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# IOWA AGRICULTURAL EXPERIMENT STATION ANIMAL HUSBANDRY SECTION

# THE SOFT CORN PROBLEM

## By John M. Evvard

Making the most of the soft corn is a problem that confronts the corn growers of Iowa. Many of our people have the idea that soft corn is practically worthless but that is very far from the truth, indeed.

What is soft corn? Generally speaking, soft corn is corn that runs anywhere from 25 to 65 per cent moisture. Sometimes, however, corn with a moisture content under 25 per cent may be considered as relatively soft corn, when compared to hard, mature corn.

Soft corn invariably falls in the "sample" grade, for it contains over 23% moisture in addition to much damaged grains. To classify soft corn simply upon the amounts of moisture present, the following approximate grading on that basis may be followed:

GRADING CORN ACCORDING TO PERCENT MOISTURE

Percent Moisture	Grade
65%	Markedly soft (rare).
55%	Very soft (somewhat difficult to squeeze out visibl moisture).
45%	Soft.
35%	Fairly soft.
25%	Cribable.
20%	Safe corn.
14%	Old corn, mature.
12%	Usually two-year-old corn.
8%	Usually kiln-dried.

There is a great moisture difference in these corns. Their dry matter is the one main indication of their feeding and market value. One can readily see that if a 65 per cent corn only contains 35 pounds of dry matter, this corn is much less valuable than a corn containing only 30 per cent of moisture, because in the latter case, in every 100 pounds there is 70 pounds, or twice as much, dry matter as in the former, which really means that, other things being equal, the drier corn, with the 30 per cent moisture, is about twice as valuable as the corn which contains 65 per cent.

It is reasonable that the corn will dry out much more rapidly in the field than in the crib, and common experience corroborates this reasonable expectation. When one has a large acreage, he can not afford to allow it to remain indefinitely in the fields. Generally speaking, it is well to let the new soft corn remain on the stalks, but preferably in the shock, as long as general conditions and other controlling factors on the farm will permit.

Handling the soft corn crop successfully is somewhat of a perplexing problem, but there are a number of methods that suit different conditions, such as (1) ensiling, (2) shocking, (3) cribbing, (4) shredding, (5) marketing, and (6) feeding.

# 1. ENSILING

The silo is by all odds the most acceptable place for storage for soft corn. Usually, it is a safe proposition, in case of doubt, to add water, but the aim always should be to produce a silage that will run about 60 to perhaps as much as 70 pounds of water in every 100 pounds of material, as it is taken from the silo. The silage at Ames which has run from 60 to 65 per cent water has been the best.

Remembering that ordinary mature dry fodder corn which is siloed in January and February will require about a ton of water with every ton of

fodder, and further, that in a soft corn year, as this one, no water may be needed, we can judge as to the amount of water necessary.

To ensile the soft ear corn without the stover is practical; in other words, soft corn ears can be preserved and conserved in the silo without adding the entire plant. This has been demonstrated in silo tests com-pleted in the fall and winter of 1915 and 1916 by the Iowa experiment station, A. R. Lamb, of the chemistry section, working with the author.

To play absolutely safe it is considered a good plan to add some stalks to the ear corn because the stalks furnish much sugar which is essential to the proper acid fermentation.

An ordinary silo, strongly built, will hold a surprising quantity of soft corn ears, not only on the total weight basis, but on the acreage basis, and herein lies the great advantage of ensiling the soft corn ears. In addition, these soft corn ears may be fed as a concentrate rather than as a roughage. Thus ear corn silage is more valuable, pound for pound, when it comes to fattening cattle, for instance, or sheep, or swine, for the market.

#### METHOD OF ENSILING SOFT EAR CORN

The soft ear corn silage made at Ames was ensiled as follows:

The soft corn ears in late roasting stage were husked, run thru a silage cutter and tightly packed into small silos. The silage resulting after 12 days of fermentation (ordinary silage is practically made in ten days) was surprisingly good, having a favorable odor, much like ordinary entire corn plant silage. In appearance, the soft ear corn silage was good, being quite bright and light colored, free from mold, and palatable. Chemical tests showed sufficient silage acids to have been developed to preserve without over-acidity or sourness. Such corn grain and cob silage will not develop as much acidity as ordinary silage, but enough to preserve it well if properly cut up and packed. At the end of two months, this soft ear corn silage was in excellent feeding condition.

