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Field Corn Harvest Recommendations for Idaho

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Introduction

FIELD CORN (*Zea mays*) is grown on approximately 300,000 ac along the Snake River Plain in southern Idaho (United States Department of Agriculture-National Agricultural Statistics Service 2018). Approximately 25% is grown for either high moisture corn or dry grain (USDA-NASS 2018), with the remainder intended as silage or high moisture ear corn (HMEC) known as earlage or snaplage.

Field corn is a warm-season crop that requires irrigation in arid climates such as southern Idaho and, depending on the final use, requires at least 150 days of frost-free growing conditions to reach harvest maturity (Sprague and Dudley 1988). Because corn grown for grain needs additional time to dry in the field, planting dates in southern Idaho range from the middle of April to the first week of June, depending on end use and location. Seeding depth at planting should be 1½"–2" deep in most soils, with the soil temperature at least 50°F or warmer. Any temperature below that rarely supports germination (Roozeboom et al. 2007). Successful plant populations range from 36,000 to 42,000 plants/ac depending on end use, according to previous University of Idaho corn variety trails. For silage corn, harvest occurs from the end of August to mid-October. Grain corn is harvested from late October to as late as the next calendar year, depending on end use and weather.

The purpose of this publication is to discuss field corn harvest recommendations for Idaho, including how to maximize yield in the field at harvest and while maintaining feed quality in storage. It is not intended as a corn growers' guide, nor does it address sweet corn, although the latter is grown commercially in the western part of Idaho on relatively small acreages. Sweet corn is grown for food or seed and is not grown together with field corn. This is a timely discussion, not only because Idaho

Figure 1. Cross section of a corn ear, showing approximately ½–⅔ milk line.

Figure 2. Corn for silage being harvested by a self-propelled forage harvester.

corn is used for livestock feed but also because most Extension corn agronomy publications concentrate on the Corn Belt region. While the agronomy of raising corn in the two regions is similar, Idaho's harvest recommendations and timing differ. The state's climate and other regional considerations present significant complications, including the fact that Idaho livestock feed producers operate at higher elevations (about 4500 ft on the eastern side to about 2500 ft on the western).

Silage

Most of the corn grown in Idaho is grown for use as silage (USDA-NASS 2019). Corn silage is a major feed source for the dairy and beef cattle industry in southern Idaho. Silage is harvested when the aboveground crop whole plant moisture (an oven test that determines the proper timing for harvest) rests between 65% and 70%, depending upon storage method (University of Wisconsin-Madison Extension, "Harvesting and Storage"), ideally about 68%. The target for harvest maturity varies among producers and their livestock nutritionists. Milk line (the line in the kernel that separates hardening starch with wet starch) is the most common method to estimate harvest readiness (Figure 1).

To evaluate corn based on this method, break a cob in half and look down at the tip half of the cob. If you look at the butt half instead, you will see embryo, not the milk line. Starch hardens from the top hull of a kernel in toward its tip, meaning the milk line advances toward the tip. A ½–⅔ milk line stage equals approximately 66% plant moisture (UW-ME, "Harvesting and Storage"), a level that indicates the corn is ready for harvest. If a producer has many acres of corn to harvest, planting different day-length varieties can help to keep the corn near the ideal moisture when harvest crews finally get to those last locations.

Using a forage harvester, crews first cut and chop the corn silage, blow it into trucks, and then haul it to a storage location (Figure 2), where they put it into bunkers, pits, drive-over piles, or plastic bags for fermentation. (Tower silos are rarely used in Idaho due to the volume of silage stored on large livestock operations.) The forage harvester should be adjusted so that the corn is cut into approximately ⅜"–½" in length (chop length) for unprocessed corn and ¾" in length for processed corn. Regarding the latter, most forage harvesters have kernel processors, which crack open or crush the kernels and cob pieces so that they become more digestible. (The goal of processing is to crack at least 70% of the kernels.) Lastly, crews unload the silage at the storage location, use tractors to push the chopped forage back into a bunker or pile, and then drive over it continuously to pack it. A packing tractor can efficiently pack its weight of silage in an hour and should build no more than a 6" layer at a time.

