CHAMPION Feed Services Ltd.

How To Make Barley Silage

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Take Home Message

- ✓ Making barley silage is the process of taking green wet whole plant barley and processing it in such a way that it can be stored for future use in the livestock operation.
- ✓ When the whole plant barley is stored, bacteria ferment plant sugars to produce acid.
- ✓ Proper acidification occurs when there is no oxygen present.
- ✓ If done properly, this process occurs easily and with little spoilage.

The Ensiling Process

It is easier to understand why we must do things when making silage if we first understand the ensiling process. There are two main stages in the ensiling process:

1) The first is the aerobic stage which occurs in the presence of oxygen (air). When the plant material is first put in the silo there is oxygen present. Bacteria use this oxygen and the plant sugars to produce carbon dioxide and heat. This heat can raise the temperature of the plant material and cause the production of butyric acid and ammonia which lowers the quality of the feed, and in extreme cases heat damage can reduce the digestibility of the plant protein. There is a myth in the industry that the silage must heat in order to be good silage - this is not true. The less heat and the shorter the aerobic stage of the ensiling process the higher the quality of the silage. This stage can be shortened by rapid silo filling, good packing and covering the silo quickly and effectively to eliminate the oxygen from the pit.

2) The second stage is the anaerobic or fermentation stage which begins once the oxygen is used up during the first stage. Microorganisms use the plant sugars to multiply and produce lactic acid which lowers the pH of the silage. This fermentation process is completed in 3 - 4 weeks. Barley cut for silage has adequate supplies of lactobacilli present to successfully ferment the plant material. If conditions are not favourable for the lactobacilli organisms, clostridial type

microorganisms utilize the plant sugars to produce butyric acid. If this type of fermentation takes place the quality of silage is greatly reduced. Plant sugar (water soluble carbohydrate) levels in whole plant barley are very high at the milk to soft dough stage. A minimum level of 6 - 12% plant sugars are needed to effectively ensile a forage. Barley has plant sugar levels of 24 - 32% under normal growing conditions, depending on the stage of cut. Plant sugars increase up to the milk stage and then begin to decrease. This high level of plant sugars make barley a very easy crop to ensile.

Barley Agronomy

Choose a barley variety which is high yielding and has some lodging resistance (see **Selecting Crops and Varieties for Silage**). Barley for silage should be seeded at 75 - 100 lbs/ac, using the higher rates for high moisture or irrigated areas. Delayed seeding of some fields or choosing early or later varieties may be necessary to prevent the possibility of all the fields being ready to harvest at the same time. This will depend on the number of acres seeded for silage and the size of the harvest equipment available. Barley is very responsive to nitrogen fertilizer and high rates of nitrogen will produce high yields of barley silage. Too much nitrogen fertilizer may cause the barley crop to lodge which will affect yield and be difficult to harvest.

Harvest should begin at moisture contents above 65% and the crop allowed to wilt to the desirable moisture level, which is 60 - 65% for pit or bunker silos. Use the microwave oven method (see Silage Manual - Alberta Agriculture Agdex 120/52-2) for determining the exact moisture of the silage or use the hand method for an estimated moisture content (table 1).

Table 1. Hand Method For Estimating the Moisture Content of Silage[1].

Silage squeezed in the hand	Moisture (%)
Water squeezed out and material holds shape	more than 80%
Water can just be squeezed out and material holds shape	75 - 80%
Little or now water squeezed out but material holds shape	70 - 75%
No water can be squeezed out and material falls apart slowly	60 - 70%
No water can be squeezed out and material falls apart rapidly	less than 60%

[1]Silage Manual - Alberta Agriculture Agdex 120/52-2.

Figure 1. Changes in moisture level with growth stage of barley, oats and triticale.

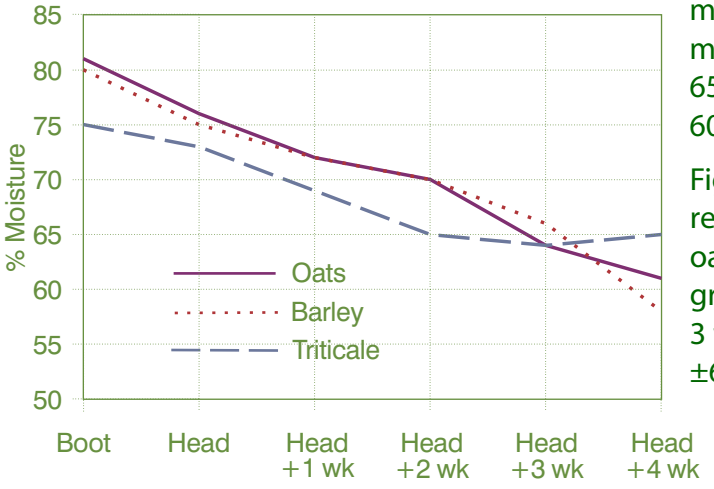


Figure 2. Increasing yield with advancing maturity of barley, oats and triticale.

