HARVESTING AND STORAGE OF GRAIN CORN

Grain corn harvesting can begin when the kernel moisture reaches 30%. Most producers aim to harvest grain corn between 20 and 27% moisture.

If the moisture content is too high, many of the kernels will rupture before breaking away from the cob and longitudinal cob breakage may increase. If the moisture content is too low, field losses due to lodging and dropped ears will be increased and more kernels will be damaged when the cylinder bar strikes them.

Harvesting losses can be a major problem in corn production. In a 3-year study in Ohio, the average loss in harvesting corn with a combine equipped with a corn header was 7.5 bu/acre. The range of losses was from just over 2 bu/acre to well over 20 bu/acre. The whole-ear loss from the combine corn headers averaged about 4 bu/acre. These losses were from total yields averaging 108 bu/acre thus giving about 4% loss. Losses ranging from 1-20 bu/acre have also been observed in Manitoba. Major losses occur when corn stalks are bent over or broken off by strong winds. Most of the losses occur at the corn header, so careful adjustment and operation is critical. Various adjustments and harvesting practices should help to keep losses to a minimum. Information on the appropriate calibration for specific harvesting systems can be obtained from the dealer or by consulting the operation manual.

Drying Grain Corn

Artificial drying of grain corn is the common way to prepare the crop for storage. Corn is shelled when kernel moisture content is below 30% but to store it safely, the moisture must be reduced to 14-15%.

Grain quality is the factor that can be most easily controlled by the dryer operator. Quality problems are identified under three areas:

- Brittleness
- Heat damage
- Reduced feed value

Rapid drying and high temperatures lead to increased brittleness in the grain. Stress cracks, which develop when the temperature gradient across the corn kernel is large, lead to breakage when the grain is handled.

Heat damage, breaking and stress cracks will result in lower grades of corn. Although this will not reduce its value in the animal feed market, it is of concern on the export market and in the wet milling industry.

Corn dries as the moisture it contains is evaporated from the kernel surface. At the start of the drying process, the heated air removes the moisture located near the kernel surface. These first few percentage points of moisture can be removed quickly and with relatively little use of energy. As the kernel dries, moisture must be drawn from progressively greater depths within the kernel. In high-temperature dryers, moisture cannot move from the interior of the kernel to the surface as quickly as it is being evaporated. The outer layers of the kernel become extremely dry while the centre remains wet. Once the outer part of the kernel becomes dry, the hot air flowing through the corn collects only a small fraction of the moisture that it could otherwise remove. Thus, fuel is used inefficiently in the final stages of drying in a high temperature unit (i.e. after the corn has been dried to 18-20% moisture).

Stress Cracks

Stress-cracked kernels are broken kernels held together by only a thin pericarp or skin which surrounds the kernel. Although stress-cracked kernels may hold together long enough to grade well upon initial inspection, the pericarp is easily ruptured during handling. Severe stress-cracking can make corn unsuitable for industrial users and may limit the export opportunities for corn.

Stress cracks result mainly from rapid cooling of hot corn. When hot grain is cooled rapidly, which happens in most continuous-flow dryers, the outer layers of the kernel become cool while the centre remains hot. The resulting stresses cause the kernel to break. If corn is intended for industrial or export markets, consideration should be given to systems which reduce stress cracking. These include dryeration, low-temperature drying and combination high-low temperature systems.

Chemical Damage

If corn kernels reach too high a temperature, chemical changes in the starch cause it to become gummy and to bind with the protein in the kernel. This can reduce the suitability of the grain for many uses. For example, separation of the starch from the rest of the kernel during milling becomes more difficult.

Low Temperature Drying

In low temperature drying, the corn is dried with unheated, or slightly heated air until it is dry and cool enough for long-term storage. This drying takes place over a period of several weeks or months. In some cases, the corn may not be dried enough to store safely beyond the winter. Additional aeration in the spring may be necessary to complete the drying process unless the corn can be sold or fed before the weather warms up.

Low temperature drying is a race between the rate of drying and the rate of grain deterioration due to mould growth. Low temperature drying completely eliminates damage from over-heating and stress cracks. It seems well suited for economically producing quality corn where 400 tonnes (16,000 bushels) or less are to be dried, although it has been used for much larger quantities. The major drawback is that most farms do not have the electrical power to handle large low temperature dryers.

Careful management is essential to ensure that drying is completed before mould damage occurs. In particular, the corn must be clean and free from damage to ensure uniform movement of air.

Over-Drying

Corn is considered dry on the basis of a moisture content of 15.5% although certain markets will require lower moisture contents. Because there is no price adjustment for corn at lower moistures, the marketing of over-dried corn creates a loss of potential income to the producer. Corn should be dried no more than is necessary to ensure safe storage and meet the market requirements for moisture.

GRAIN CORN STORAGE

Corn must be stored in a manner that will preserve its quality regardless of whether it is kept for a livestock feed or for sale to industrial users. Corn can be sold immediately after harvest and drying, but storage of the corn for later marketing can be advantageous. Storage allows the corn grower to take advantage of price changes throughout the year. On-farm storage also offers greater flexibility in the choice of markets. However, storage adds to the cost of corn production through increased overhead or capital costs, drying and handling costs and interest charges.

Aeration

One of the biggest problems in stored grain is the migration of moisture through the grain mass because of temperature differences within the grain. This occurs most often when the difference in temperature between the grain mass and the outside air is greater than 10^{o} to 12^{o}C. Moisture migration results in condensation of moisture and spoilage in pockets of corn. Grain masses under 25T (1000 bushels) usually cool uniformly, but larger amounts require aeration.

Aeration should begin as soon as the corn is put into storage and continue periodically until the grain has reached a safe storage temperature. This cooling should be done in steps of 3^{o} to 5^{o}C as outside temperatures fall. For each step, aerate until the air coming out of the grain is the same temperature as the outside air. This will ensure that all of the grain has been cooled.

During the winter, corn should be checked weekly for temperature changes and the presence of hot spots. Run the fan briefly and record the temperature of the air coming out of the bin. Note any unusual odours. Compare the results against previous readings to see if any problems are developing. Under some conditions, it may be necessary to aerate during the winter to re-establish a uniform temperature within the corn.

In the spring, the corn should be aerated to warm it up slowly. This should also be done in steps, keeping the grain temperature within 10^{o}C of the average outside temperature. Warming the grain should begin in March. Aerate on cool, dry days to reduce condensation. Never draw warm, moist air through cold grain because the resulting condensation will cause spoilage.

Prevention of Grain Spoilage

Damage from moulds can be prevented by proper drying and aeration of the corn as outlined above. However, considerable damage can also be caused by insect infestations which can occur in dry corn. Insects are present in most grain-handling systems and it is almost impossible to eliminate them completely.

However, loss from insect damage can be kept to a minimum by using the following program:

1. Remove all dust and old grain from bin walls, ceilings, floor and aeration ducts before refilling the bin.
2. Repair cracks where insects might enter.
3. Spray inside the bin with a residual insecticide at least one week before storing new grain.
4. Never store new corn on top of old since insects will move from the old grain into the new.
5. Cool grain as quickly as possible. Insects cannot reproduce at temperatures below 18^{o}C.
6. Check stored grain regularly to detect hot spots.
7. Fumigate difficult insect infestations.

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