Packing is part of a multistep harvesting process, one that is critical to good silage formation and quality storage. First, growers must have enough packing equipment to meet the incoming silage volume (Figure 3). The minimum packing density goal for any operation is 14 lb of dry matter (DM)/ft3, but southern Idaho corn harvesters struggle to meet that standard. In 2008–9, University of Idaho Extension conducted a silage density study across southern Idaho and determined that producers on average were just meeting the 14 lb minimum. The study concluded that about half of the piles or bunkers are insufficiently packed, which creates larger storage losses. Second, maintaining quality harvested corn requires airtight storage. After adequately packing the silage, crews cover it with impermeable material like plastic to prevent spoilage. Another option is to place the silage into long plastic bags. This method is referred to as "bagged silage." Most livestock operations have discontinued this practice due to concerns about the space it requires and the plastic waste it incurs (of single-use bags).

Crops harvested when they are too dry inhibit proper packing, which leads to dry matter loss, poor fermentation, and molding while in storage. Crops harvested when they are too wet, particularly corn harvested above 70% moisture, suffer too. Excess dry matter losses, due to seepage of highly acidic/corrosive liquids, and other fermentation problems can develop. Growers thus need to be very particular when timing their harvesting operation.

Good packing, no matter the storage method, removes oxygen and allows anaerobic bacteria to begin breaking down the corn's carbohydrates, sugars, and cellulose into lactic acid, acetic acids, ethanol, carbon dioxide, and other products (UW-ME, "Ensiling"). Several management practices, in addition to excluding air, can help meet silage quality objectives, such as adding inoculants during harvest which aide in rapid fermentation and growing several different day-length varieties, which will help to ensure the corn is cut at the proper moisture. (For a good discussion of silage additives and inoculants, see UW-ME, "Harvesting and Storage.")

Do not feed silage until it has fermented for 3–4 months (Amaral-Phillips n.d.; Ward and De Ondarza 2010). Maximize feed quality by making piles or bunkers of a size where you can remove the entire face of the silage each day. A good rule of thumb is to remove and feed 6" off the entire face every day. When you remove a silage pile's protective cover and open the face, you reintroduce oxygen into the system, enabling aerobic microorganisms to feed on the same starch the cattle will eat. Their active presence removes valuable feed components. Losses can be quite substantial, particularly if large amounts of silage are exposed and left unfed, or if the pile is opened at different locations.

High Moisture Ear Corn (HMEC)

High moisture ear corn, also called earlage or less commonly snaplage, includes the corn grain, cobs, husks, and sometimes portions of the stem of a corn plant. The common harvest method for HMEC is to use a snap roll header from a combine attached to a forage harvester, which removes and chops the ear components, leaving the remaining stover in the field (Figure 4).

HMEC is harvested a few weeks to a month after silage corn in Idaho and is typically stored in the

Figure 3. Two large packing tractors are needed to pack down a silage pile because significant machine weight is critical to ensure good quality silage.

Figure 4. Corn ears are picked and chopped by a forage harvester before being piled and packed as high moisture ear corn.

Figure 5. Black layer present at the tip of a corn kernel. Black layer indicates the physiological maturity of a kernel.

same fashion as silage—either in piles, bunks, or airtight plastic bags. The ideal kernel moisture for earlage is between 28% and 32% (UW-ME, “High Moisture Corn, Ear Corn, and Snaplage”). The presence of black layer (a black line) is a good indicator of harvest readiness. Its formation indicates that the corn grain has reached physiological maturity, quantified as approximately 32%–36% kernel moisture (Fiez 1984). Black layer appears when the cells at the tip of a kernel die, forming a distinct dark-colored layer (Figure 5) that specifies the grain has finished developing, starch deposition is complete, and the kernel can no longer take up moisture.

Like silage, earlage must be packed tightly in a storage area to prevent losses of total digestible nutrients (TDN) or seepage. Inoculants and other additives may be added to ensure the earlage is properly fermented, much like silage. The HMEC has more energy in terms of feed (TDN) than silage due to high grain content but it has less energy as feed compared to high moisture corn or dry corn grain feed.

There are several advantages to harvesting corn as earlage rather than grain. It allows a high-energy crop, if the corn dries too much for silage; there are no drying costs; dry-matter yields increase; it is harvested earlier than grain; it provides increased yields due to the use of longer-season varieties; it supplies a viable/palatable feed source for cattle; it offers cattle a longer grazing time on residue; and its residue remains on the soil, improving erosion control.

High Moisture Corn (HMC)

University sources vary on the definition, but high moisture corn is grain harvested somewhere above 22% grain moisture. The ideal harvest kernel moisture for HMC is 24%–33%, similar to HMEC (UW-ME, “High Moisture Corn, Ear Corn, and Snaplage”; Lardy and Anderson 2016). The difference between HMC and HMEC is the harvest method: HMC requires a combine for its removal. After harvest, crews must immediately grind or roll and then ensile the grain in either bags, bunkers, or drive-over piles (Figure 6).

