is about 1/2 - 2/3 of the way down the grain. Cut at 65% moisture	65
Forage sorghum	S, Mar. - Jul. N, Mar. - Jun.	6 - 8 (in rows only)	When first seed heads reach soft-dough stage	70
Grain sorghum	S, Mar. - Jul. N, Mar. - Jun.	6 - 8 R <sup>4</sup> 10 - 15 BC	When first seed heads reach soft-dough stage	70
Sorghum-sudangrass	S, Mar. - Jul. N, Mar. - Jun.	8 - 10 R 24 - 30 BC	From boot stage until seed heads begin to appear; add preservative <sup>5</sup> 3 feet in height	80 - 70
Sorghum-sudangrass	S, Mar. - Jul. N, Mar. - Jun.	8 - 10 R 24 - 30 BC	From boot stage until seed heads begin to appear; add preservative <sup>5</sup>	80
Pearl millet	S, Mar. - Jul. N, Mar. - Jun.	8 - 10 R 24 - 30 BC	From boot stage until seed heads begin to appear; add preservative <sup>5</sup>	80
Rye	Nov. 15 - Dec. 15	100	Late boot <sup>6</sup> to early head	80 - 70
Oats	Nov. 15 - Dec. 15	100	Early-soft-dough to dough stage	70
Wheat	Nov. 15 - Dec. 15	100	Early-soft-dough to dough stage	70
Triticale	Nov. 15 - Dec. 15	100	Early-soft-dough to dough stage	70
Summer annual legumes	Apr. 1 - Jun. 30	---	Pre-flower <sup>6</sup>	80
Winter legumes (Alfalfa)	S, Oct. 15 - Dec. 1 N, Oct. 1 - Nov. 15	---	First flower <sup>6</sup>	80
Perennial grass	---	---	Take first cut when accumulate 14 - 16 inches growth then every 4 - 6 weeks <sup>6</sup>	75-80

<sup>1</sup> Use recommended varieties and fertilize according to soil-test recommendation.

<sup>2</sup> S = South Florida, N = North Florida.

<sup>3</sup> For maximum yield of digestible dry matter, with exception of sorghum-sudangrass harvested at 3-feet height.

<sup>4</sup> R = Rows; BC = Broadcast.

<sup>5</sup> Add citrus pulp or a lactic-acid-producing inoculant or another suitable preservative to improve the ensiling process.

<sup>6</sup> Wilt to 60 - 70% moisture; if moisture is lower than 60%, add a lactic-acid-producing inoculant or a suitable preservative.