DIVISION OF AGRICULTURE
RESEARCH & EXTENSION
University of Arkansas System

Agriculture and Natural Resources

FSA3053

Bagged Conventional Silage

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Introduction

Traditionally, silage production in the United States has consisted of precision-chopping a standing row crop (corn) or a swathed forage (alfalfa, red clover, small grains, etc.) and subsequently storing the chopped forage in tower- or bunker-type silos. During the last 20 years, high-quality plastics have been adapted to provide a new storage system for precision-chopped silage. In this system, silage is fed into a machine, often called a "bagger," that packs the silage into long plastic tubes, which serve as temporary silos.

Originally, most silage baggers were designed to handle forage discharged from self-unloading wagons. The system worked reasonably well for small to mid-size operators (usually dairymen) who owned their own silage harvesting equipment, typically a pull-type harvester and two or three self-unloading wagons. Some producers or entrepreneurs also purchased bagging machines specifically to rent them out to other producers on a per-bag basis. However, many custom harvesters, who often operate on a tonnage basis and have huge capital investments in equipment, were frustrated because these bagging systems were primarily designed for side-discharge wagons and they could not process the chopped forage nearly as fast as it could be harvested, thereby reducing their income potential. This was a particular problem with corn and sorghum silage, which can be harvested rapidly. In recent years, manufacturers have generally worked to accommodate the higher-capacity needs of many producers and custom harvesters. This has been achieved by increasing the size and diameter of silage bags, improving packing efficiency (more tonnage per unit time), reducing setup time between bags and improving compatibility with truck transport of silage. Many models available today are designed specifically to unload trucks (see Figures 1A and 1B). Smaller models are still available to meet the needs of small to mid-size producers who own side-discharge wagons.

Equipment Design

The original silage bagging machines generally operated on a fairly simple principle (see Figures 1A and 1B). Each bagger had two wire cables, one on each side of the machine, which were wound on large spools. (Some cables were made of woven straps or other materials, but the principle was the same.) These spools were connected to each other via a large internal shaft. To begin to fill a silage bag, the bag or "silo" was mounted on a large tunnel at the rear of the machine and the end was tied. This can be visualized as a large "sausage casing." A backstop was positioned immediately behind the

