This article was presented on
June 22, 2000 at the Purdue Forage Day.

WHAT WE'VE LEARNED ABOUT STORING FEED IN BAGS

Cecil Koons
Agri-King
West Lafayette, IN

Michael Schutz, Ph.D.
Dept. of Animal Sciences
Purdue University,West Lafayette, IN

At the Purdue University Dairy Research and Education Center, silage bags were tested, but were used extensively beginning in 1999. To date, bags have been used primarily to ensile alfalfa silage, but have also been used for wheat silage, triticale silage, and wet corn gluten feed. For the most part, results have been good, but there are a few things we've learned along the way that may be of interest for farms considering the use of silage bags or even ones that have used them in the past.

Background

In the Midwest, using silage bags for silage storage has become popular for expanding dairy farms. Silage bags offer several advantages over upright concrete silos and bunker silos:

- Lower initial investment cost is especially appealing to producers who are investing in dairy expansion projects and want to invest more of their capitol in herd housing and for purchasing cows. A comparison of investment costs of silage bags and other silage storage methods is in Table 1.

Table 1. Initial investment costs for silage storage in three herd sizes. [source: Holmes, U of WI, 1995]

Storage Capacity	Concrete Upright Silo	Concrete Bunker Silo	Silage Bags
55 cows 1,097 ton[1]	$73,825	$58,525	$33,895
110 cows 2,194 ton[1]	$105,985	$78,945	$40,715
219 cows 4,389 ton[1]	$202,345	$135,603	$54,355

[1]As fed. Assumes 65% moisture content. Based on 7.0 ton forage per year per cow with replacement.

Table 2. Total annual costs for silage storage in three herd sizes. [source: Holmes, U of WI, 1995]			
Storage Capacity	**Concrete Upright Silo**	**Concrete Bunker Silo**	**Silage Bags**
55 cows 1,097 ton[1]	$17,502	$17,290	$14,703
110 cows 2,194 ton[1]	$27,755	$28,219	$24,322
219 cows 4,389 ton[1]	$53,702	$53,027	$43,562
[1]As fed. Assumes 65% moisture content. Based on 7.0 ton forage per year per cow with replacement.			

- Lower total annual costs (see Table 2).
- Much of the investment is in machinery that can be sold if plans change.
- Lower storage losses due to spoilage, especially compared to bunker silos or silage stacks.
- Generally higher quality silage when a bag is filled and stored properly.
- Reduced risk to employees. Upright silos have inherent risks of falls and bunker silos and stacks posed rollover risks when packing. Also, there is less risk of poisonous gas or harmful molds than for upright silos, because of less spoilage and much improved ventilation around bags.

At the Purdue Dairy Research and Education Center, the decision to use silage bags was made for the above reasons and because of the difficulty of removing hay silage from the upright silos, maintaining silage quality, and retaining effective fiber length. The decision was made to expand silage storage by using the existing upright and bunker silos for corn silage and to store all alfalfa, wheat, and triticale silage in bags. More recently, wet corn gluten feed has been stored in silage bags to prevent spoilage. Previous storage of corn gluten in a bunker led to a great deal of spoilage and feed loss with this very wet feed.

There are a few disadvantages to using silage bags. Among them are the importance of pest control to prevent the bags from damage, containment and disposal of plastic when silage is removed from the bag, and the capacity of the bagger to keep up with silage harvesting equipment. With careful planning, all of these obstacles can be overcome.

Our Experiences with Storage

It is important to pick a **suitable location** for the storage bags. Obviously, one would wish to keep them relatively close to the feed center on the dairy farm. However, care should be taken in selecting an area that has adequate drainage, easy access for bagging equipment, forage wagons, skid-loader for silage removal, and TMR mixer wagon. Keeping the bags away from other feed sources may reduce damage from birds and rodents. Even wandering cows have been known to break open a silage bag for an early morning snack.

The **surface area** selected for storage of silage bags will have a large impact on silage quality and ease of feeding from the bag. Based on our limited experience at Purdue, we would rate the surfaces as follows:

1. Concrete Pad. Provides excellent surface for silage bag, easy removal of feed with little or no damage from skid-loaders, can achieve exceptional drainage of water away from bags, discourages pests and makes inspection for damaged bags very easy.