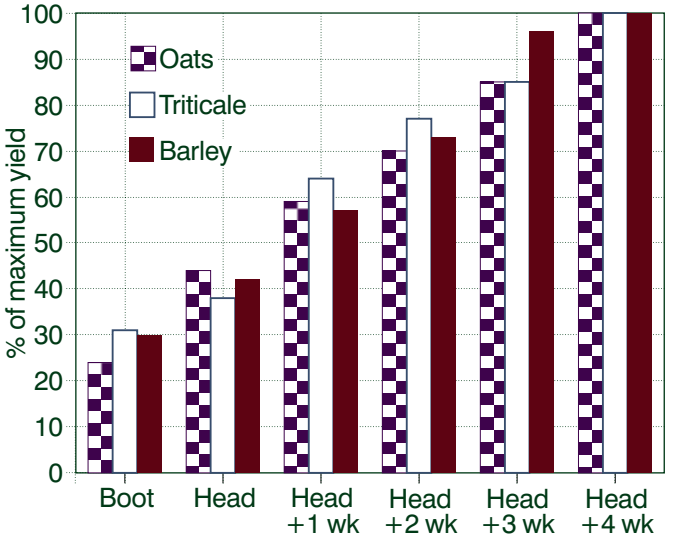
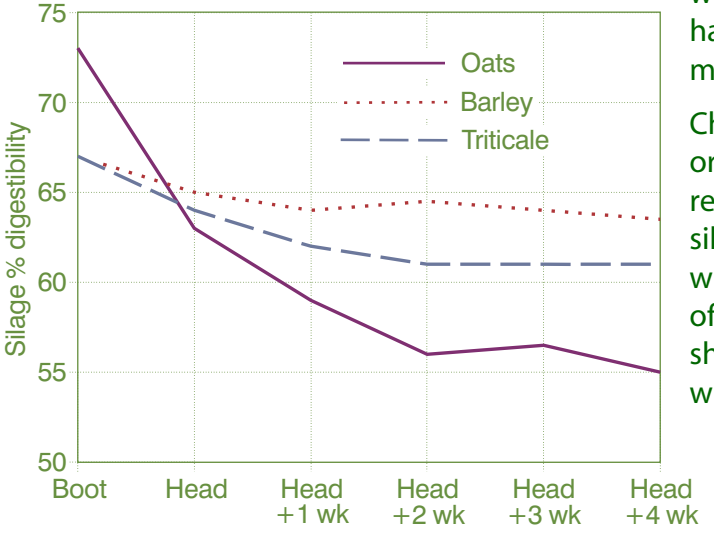


Figure 3. Effect of growth stage on digestibility of barley, oats and triticale silages.



Upright silos may require lower moisture levels as recommended by the manufacturer. Generally barley at 70% moisture is in the watery dough stage, at 65% moisture is in the early dough and at 60% it is in the soft dough stage.

Figures 1, 2, and 3 show the moisture, relative yield and digestibility of barley, oats and triticale at different stages of growth. Barley harvested at heading plus 3 weeks will produce a silage which is ±65% moisture, with a digestibility of ±63% and produces approximately 96% of it's maximum yield.

Notes for figures 1,2 & 3:

Oats and triticale reached the heading stage in 69 days; barley in 63 days.

Maturity was as follows:

Oats - Heading plus 2 weeks was medium milk, heading plus 3 weeks was late milk and heading plus 4 weeks was the early dough stage.

Triticale - Heading plus 3 weeks was early milk and heading plus 4 weeks was the watery dough stage.

Barley - Heading plus 2 weeks was watery dough, heading plus 3 weeks was early dough and heading plus 4 weeks was the soft dough stage.

Cereals are considered to be headed when 50% of the heads on the main tillers have cleared the boot. These stages of maturity may vary from year to year.