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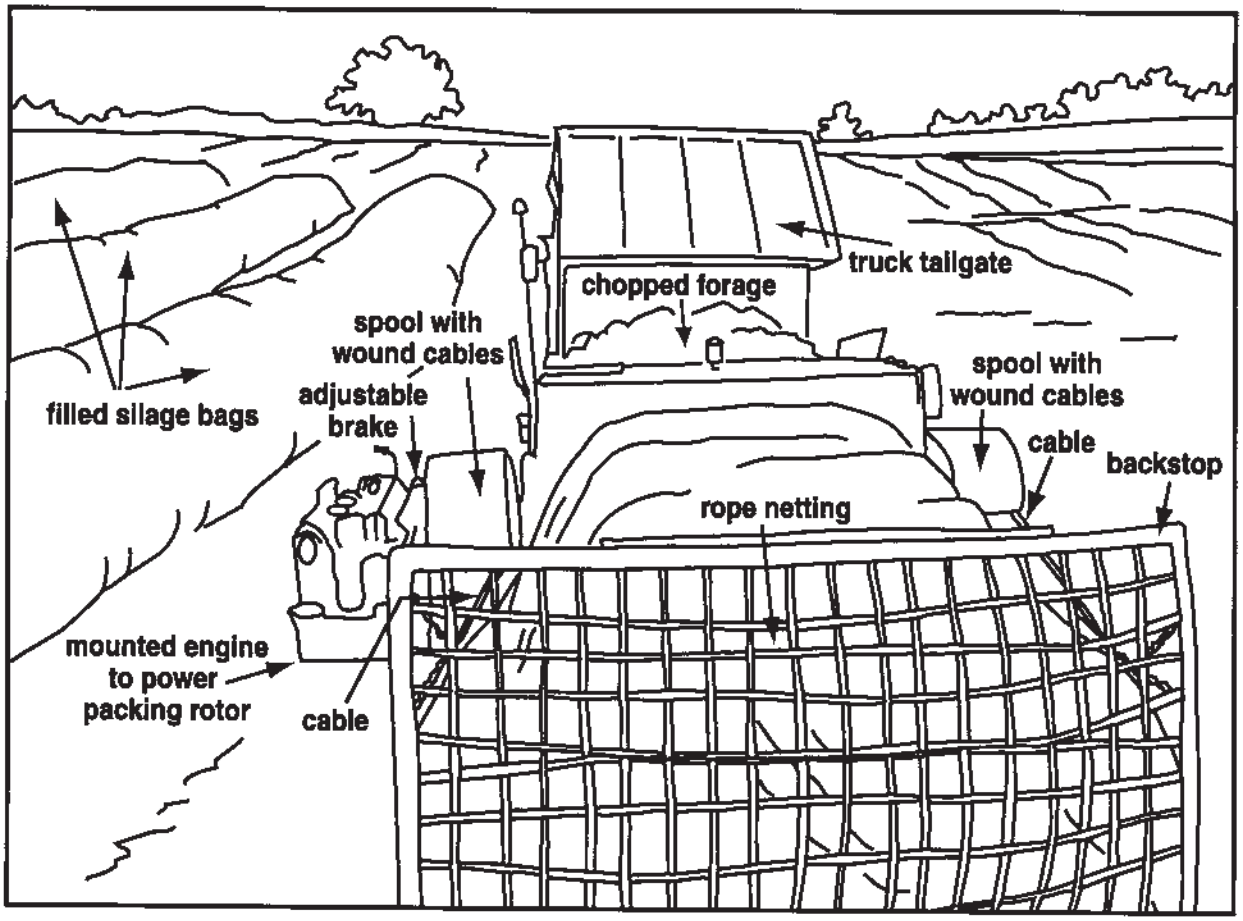
Figures 1A and 1B. Labeled pictures showing the various working parts of a typical silage bagging system (1A, rear view; 1B, side view) designed to process dump truck loads of chopped silage. The packing rotor (not visible) is powered by a mounted engine.

Figure 1A – Silage System (Rear View)

