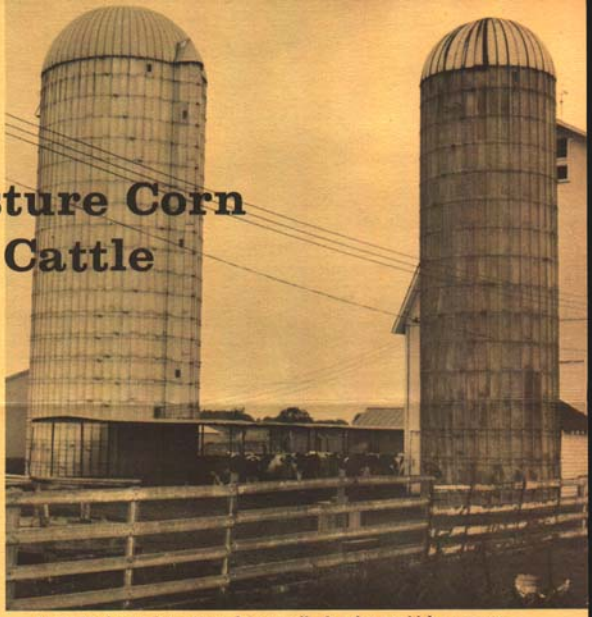
SEPTEMBER, 1963
EXTENSION BULLETIN E-422
FARM SCIENCE SERIES

High-Moisture Corn For Dairy Cattle

COOPERATIVE EXTENSION SERVICE
MICHIGAN STATE UNIVERSITY

DONALD HILLMAN,
Extension Dairy Specialist



Many Michigan dairy farms have small silos that could be conveniently adapted to high-moisture corn, such as the one on the right.

HIGH-MOISTURE CORN is gaining favor among dairymen as a means of harvesting and storing corn grain. The corn is stored in concrete stave, poured concrete, or gas-tight silos as ground ear corn, ground shelled corn or whole shelled corn at 25 to 35 percent moisture levels. High-moisture corn handled in this manner offers certain advantages over conventional corn handling methods.

1. Harvesting can be done 2 to 3 weeks earlier than for cribbing—frequently this could mean the difference between saving or losing much of the corn crop.
2. Illinois studies show 7% less field, harvesting and storage losses for 25-30% moisture corn than with dry corn. Several re-handling operations are eliminated since the high-moisture corn is ready to feed when removed from storage.
3. Storage costs are comparatively low—estimates indicate annual silo storage cost (including unloader) are 2 to 4 cents per bushel less than crib storage and up to 8 cents per bushel less than for heat-dried shelled corn.
4. Storage is relatively rodent free.
5. Mechanical feeding is simplified for feeding grain in the lot.

Nutritional Value.

Feeding trials with milking cows at the University of Illinois and Michigan State University indicate that properly handled high-moisture corn is fully as satisfactory as dry corn for milk production. Growth studies with heifers indicate that high-moisture corn is equivalent to dry corn but not better. Beef cattle fattening trials have shown variable results with high-moisture corn compared to dry corn. In general there appears to be a slight, but not significant, advantage in average daily gain and feed efficiency with high-moisture ear corn compared to dry ear corn. This advantage was not apparent in numerous trials com-

paring high-moisture shelled corn with dry corn. Since the nutritional value appears to be about the same as for dry corn, any advantage for high-moisture corn must result from greater efficiency in handling and storing.

Harvesting and Storing.

Corn kernels continue to add dry matter until they drop to 35 percent moisture although a few hybrids will mature at 40 percent moisture. Corn is considered to be mature after it has accumulated all of the dry matter possible. Fifty percent moisture corn is dented and in medium soft stage but is not mature. Twelve to 16 days are required to mature corn from 50 percent to 40 percent. The yield increases at a rate of ½ to ¾ bushel per acre per day during this time.

Recommended Storage Moistures.

High-moisture shelled corn—ideal kernel moisture is 28 percent, the recommended range is from 25 percent to 30 percent and the limits are from 25 percent up to 33 percent. High-moisture ground ear corn—ideal kernel and ear moisture is 32 percent, recommended range is from 30 percent to 35 percent and the limits are from 28 percent to probably 40 percent.