2. Asphalt surface. Less expensive than concrete. Has most of the same advantages of concrete, except that the surface may not be as durable against damage from a skid-loader. Precautions to maintain surface include using larger aggregate, increasing content of binder, and avoiding loading feed during the hottest hours on summer days. [Potential for toxicity from asphalt and damage from silage acids have limited the use of asphalt in bunker silos, this should not be a problem for storage of silage bags, since the silage is enclosed in plastic.]

3. Crushed rock. Initially, this appears to be a good surface for filling and placing the bags. Weed and pest control is quite good. However, feedout can be difficult. The crushed rock surface does not support skid-loader traffic very well, and small stones frequently are mixed in the TMR. This wears on TMR mixers and cows teeth!

4. Dirt surface. This can work reasonably well if there is adequate drainage away from bags. Weed control must be practiced and it is very helpful to have a second location of silage for use when it is extremely wet, especially in spring.

Our Experiences with Filling Silage Bags

Packing the silage bag correctly is the most important factor that will effect silage quality.

1. Select a good bag. There are a number of good silage bags available; Ag Bag, Agri-Pac, and Up North are several brands available in Indiana. Most come equipped with stretch lines to indicate when the bag is filled properly. Be sure to ask for the manufacturer's recommendations for proper filling of the bags.

2. Adjust for varying moisture levels. For most silage crops, the goal is 65-70% moisture. If moisture levels are higher, then reduce the packing pressure to avoid creating mushy, oozing silage, or better yet, shut down and wait until the forage is drier. If moisture levels slip below 65%, it will be difficult to distribute the silage throughout the bag. In this case, increasing the packing pressure can help. Follow the suggestions of the packing machine's manufacturer.

3. Monitor particle length. A shorter chop length of 3/8-inch will pack better, but may not retain enough physical fiber for the ration. It is possible to successfully pack bags with forage as long as 3/4-inch chop length, but moisture levels must be monitored. Checking particle length with a forage particle separator allows adjustment of chop length before filling other bags.

4. Fill rapidly and pack uniformly. Each bag should be filled in one or two days at maximum. This is needed to maintain forage consistency. Usually, baggers can keep up with forage harvesting equipment quite well. A bagger for a 9-foot bag can pack as much as a ton of silage per minute. The silage must be packed as densely as possible to avoid air pockets that can interfere with proper fermentation. Air pockets can develop more frequently when longer chop lengths are used. Fourteen pounds of dry matter per cubic foot is a good goal.

5. Don't over-fill bags. Most bag manufacturers provide recommendations on how full bags can be filled. Some provide stretch lines as gauges right on the plastic bag. Measuring the distance between the outsides of these lines will give an indication of when the bag is full or over-filled. One can also measure the circumference of the bag from the ground on one side, over the top of the bag, and to the ground on the other side. Table 3 has some expected fill sizes for Ag Bags. Again check with manufacturer recommendations.

6. Seal tightly. Several methods can be used to seal the bags. Perhaps the best method is to stretch the remaining plastic as far as it will reach, then place a board on the plastic and wrap it around the board back toward the bag, like re-sealing a bag of potato chips. One can then hold the plastic in place with a heavy weight, by laying a mound of sand between the seal and the silage in the bag, or simply by nailing another board to the one used to wrap the end of the plastic bag. Most importantly, just be sure the end of the bag has a seal that is and will remain airtight.

7. Venting gasses. Follow the manufacturer's recommendation for adding vents to the bag to allow gasses to escape. Remember that these gasses are poisonous.

8. Inspect frequently and seal holes at once. Damage can happen for various reasons. Birds, rodents, and other animals can puncture the plastic. This lets air in the bag and can result in spoilage. Children and cattle can do the same. Punctures should be repaired with a tape recommended by the manufacturer.

Duct tape is not airtight and is not the best choice for making repairs. More damage can be repaired with paint-on materials and sealants. If damage is extensive, like that which would result from a hailstorm, the silage may need to be re-bagged as soon as possible.

Wrap-up

At Purdue University, silage bags have become a cost-effective and simple way of handling and storing alfalfa, wheat, and triticale silages. Several precautions are needed to assure that the handling remains effective and simple. Careful thought should be given to locating the bags in a suitable location, harvesting at proper moisture levels, and packing the bag carefully to prevent air pockets and encourage optimal fermentation.

Table 3. Ground to ground circumference measurements for Ag Bags [source, Russ Kuehl, Knowles Produce and Trading]

Bag Diameter	Measurement (feet)
8 foot	19.5
9 foot	20.5
10 foot	21.5
12 foot	27