Harvesting, Storing and Feeding High Moisture Corn

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During the past 15-20 years, feeding of high moisture corn has increased in popularity for all classes of livestock. Reduced losses associated with harvesting and storage, increased costs of artificial drying and improved mechanical handling during harvesting and feeding has led to this popularity. Corn harvested as high moisture corn (HMC) can be harvested earlier and storage is adaptable to various storage structures.

This bulletin discusses harvesting, storing and feeding of high moisture corn.

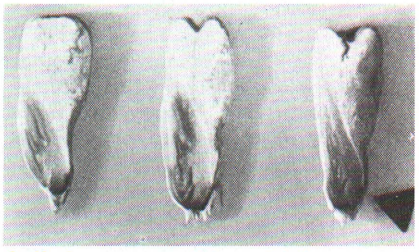
Harvesting High Moisture Corn

As with any crop, the goal is to harvest the maximum available nutrients. Within a year, factors such as weather or other uncontrollable occurrences often limit productivity. However, in many cases proper management can increase yields by as much as 10 to 20%. Some factors such as seeding rate, fertilizer application, weed control and row spacing are important in determining yield and quality. Proper harvesting and storage techniques determine quantity and quality of all previous management decisions.

Under ideal conditions, average field losses for picking and cribbing ear corn are about 8%, whereas losses of 3 to 4% have been reported for high moisture ear corn.

During the growing phase, the corn plant is one of the most metabolically active plants in nature. Solar energy is gathered by the plant and used to convert carbon dioxide and water into carbohydrates. These are classified as either a) structural or b) storage forms of carbohydrates. The principal storage carbohydrate is starch and is found primarily in the kernel. Starch accumulates in the kernel until the corn becomes physiologically mature. At maturity, a visible black layer develops in the base of the kernel near where the kernel joins the cob. From this point on, no further increase in dry matter accretion occurs in the kernel, thus maximum yield occurs at this time. At maturity, moisture content of the kernel may be 30 to 35%, or greater, depending on weather conditions. A few cold nights or a heavy frost may cause black layer formation at higher moisture levels. Moisture content in the cob is higher than in the kernel so that if high moisture ear corn is stored, moisture content will be somewhat higher than in high moisture shelled corn. Generally, ear corn will be about 5% higher in moisture than the same crop ensiled as shelled corn (Table 1).

High moisture corn can be stored as shelled, ground shelled, ear or ground ear corn. The limits for storage of



shelled corn are 24 to 33% moisture with ideal moisture level between 26 and 28%. For storage of ear corn, the limits in moisture content are 25 to 40% with 30 to 33% moisture considered to be ideal. At these moisture levels good machinery performance results and field losses are minimal. Horse power requirements for grinding ear corn are higher for the higher moisture ear corn since the cob is spongy and tends to plug the screen.

Storage of High Moisture Corn

High moisture corn can be stored in sealed silos, concrete-stave and poured concrete silos that are in good condition. In studies at Michigan State University, storage dry matter losses of high moisture corn have been less than 5% in concrete-stave silos.

TABLE 1. Kernel-Cob-Ear Moisture Ration.

Kernel % moisture	*Cob % moisture*	*Whole Ear % moisture*
12	12	12
14	15	14
15.5	18.6	16
18	27	20
20	33	23
22	38	25
24	44	28
26	47	31
28	50	33
30	52	35
32	54	37
34	56	39
36	57	41
38	58	43

**Iowa data: this and other information on corn maturity provided by Elmer Rossman, Farm Crops Department, Michigan State University. From: Michigan Cattle Feeder, Vol. 1:1, November 1960. Animal Husbandry Department, Michigan State University.*

CORN

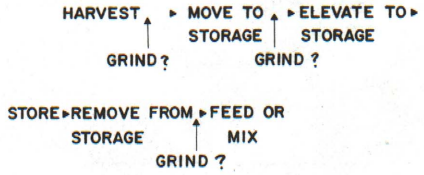
HM	vs	Dry
Field Losses 3–4%		7–8%

Storage structures should be in good condition when filled. Due to the extremely perishable nature of high moisture corn, silos should be sealed around silo doors and covered with plastic until corn is to be fed. Once feeding begins, at least 2 inches in winter months and 4 inches in summer months should be removed daily from the top to prevent top spoilage.

High moisture corn can be stored successfully in whatever form it comes from the field. Conflicting recommendations on form of storage exist, however. Early recommendations were for storing high moisture corn in the ground form. Recent research suggests that high moisture corn can be effectively stored shelled. In either case, proper silo management will determine storage success.

If grinding is desired, it can be done at several points in the harvesting and feeding scheme. The flow chart (below) shows the steps from harvest to feeding and possible steps where grinding can be incorporated. A major consideration here is the time required to grind. Field grinding probably requires less overall time but some special machinery is required and the picking (shelling) operation may be slowed. Grinding before putting into storage can be accomplished with a mill or recutter attached to the blower. Again, this process may serve as a bottleneck in the harvest scheme. If grinding ear corn before ensiling is preferred, separation of cob and grain particles may occur. Mold may become a problem in areas of high cob particle concentration. Finally, high moisture corn can be ground just prior to mixing with other ration components. This must be done on a day-to-day basis rather than grinding and storing an amount sufficient to feed for a few days at a time. High moisture corn (ground ear or whole) when left in the feed cart at barn temperature for four hours, heated and cows refused or reduced their intake.