An HMC harvest can begin any time after the corn reaches physiological maturity, indicated by the formation of a black layer at the tip of the kernel where it attaches to a cob. Depending on the hybrid, grain will be in the low 30% range for moisture at black layer. An HMC harvest in Idaho takes place from the end of September in the southwest part of the state to the end of October in the south-central section. Grain hybrid relative maturities should not exceed 110 days in the southwest and 100 days in the south-central region. Indeed, frost can kill long-maturity varieties before they reach proper harvest maturity.

Although HMC is similar to dry corn in feed value, it offers many advantages. A major benefit is earlier harvests and fewer winter harvests, typical of dry corn grain farming. The earlier harvest schedule creates other favorable effects. Livestock feeding facilities do not have to invest in additional bins or barns to store dry grain. Producers can grow later-maturing hybrids with higher-yield potentials,

Figure 6. A pile of high moisture grain being ground and packed before covering. In this case the ground corn is being discharged onto the pile, dispersed by a box scraper, and packed by a large tractor.

because the grain does not have to be as dry at harvest. Higher yields are also possible because of less ear drop and loss due to wind, rain, snow, deer, elk, pheasants, and other wildlife that commonly plague standing corn. Indeed, many places along the Snake River are winter range for large wildlife—standing corn provides a high-energy food source within easy reach. A final advantage is that livestock can graze on snowless fields and stover for a longer period.

If you time your harvests properly, maximum yield and quality can be achieved with HMC. It is critical to harvest the grain when it attains the correct moisture level and physiological maturity. When you harvest too early, it is difficult for the combine to properly thresh the grain from the cobs, incurring significant losses out the back of the machine. Forty percent grain moisture is the maximum for a good HMC harvest (Lardy and Anderson 2016). You may have to tighten the concave adjustment to break the grain loose from the cob when harvested at higher moisture. Since the grain must be ground or rolled before it is piled or bagged, some damage is acceptable.

Harvesting HMC drier than 24% grain moisture increases difficulties with proper packing and storage. In these situations, some publications recommend harvesters grind the drier grain more finely and add water back in. The volume of water necessary to increase moisture in grain at the pile is significant and not practical for the volumes harvested in Idaho. If grain moisture drops below 24%, then allowing the crop to dry more and harvesting it as dry grain is a better option. Operating the combine at the proper field speed and making correct header, cylinder, and separator adjustments will help prevent unnecessary field losses. Refer to the operator manual of your specific combine make and model to avoid these problems and to determine the proper adjustments. Also, check adjustments often, since field conditions change throughout the day. A general rule of thumb is 2 kernels/ft2 in the field equal one bushel lost (Humburg 2016), with 2%–3% of per-acre yield loss acceptable (Sumner and Williams 2012). For a 200 bu crop, 2%–3% equals 4–6 bu/ac lost. Machine losses less than 2% place the combine and operator in the top echelon of corn harvest operations.

Storage for HMC is similar to silage. Bunkers or drive-over piles are the preferred storage method for Idaho growers. Like with silage, tractors pile and pack the corn after grinding or rolling it—packing removes oxygen and thus aids in preventing spoilage, though the addition of acid preservatives helps as well. Once you've filled the bunker or completed the pile, tarp the corn immediately to help further reduce storage loss. When the corn is fed out, face it like silage and remove only the amount needed for one day. But remember: opening the pile and removing corn introduces oxygen back to the system, increasing the rate of dry-matter loss and spoilage.

Dry Corn Grain

Moisture percentages and storage time dictate dry corn agronomy. Therefore, harvest dry corn grain when its moisture drops below 22%, although corn harvested above 15.5% moisture must be dried before undergoing extended storing (duration will vary, since moisture affects storage life). Purdue University Extension offers a few guidelines (maximum storage moisture versus time for safe storage of high-quality corn grain): 15.5% moisture/less than 6 months, 14% moisture/6–12 months, 13% moisture/longer than 1 year (McKenzie and Van Fossen 1995).

Unfortunately, maintaining these harvest specifications for dry corn is challenging in Idaho. Unlike in the major corn-growing regions of the United States, the presence of commercial drying facilities in the state is rare. A producer has more flexibility with harvest time and a lack of drying facilities is a significant deficiency. The Idaho climate often forces growers to leave corn in a field for most or all of winter before the grain moisture finally drops low enough for proper storage. In some years it may take until March before the grain can be harvested; certainly, that is not ideal. It's basically a waiting game, particularly if the corn grain isn't field dry by the end of October, until the coldest temperatures arrive, effectively freeze-drying the grain. All the while, short, cool days, heavy dews, elevated humidity, and cold night temperatures work against the goal of removing moisture from corn in Idaho fields.