Table 1.—Kernel-Cob-Ear-Moisture Ratio[1]

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
26	47	31
28	50	33
30	52	35
32	54	37
34	56	39
36	57	41
38	58	43

[1]Iowa data—this and other information on corn maturity provided by Elmer Rousman, Farm Crops Dept., Michigan State University. From: Michigan Cattle Feeder, Vol. 1:1, November, 1960. Animal Husbandry Dept., Michigan State University.

Storing High-Moisture Corn.

Concrete stave or poured concrete silos that are in good condition and airtight silos will all do a satisfactory job of storing high-moisture corn. Total dry matter losses have been less than 5 percent of the ensiled material with concrete stave silos in tests at Michigan State University.

In general dairymen should provide 70 to 80 bushels of ear corn (@ 70 lb. per bu.) or 80 to 90 bushels of shelled corn (@ 56 lb. per bu.) per cow or equivalent amounts of other grain for milk production. Another 5 to 6 bushels per milk cow will be needed for young stock.

The approximate amount of storage space in bushels of high moisture-corn provided by various diameter silos is shown in Table 2. This can be used to estimate silo space requirements for your herd.

Concrete silos used for storage of high-moisture corn must be in a good condition and doors must fit tightly to prevent air from leaking into the mass. For older silos it may be advisable to either caulk the door joints or cover the doors with a strip of plastic film available at most farm supply stores.

The filled silo must be covered with a plastic silage cap. Always crown the surface slightly, make a ditch at the silo edge, lay the cap smoothly over this surface, and tuck the cap down into the ditch and up around the silo. To hold the cap in contact with both silage and silo, fill the ditch with anything which cannot freeze, run out, or blow away. A light weight logging chain can be used. If the cap is close to the top of an open silo it is advisable to weight it down in the center.

Grinding.

Several types of equipment are now available for grinding high-moisture corn before ensiling. Grinding can be done with a burr mill, hammermill, or with certain types of blowers, field-choppers and pickers equipped with recutting screens and special attachments. High capacity roller or crushing mills are available. Obviously ear corn must be ground before ensiling. A medium to coarse grind is satisfactory for 28 percent (kernel moisture) ear corn and above. This can be accomplished with a ¾ inch to 1 inch screen hole size. With dryer material a ½ to ⅝ inch screen might be desirable. When a large volume of corn is to be ground, most farmers are willing to sacrifice a small percentage of whole kernels and will use a very coarse grind in order to increase the grinding capacity of the machine and reduce power requirements.

Shelled corn must be ground before feeding to prevent a high percentage of the whole kernels from passing through cattle undigested. Studies indicate about 20 percent of the whole corn passes undigested. However, farmers handling a large volume of corn using a picker-sheller find it is simpler to store the high-moisture corn as shelled corn and run it through a small roller mill or other grinding device as it is

Table 2.—Approximate Bushels of Corn per Foot of Silo Height for Various Moisture Contents and Inside Diameters of Silos*

Moisture Content %	Approximate volume to yield a standard bushel		Approximate bushels per foot of silo height — Silo Diameter						
	Weight	Cu. Ft.	10'	12'	14'	16'	17'	18'	20'
Shell corn 1/									
15.5	56	1.25	63	90	123	161	182	203	251
25.0	63.1	1.50	52	75	102	134	151	169	209
30.0	67.5	1.60	49	71	96	126	142	159	197
35.0	72.8	1.70	46	66	91	118	134	149	185
Ear corn 2/									
15.5	70	1.40	56	80	110	144	162	182	224
25.0	81	1.66	47	68	93	121	136	153	190
30.0	89	1.78	44	63	87	113	127	143	176
35.0	95	1.90	41	59	81	106	119	134	165

Stored as whole shell corn. For ground shell corn, increase bushel capacity per foot by 14 percent.
Stored as ground ear corn.
**Prepared from Minnesota data by C. R. Hoglund, Michigan State University, Agricultural Economics Department.*

removed from the silo. Grinding at a rate sufficient to keep up with a picker-sheller generally requires too much horsepower and may cause a bottleneck at harvesting time, whereas only a low capacity machine is needed for daily grinding at feeding time. Kernels need to be cracked for maximum digestion to occur in the animal.