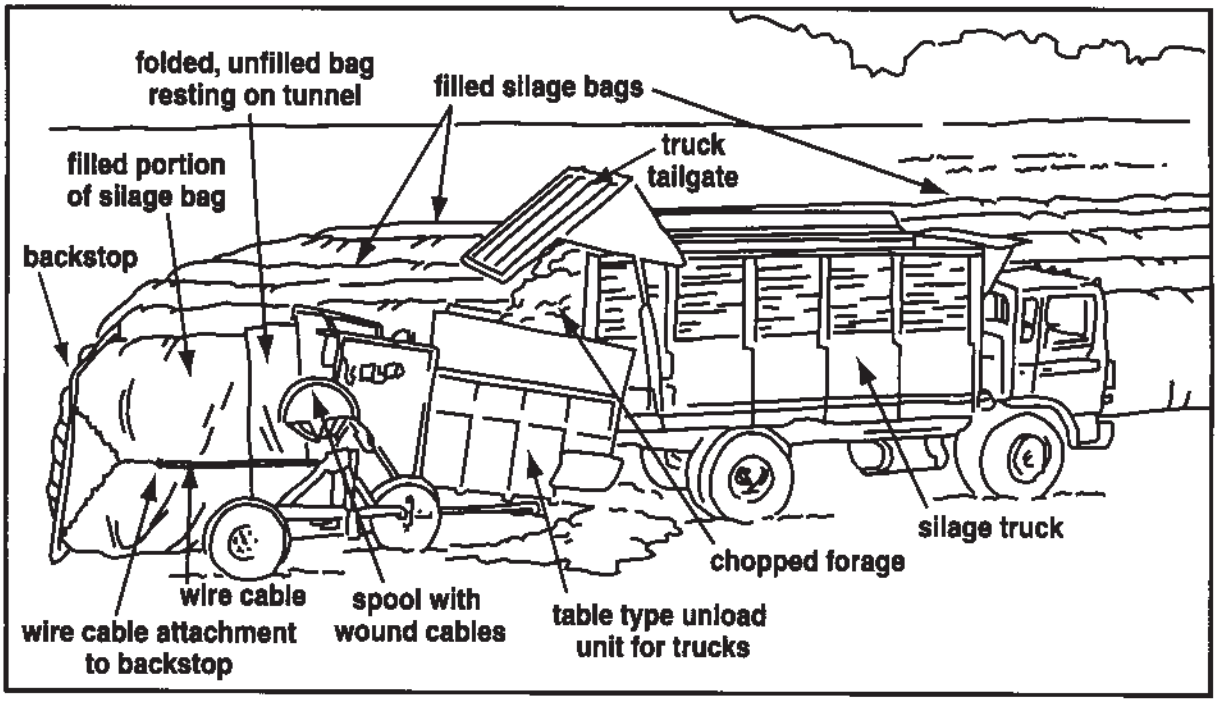


tied end of the bag, and the ends of the wire cables were attached to each side of the backstop. An adjustable braking system was mounted on one spool containing the wire cables. Pressure was applied to the braking system via a small pump. As chopped forage was fed into the machine, it was forced into the tunnel by a packing rotor. Pressure inside the bag increased because the forage was held in the rear by the backstop and in the front by the bagging machine and braking pressure against the cables. Pressure within the silage bag continued to build until it exceeded the capacity of the braking system to hold the cables. At this point, the bagging machine would creep forward as cable was slowly released. This process continued as the bag filled. When the bag or "silo" was full, the machine was pulled away from the filled bag and the open end was sealed.

With limited experience, operators learned easily to adjust the braking pressure against the cables properly and fill the bag correctly. The appropriate braking pressure varies substantially with forage characteristics. If too little braking pressure is applied, the bag will not fill to capacity. This increases both plastic costs per ton of silage and the probability that more air will be entrapped in the silage mass. Conversely, excessive braking pressure causes overfilling that increases wear on the machine and tension on the plastic silage bag. Wet forages must be packed under lower braking pressure to limit juicing caused by the action of the packing rotor and the production of effluent.

It is important to note that the power source for the packing rotor was often a hydraulic pump mounted on a tractor and powered by the power takeoff. Alternatively, the packing rotor on many newer models is powered by a separate engine mounted directly on the bagging machine. These mounted engines can range from 120 up to 475 horsepower and are generally found on higher capacity machines, which may pack up to 15 tons of silage/minute. Most models will pack silage at a third of that rate or less. A common misconception is that power takeoff-driven

Figure 1B – Silage System (Side View)



baggers are pulled or steered with the tractor. In reality, the tractor is pushed by the bagger, and some care must be used to ensure that the tractor is steered properly, thereby maintaining proper alignment in front of the bagger. Currently, the price of silage bagging machines ranges from about $15,000 for small machines to well above $100,000 for high-capacity models.

Description of Silage Plastic

The high-quality plastics used in silage bags today are the products of a generation of refinement. They are usually white on the outside and black on the inside. The white layer is designed to provide protection from ultraviolet light and to reflect sunlight, thereby reducing the temperature of the bag. The black inside layer gives the bag opacity. Some bags are made with only white plastics and are normally cheaper with a shorter manufacturer's guarantee against defects. The projected length of storage for the silage should be evaluated against plastic costs to determine which bag style is most appropriate. Most bags will carry a manufacturer's guarantee against defects for one to two years. These products are all reasonably durable and highly resistant to deterioration from weather and light; however, they will not withstand poor management and abuse. It is imperative that producers read and follow the recommendations of the manufacturer to properly fill and maintain silage bags.