Yield loss will increase the longer corn stands in a field due to ear drop, wildlife feeding, trampling damage, and wind damage. Again, timely removal of grain from a field is critical. Planting a proper variety with a short day length is one way Idaho growers can circumvent the scheduling concerns. From the Magic Valley region to the east, 95-day relative maturity should be considered maximum. In the western part of Idaho, from Glenns Ferry to the Oregon border, relative maturity may increase to 100 days due to longer growing seasons. Whatever strategy a grower ultimately chooses, it's best to work with a seed supplier to obtain the appropriate day-length corn for an area.

Once harvest starts and the field is opened it is prudent to remove grain from the field as fast as possible to avoid losses incurred by weather, wind, and wildlife. Timely removal is not always possible because a producer may try to dry grain in small batches and can only handle a truck or two a day. Similarly, a receiving elevator or feedlot may only be able to process a small amount at one time. Regardless, as with HMC, proper combine field speed and adjustment are critical for maximum harvest efficiency. Combine field speed, ear loss, shatter at the head, cylinder misadjustment, and separator losses of grain out the back of the combine all contribute to field losses of corn grain. Refer to the operator manual of your combine's specific make and model to determine the proper adjustments and check them often since field conditions change throughout the day. Just as with HMC, 2 kernels/ft2 in the field equal one bushel lost, with 2%–3% of per-acre yield loss considered acceptable.

Idaho corn producers store dry grain in bins or barns but most often bins. Although insects, birds, and rodents can cause storage losses, most dry-grain storage losses are associated with moisture and temperature changes within the bin (McKenzie and Van Fossen 1995).

Proper aeration of a bin is necessary to maintain grain quality and reduce losses attributable to mold. Keep in mind that aeration is not drying. Grain must be dry prior to storage. Aeration is simply the process of keeping the temperature in a bin similar to temperature outside of a bin. The goal is to keep moisture from moving through the grain due to dissimilar temperatures on either side of a bin wall. But the key is to start with properly dried grain of high quality. As discussed previously, harvest and storage moisture will affect storage time.

Glossary

aeration. The introduction and circulation of air into a storage bin to prevent moisture from building up and causing damage to the stored grain.

bagged silage. Chopped feed that has been placed in large plastic bags (from 7'–14' in diameter and 100'–500' long) for preservation and storage.

black layer. A black line that appears when the cells at the tip of a kernel die, forming a distinct dark-colored layer that specifies the grain has finished developing, starch deposition is complete, and the kernel can no longer take up moisture. It is often necessary to scratch the very tip of the kernel with a fingernail to expose the black layer.

dry corn grain. Corn grain that is harvested once the kernels' moisture has dropped below 22%.

earlage. See high moisture ear corn.

high moisture ear corn (HMEC). A type of corn harvested using a snap roll header from a combine attached to a forage harvester. The snap rolls harvest only the ear and the forage harvester chops the ears, the same as whole plant silage. The storage method is the same as whole plant silage. Commonly called earlage and less commonly snaplage.

high moisture corn. A type of corn harvested using a combine to remove the kernels from the cob while the kernels are still too wet for bin storage, generally 24%–33% kernel moisture. The kernels are ground or rolled and stored similar to silage, in piles or bags.

milk line. A distinct layer or line that maturing corn kernels develop, where drying starch meets the wetter starch as moisture begins to evaporate. An indicator of harvest readiness in corn silage. When the line has advanced ½–⅔ distance from the outer hull to the tip, whole plant moisture is approximately 66%–68% and ready for harvest.

silage. A forage crop, such as corn or alfalfa, that is harvested by chopping the crop into fine pieces and converting it to a preserved feed through the process of anaerobic bacterial fermentation during storage.

snaplage. See high moisture ear corn.

whole plant moisture. The percentage of water versus the percentage of dry matter in a whole plant based on weight. To carry out the calculation, weigh the fresh plant material and place it in a 60°C (140°F) oven for 24 hours. Reweigh the material, then dry it for another 4–6 hours. Continue to monitor its weight. When the weight is the same for two consecutive checks the plant is dry. Divide the dry weight by the wet weight and multiply the result by 100 to get the percentage of dry weight. Then subtract that figure from 100 to obtain the percentage of moisture.

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