Ensiling.

An ensilage blower or elevator can be used to put the high-moisture corn into the silo. When a blower is used particular attention should be given to distribute the material evenly in the silo. Separation of the heavy and light materials will tend to cause moldy spots in the silo. This can be prevented by using a silage distributor or frequent leveling by hand.

Feeding Considerations.

About 1.2 to 1.3 pounds of high-moisture corn is equivalent to 1 pound of normal air-dry corn. Therefore 20-30 percent more feed should be fed than when normal corn is used.

In general 2-3 inches of high-moisture corn should be removed from the silo daily to prevent spoilage. The removal rate has not been a serious concern in practical feeding situations except in hot humid weather. In cold weather it is not a problem and in dry weather the material tends to dry out on top rather than spoil over short periods.

Silo unloaders work well for removing high moisture corn from the silo. The material can be readily removed by hand with a shovel where the volume does not justify an unloader.

Where cattle are fed in the lot high-moisture corn can be augered and metered into a feed bunk conveyor at a specified rate with silage, or fed in batchs from a self-unloading wagon with or without the silage. Protein supplement can be metered from a storage bin and fed with the mixture.

Ground high-moisture corn tends to bridge and will not flow freely from storage bins. Also it should be fed soon after removal from the silo or it will spoil.

A system can be designed for continuous flow from the silo through augers to straight-sided gravity feeders in the milking parlor that are kept full only at milking time. For most existing loose-housing systems it is more practical to feed high-moisture corn in the lot and feed a minimum amount of dry grain containing the supplements in the parlor.

Additives for High-Moisture Corn.

UREA.

Feeding grade urea can be added to high-moisture ear corn during ensiling to increase its crude protein content. Research to date indicates that 0.5 percent

urea (10 lbs. urea per ton) can be safely added to high-moisture ground ear corn with no apparent effect on its palatability. This is enough to increase the crude protein content of the dry matter from about 9 percent to about 11 percent. Recovery of the urea nitrogen at feeding time will be 90-100 percent of that added. Satisfactory mixing of urea and ensilage has occurred when the measured amount of urea was evenly distributed over the top of the loads. It can be added by hanging a calibrated funnel or similar metering device in position to feed into the blower.

LIMESTONE OR CALCIUM CARBONATE.

Recent studies indicate that the addition of 0.5 percent (10 lbs. per ton) of high calcium limestone usually called "feeding grade limestone" aids in the fermentation of high-moisture corn and increases the feeding value. The additional cost is about 10 cents to 20 cents per ton of ensilage depending on the amount and source used.

Limited feeding trials with beef cattle indicate an increase in rate of gain up to about 14 percent (average about 10%) and a similar increase in feed efficiency when limestone treated high-moisture ear corn was compared with similar untreated ear corn.

Direct comparisons on the value of limestone treated and untreated high-moisture corn for dairy cattle are not available. Results similar to those reported with beef cattle should be expected but actual proof must wait for additional data.

WATER

Water can be added to corn that is less than 25 percent (kernel) moisture at the time of ensiling as high-moisture corn. For a rule of thumb, add 5 gallons of water per ton for each 2 percent moisture that the corn is below 28 percent moisture. Example: to increase 20% moisture corn to 28% add 20 gallons of water per ton ($28 - 20 = 8 \div 2 = 4 \times 5$ gal. = 20 gallons per ton).

Table 3.—High-Moisture Corn Feeding Schedule For Milk Production*

Milk Pounds Per Day	Grain Pounds Per Day	Milk Pounds Per Day	Grain Pounds Per Day
30	15	66	32
36	18	72	36
42	21	78	40
48	24	84	45
54	28	90	50
60	30	96	unlimited

**Assumes protein supplement mixed with the high-moisture corn. If corn is fed separately feed 10 percent less than indicated in the table.*

Cooperative extension work in agriculture and home economics. Michigan State University and the U. S. Department of Agriculture cooperating. N. P. Ralston, Director, Cooperative Extension Service, Michigan State University, East Lansing. Printed and distributed under Acts of Congress, May 8 and June 30, 1914.