Snapped corn, or corn ear plus husks, will make good silage, the husks being of advantage in that they will tend to tie or pack the small ear pieces more closely together and hold the desirable moisture.

#### PRECAUTIONS FOR ENSILING SOFT CORN

Precautions which must be observed to secure the best results are:

(a) Chop quite finely. No pieces should be over an inch across, the smaller the better, within practical limits.

(b) Pack tightly by tamping well, especially near the walls.(c) Add water. This is best done by adding slowly during the filling, being careful not to add an excess, so that the water collects at the bottom of the silo. A good scheme is to have an opening at the base of the silo, which will indicate when there is a surplus of added water. Later this opening should be closed. Late roasting corn will take a ton of water to about every six or seven tons of silage corn; whereas, quite milky ear corn will not require nearly so much, perhaps none.

(d) Cover the filled silo over with cheap material, such as stover, straw, or other stuff, in order to avoid loss of good, concentrated ear corn feed. Dry stover, well wet down, is usually most economically used and conveniently handled.

It is well not to have too large a proportion of mature or nearly mature corn, because the hard cobs prevent packing, and further, because it does not contain enough sugar to allow of correct acid fermentation so necessary for preservation.

Soft corn which has been frozen, but not spoiled, will make good silage; this has been demonstrated in special tests.

Immature snapped or ear corn silage can be fed to the same stock as ordinary silage, but it is to be remembered that it is a concentrate and not a roughage. Swine, for this reason, can use this silage to considerable advantage, whereas ordinary silage has a very limited field of usefulness with them. Lamb and Evvard have shown that swine can handle the silage acids, lactic (same as in sour milk) and acetic (same as in vinegar) in good shape.

If corn is too moldy it will not ensile well, partly because the molds, depending on kind, may use up some of the sugars which are quite necessary for acid fermentation. Slightly moldy corn will ensilage fairly well and the mold will stop growing after ensiling because of the absence of air.

# 2. SHOCKING THE CORN

Shocking the corn, especially placing it in small shocks, will help to save the fodder (the stover) which is of high quality in a soft corn year. It will be of further advantage in that the ears will dry out quite rapidly, this being especially true in favorable seasons, when rains are not abundant. In a wet, muggy season there is some risk in the shocking process. The ears really dry out so as to make a little better feed (in a favorable season) than if allowed to dry out and weather on the stalk.

### 3. CRIBBING

Cribbing the corn is, of course, the only storage means many farmers have. However, it is well to leave the corn in the fields as long as possible, the ears hanging in their natural position upon the stalks; here they dry better. Usually corn is safe to crib when it runs from 25 to 30 per cent moisture, altho in 1903-1904 the Iowa Agricultural Experiment Station stored successfully ear corn that ran 37 per cent moisture in the entire corn ear. Corn that shells nicely, having 22 to 25 per cent moisture, cribs efficiently and safely.

Some suggestions as to methods of harvesting the corn for the cribs, and as to methods of cribbing, may be in order:

Divide the fields, if possible, keeping the soft corn by itself, preferably feeding it out early to the hogs, sheep, cattle, and dairy cows. The more mature corn, from the hillsides, the high ground, and the earlier plantings, may advantageously be stored in the crib.

*Husk the corn clean.* The silks and husks and other foreign material tend to hinder ventilation and promote souring and molding—all of which are undesirable.

Sort as much as practical. This is difficult to do in the field, but if one has plenty of time it can be done. The wagon bed can be divided into two bins, one in front for soft corn and one behind for hard corn. After a time one grows somewhat expert in making the wagon sort, but, generally speaking, field sorting is a disappointment of times, even tho the owner does it. One place where sorting is practical, however, is at the farm ear corn elevator, especially the power elevator. The soft ears can be picked from the elevator chute and thrown out, while the mature ears are allowed to proceed upward.