Generally, silage bags are available in a wide range of diameters (6 1/2 to 12 feet) and lengths (100 to 500 feet). These bags have a wide range of capacities (Table 1). Bag costs will vary considerably with diameter and length. Commonly used sizes

Table 1. Estimated capacity of silage bags without tie-off. Source: Alberta Ag-Industries, Ltd.

Diameter	Length	Capacity
- - - - - - - - - - feet - - - - - - - - - -		$feet^3$
6.5	100	3,296
6.5	200	6,592
8	100	5,382
8	150	8,074
8	200	10,764
8	275	14,801
9	135	8,833
9	150	9,814
9	200	13,086
9	275	17,993
10	150	11,976
10	200	15,968
10	300	23,952
11	200	20,257
11	250	25,321
12	200	23,807
12	500	59,517

(8 or 9 foot diameter; 150 feet long or less) can usually be purchased for less than $300. Plastic costs per ton of silage will decrease as bags increase in length. The diameter of the silage bag must match the diameter of the tunnel mounted on the rear of the bagging machine. The length of the bag can vary, but the upper limit is set by the length of the wire cables on the bagging machine. Recently, manufacturers have attempted to change the basic equipment design to eliminate the need for wire cables and the backstop. With these designs, longer bags can potentially be used. The amount of specific silages that can be stored in each bag varies with forage species, dry matter content and bag capacity. A good rule of thumb for corn silage is 1 and 1 1/2 tons (wet basis) per running foot for 9- and 10-foot diameter bags, respectively.

Bag Maintenance

It is important to closely inspect the silage bags for holes regularly. Livestock should not be allowed access to silage bags. It is equally important to prevent smaller animals, such as dogs, cats, birds or other wild animals, from climbing on the silage bags and tearing holes in the plastic. Any holes should immediately be sealed with tape to prevent oxygen from entering the silage mass. Most manufacturers offer special patch tapes that adhere tightly to plastic silo bags and are weather and light resistant. Commonly available duct or masking tapes are not generally suitable for this purpose and will not provide a long-term seal. Weeds and other trash that potentially shelter rodents and other pests should be removed from the storage site. If several bags are to be stored at the same site, regular mowing or herbicide treatment should be used to control plant growth around the bags.

Rye silage has commonly been observed to put extreme pressure on silage bags. Bags of rye silage should not be overfilled, and the top of each silage bag should be watched closely for holes and tears. If tears are observed, they should be taped immediately and every possible effort should be made to feed or sell the silage as quickly as possible.

Immediately after filling, silage gases may accumulate within the bag. If this occurs, bags should be vented with a knife to release gaseous pressure and then patched with the appropriate tape. During feedout, some manufacturers suggest that silage should be back-bladed out of the bag before loading. This should help to reduce unnecessary pressure on the silage bags.

Advantages of the Bagging System

The major advantage of this silage system is flexibility. Forages of different types and qualities can be packaged in separate bags or in different parts of bags. Silage bags can be marked with paint or other permanent markers to show the location of various feed inventories. In tower or trench systems, forages leached by rain or that have heavy weed infestations must be included in the silo at the time they are harvested and then fed when that portion of the silo is reached during feedout. Because the diameters of silage bags are small (6 1/2 to 12 feet), most producers can easily feed and/or sell silage from two or more bags at one time and still maintain a fresh forage face in each bag. This allows producers more options as they try to match the quality of harvested forages with the nutrient demands of various livestock classes. While forages harvested between 50 and 70 percent moisture are the primary commodity stored in silage bags, other uses have also developed. These include, but are not limited to, high-moisture grains, dry grains and chopped dry fodder or straw for use as bedding in loose-housing facilities or dairy free stalls. Some manufacturers offer special products to meet the specific needs of these niche uses.