Chopping silage at moisture levels of 65% or less will improve the fermentation, reduce the amount of seepage from the silo, reduce freezing problems in the winter and may increase dry matter intake of the animals being fed. The chopper should be set to cut the barley at ½ inch with silage at 60 -65% moisture.

This will allow the silage to be packed sufficiently in a pit or bunker silo. At lower moisture levels the barley should be cut shorter to allow proper packing, and for higher moisture barley it may be cut longer.

Silage Storage

The main goal in making silage is to remove and exclude air from the forage mass. In an upright silo this is done by the weight of the silage moving the air upwards and out of the silage. In silage bags the air is forced out, as the silage is packed into the bag. In a horizontal silo this air must be removed by packing. This is done by driving a heavy tractor over the silage as it is layered into the silo.

Horizontal silos should be filled and packed in layers. After each truckload of silage is dumped in the pit, the silage should be pushed up into the pit and packed thoroughly in layers. Packing should be done immediately and the surface should feel firm to walk on. If you sink up to your ankles or if the silage feels spongy, it will need more packing. Silage that is too dry will not pack well unless it is chopped short. Higher moisture silage is easier to pack, but if the moisture is too high (>65%), the silo will seep and nutrients will be lost.

Once the silage has been effectively packed, the plant material will go through the aerobic stage of fermentation and the oxygen still present will be used up. If the silage is disturbed it will reintroduce more oxygen into the silage which may cause spoilage.

Immediately after the horizontal silo is filled, it should be covered with a six mil silage grade plastic covering. This covering will prevent air and rainfall from entering the pit which will cause spoilage. The plastic should be held down with old tires, chopped straw or some other material to prevent it from flapping when the wind blows, which will reintroduce air into the pit or possibly tear the plastic. The spoiled silage on the surface of an uncovered pit is estimated to be worth more than six times the cost of the plastic.

The temperature of the silage during ensiling is an indicator of the success of the silage making operation. The following adjustments should be made if the silage temperature exceeds 40°C (100°F):

- Harvest the crop at a higher moisture content;
- Reduce the length of chop so the packing will be more effective;
- Pack the silage more to exclude air.

Table 2 summarizes criteria forthe evaluation of silage.

Conclusion

Barley silage is an easy crop to ensile. The high level of plant sugars which the crop contains make it a very forgiving crop to ensile. As long as the crop is chopped, packed and covered quickly it will generally ensile to the desired pH of 4.2 -4.5. For more information on silage crops and silage making see the Silage Manual - Alberta Agriculture - Agdex 120/52-2.

Table 2. Visual and pH Evaluations of Silage

Silage Characteristics	Good Quality	Intermediate Quality	Poor Quality	
			Poorly Fermented	Overheated
Colour	Bright, light green-yellow or green-brown depending on material ensiled	Yellowish green to brown-green	Very dark green, blue green, grey or brown	Brown to black
Smell	Lactic acid[1] odour with no butyric acid[2] odour	Slight butyric acid and ammonia[3] odour	Strong butyric acid, ammonia and rancid odour	Burnt sugar or tobacco smell
Texture	Firm, with soft material not easily rubbed from fibre	Softer material can be separated from fibre	Slimy, soft tissues easily rubbed from fibre, mouldy	Dry, easily broken when rubbed, mouldy
Moisture	60-70% for horizontal silos	Tends to be above 65%	Usually over 70%	Usually less than 55%
pH	Below 4.2 for wet crops and below 4.8 for wilted crops	4.6 to 5.2	Over 5.2	pH is not a reliable guide
Causes and Remedies:				
Cause	N/A	Too much moisture, not enough plant sugars	Too much moisture and insufficient plant sugars	Too little moisture, poor packing, poor sealing.
Remedy	N/A	Poor fermentation may be corrected by ensiling at a lower moisture or sealing silo quickly	Wilt in field or use microbial additives, seal silo quickly	Pack silo more effectively, shorter chop, seal silo quicker, ensile at a higher moisture, fill silo quicker, and seal if delayed

[1]Lactic acid odour is similar to that of sour milk.
[2]Butyric acid odour is similar to that of rancid butter or fat, putrid.
[3]Ammonia odour is similar to that in some household cleaners or anhydrous ammonia.
Reprinted from the Silage Manual - Alberta Agriculture, Agdex 120/52-2