GRINDING LOCATION



Chemical Treatment

An alternative storage method gaining favor with many farmers is treating high moisture corn prior to storage with some type of chemical preservative. The most common type of preservative is organic acid mixtures with the most effective being those containing a large proportion of propionic acid. Ammonia treatment has been effective also. Storage systems using preservatives require comparatively low initial investments relative to other storage systems.

Application of acids kills fungi and other micro-organisms present on high moisture grains, inhibits further microbial growth almost indefinitely and prevents germination. The amount of acid required to treat high moisture corn depends on moisture content of the corn, length of storage and temperature. Rates of application of propionic acid to high moisture corn are shown in Table 2. The upper limit of acid provides protection for a year or longer.

Storage of acid-treated high moisture corn can be accomplished in a wide variety of structures including bunkers. Since acids are corrosive to steel, especially galvanized, some form of protection such as acid resistant coatings should be applied to bins prior to filling. For example, the estimated life of a steel bin is normally about 30 years for dry corn but reduced to an estimated 3 years when acid-treated corn is stored in bins with no internal coating. Concrete is also vulnerable to acid corrosion but to a lesser degree than steel. Wooden bins or cribs are not affected by acids.

Acid-treated corn stored in makeshift bins, piles or bunkers should be provided with cover that will prevent moisture from entering the stored grain. However, moisture from the corn migrates to the top resulting in some top spoilage. Ventilation will reduce moisture accumulation which is most likely to occur when high moisture corn is stored in warm weather (60° or higher).

INTAKE AND PRODUCTION

ACID-TREATED CORN = HIGH MOISTURE CORN = DRY CORN

Acid-treated high moisture corn eliminates some disadvantages of ensiled high moisture corn: (1) removal rate from the silo is eliminated; (2) treated grains can be transported over long distances; (3) large batches of a ration which include acid-treated high moisture corn can be mixed without risk of spoilage. The major disadvantage to acid-treated corn is that it must be fed to livestock thereby eliminating marketing as a cash crop.

Treating of high moisture grain with acids requires some special equipment and care. All equipment that is contacted by acid or acid-treated corn should be thoroughly rinsed with water. It may be necessary to add baking soda (sodium bicarbonate) to the water to help in neutralizing the acids. Gloves, safety goggles and other protective clothing should be worn when handling acids. Water should be available to wash off acids when they come in contact with the skin. Additional handling precautions are available in brochure form from anyone selling acids.

TABLE 2. Rates of Application of Propionic Acid to High Moisture Corn for Prevention of Mold Growth.

Moisture Content	*Propionic Acid Required* %	*lb/ton*	*oz/bu*
18	0.3-0.6	6-12	2.5- 5
22	0.5-0.8	10-16	4.0- 7
26	0.6-1.0	12-20	5.0- 8
30	0.8-1.2	16-24	7.0-10

SOURCE: Sauer, D. B. 1973. Grain preservatives for high moisture feed grains. U.S. Grain Marketing Research Center, A.R.S., U.S.D.A., Manhattan, Kansas.

Feeding Value of High Moisture Corn

Several research reports have shown that the feeding value of properly ensiled or acid-treated high moisture corn to lactating dairy cows is equivalent to dry corn. Comparisons of milk yield and feed intake were similar (less than 5% difference) when corn was properly ensiled or acid-treated and included in a balanced ration. In some trials where high moisture shelled corn supplied more than 50% of total ration dry matter, depressed milk fat percentage occurred, while at less than 50% of total ration dry matter, high moisture shelled corn did not depress milk fat percentage. Inadequate fiber in the ration was given as the probable cause of milk fat depression in the high moisture shelled corn rations. To prevent milk fat depression, a crude fiber level of about 16% is generally regarded as the minimum dietary level.

Some form of processing (e.g. rolling or grinding) of high moisture corn improves nutrient utilization. Intact kernels appearing in feces indicate incomplete digestion. Processed corn is higher in digestible, metabolizable and net energy for dairy cows than rations containing whole shelled corn.

Summary of Recommendations

High moisture corn should not be harvested until physiological maturity occurs. This can be determined by observing for black layer formation. High moisture corn can be stored in oxygen limiting or concrete stave silos with ideal moisture content of 25 to 30% for shelled corn and 30 to 35% for ear corn. During storage, silos should be kept air-tight to prevent spoilage. A minimum of 2 inches in the winter and 4 inches in the summer must be removed daily from top unloading silos to prevent surface spoilage. Acid-treatment of high moisture corn provides safe storage in many different systems with relatively low initial investment. High moisture corn properly preserved (ensiled or acid-treated) is comparable to the dry grain in feeding value. Overall, feeding costs are reduced by the increased yield obtained from decreased harvest losses of high moisture corn and increased storage and drying costs of the dry corn.

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