Generally, these systems do a good job of packing silage and have a small layer of surface exposure to the air during silo filling, relative to a trench or large tower silo. This may allow small producers, who do not have the resources to harvest forages rapidly, a more effective method of excluding air from the silage mass during silo filling. Extended periods of inclement weather also can have a very detrimental effect on silage quality when they occur during silo filling. This is a particular problem in trench- or bunker-type silos that often remain uncovered until the filling process is complete. With the bagging system, comparatively little forage surface is exposed and the corresponding effects of prolonged inclement weather are potentially reduced.

The availability of high-quality tapes also provides the silage bagging system with a distinct advantage over tower or trench silos. Silage samples can easily be removed from small knife slits in the side of each bag several weeks before feeding. These samples can then be analyzed for forage quality and appropriate rations can be developed weeks before feedout or cash sale. After sampling, the knife slits should always be taped securely with the appropriate patch tape to prevent air access.

Bag Placement

Bagging systems work best on concrete or asphalt; however, few producers have slabs of either surface large enough to store even one bag of silage. Crushed gravel will also make a good base for silage bags; however, any surface should be carefully inspected for sharp or protruding objects that could slice or puncture the silage bags. Most producers place bags on hard-packed, relatively flat, but well-drained sites that can be easily reached in wet weather. Many are placed along access roads or farm lanes, but other producers dedicate large areas to side-by-side silage bag storage.

Ruts caused by loading silage in wet weather can cause serious problems for producers and can damage expensive loading equipment, particularly when they freeze solid. When cold freezes follow wet weather, producers will benefit by leveling any ruts with the underside of a loader bucket at the end of each day, thereby creating a flat, frozen surface to work on the next morning. If substantial silage inventories are to be stored in silage bags, producers should seriously consider investing capital in a quality front-end loader. Options such as four-wheel-drive, high dumping height or a variety of silage attachments for the loading bucket may be well worth the money.

In some areas, the topography may not be flat and it may be necessary to place bags on gentle sloping sites. Positioning silage bags parallel with the slope may aid the drainage of precipitation around the bags. However, loading silage during wet weather will require equipment to be driven and operated by moving straight up and down the slope, which can be extremely difficult, particularly without four-wheel-drive. Placing bags perpendicular to the slope will partially eliminate this requirement, but it may also restrict drainage, much like a terrace.

Summary

1. High-quality plastics offer flexible temporary storage of forages. Bags or parts of bags can be labeled to show the location of specific feed inventories. The quality of specific forages can then be matched closely with the nutrient demands of specific classes of livestock.
2. Silage bags are available in a wide range of diameters and lengths. However, the size of the silage bag must be compatible with the design and characteristics of the bagging machine.
3. Silage bags should be closely inspected for holes and tears. Any damage to the silage bags should be repaired immediately with special patching tape. Storage sites should be kept free of weeds and trash that could potentially harbor rats or other pests. All animals should be kept away from silage bags.
4. Silage bags may be used to store silages, bedding materials or high-moisture grains.
5. Some planning should be used in selecting storage sites that can be reached during wet weather.

Acknowledgments

The author wishes to acknowledge the contributions of Alberta Ag-Industries, Ltd., Westlock, AB, Canada; Ag-Bag International, Ltd., Warrenton, OR 97146; and Versa Corp., Astoria, OR 97103, for contributing information used in this report. Use of such information does not constitute an endorsement of these products over others that may perform similarly by the author, the University of Arkansas, or the University of Arkansas System Division of Agriculture Cooperative Extension Service. The author also thanks Judy Howard, former graphic designer/project manager, Communications Services, Department of Agricultural and Extension Education, University of Arkansas, Fayetteville, for developing the figures used in this report.

Acknowledgment is also given to Dr. Wayne Coblentz, former associate professor and Extension livestock specialist - forages, as original author of this fact sheet.

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FSA3053-PD-12-2017RV