Give special attention to the crib and to methods of cribbing. These points are especially practical:

Keep the cribs off the ground so that ventilation can be free and vigorous under the corn. If the crib is flush with the ground, dampness is usually attracted, rats are harbored, and other bad influences are encouraged. The six- or seven-foot crib excels the eight-foot, being much better in the soft corn year. However, one will have to do his best with his equipment.

Keep the corn out of the alleyways, because by filling the alleys, ventilation will be impeded and the corn will be apt to spoil. This is especially true of the average crib alleyway.

The sides of the crib are preferably made of four-inch lumber—liberal cracks being left. The main idea to keep in mind is: "The more air, the better."

Cover the crib with a roof. There is enough moisture in the soft corn without having more added from the clouds.

#### CRIB VENTILATION

Crib ventilation by special devices is in order. If the horizontal ventilator scheme is used, simply proceed to fill the bed of the crib about two or three feet deep with car corn; then place the ventilators on top of the corn, running them lengthwise with the crib. Then fill in another 2 or 3 feet of corn, place more ventilators and so on until the crib is filled.

These ventilators are best made out of 2x8's, these being set on edge side by side; about 8 to 12 inches apart. Nail cross cleats on the top as well as on the bottom of the two parallel 2x8's, so as to form a long, rectangular, open box. Instead of slats or cleats, a substantial grade of galvanized or plain wire mesh may be used, or even the finer mesh grades of strong, heavy, woven wire. To keep the 2x8's from collapsing and to prevent filling with corn; the cross cleats should be liberally provided; cross ties can also be placed within the box ventilator proper, providing, of course, they are made of small dimension stuff, such as 1x2's or 2x2's, and crossed so that the air circulation is not interfered with. Lay these ventilators in the crib about two to four feet apart, the distance depending upon the softness of the corn. A six-foot crib should usually have two ventilators running lengthwise; a third one would not be of great disadvantage, excepting that it would add somewhat to the cost and would likewiso take up room. It is better to play safe and over-ventilate rather than under-ventilate.

In placing the ventilators of the second set, place them midway between, not directly above the ones first placed on the next lower level. Put the third set directly over those of the first set.

Vertical ventilators are also used, but these are usually made out of tile, about S-12 inches in diameter, and extending from the floor of the crib to the roof. Between the tiles place a couple of 1x1's or 2x2's, so as to allow the air to enter the vertical tile tube at every tile joint. The horizontal ventilators previously described may be used vertically.

Then there is another ventilator built like a hog trough, which is placed in the crib in a horizontal position, turned face downward. This is not so satisfactory as a rectangular cross cleated ventilator made of 2x8's, because the air can not proceed upward thru this trough for there is only one opening, and that is on the inverted side. The chief advantage of this V-shaped type is simplicity of building.

Both horizontal and vertical ventilators may be installed.

Much thought should be given to the ventilation proposition, because it may mean the difference between spoiled and good corn in the spring.

#### PRESERVATION WITH SALT

In a few localities the ear corn in the crib is being salted at the rate of from 5 to 20 pounds of ordinary barrel salt to the ton of ears. Many claim good and favorable results. At any rate the practice is worth trying, because from  $\frac{1}{4}$  to 1 per cent salt mixed with corn is not a serious matter. Altho live stock in general eat less than  $\frac{1}{2}$  per cent as much salt as grain yet up to 1 per cent can be handled without much disadvantage. H.D. Hughes, chief of the farm crops section, this station, has a series of tests in progress on the soft car corn salting proposition so that experimental data will be available this winter.

#### 4. SHREDDING

Shredding soft corn is usually unsatisfactory; it is hard to shred, because it is sappy, and, furthermore, if it is not well dried out it will spoil in storage. Some people recommend the addition of salt, about 5 to 20 pounds to the ton, with an average of about 10 or  $\frac{1}{2}$  of 1 per cent by weight. If one must shred, however, then it is well to shred often, and not store too large a quantity of shredded material. It is also well to put the shredding off to the latest possible date, so that the corn will be well dried out in the stalk and ears, because in a soft corn year the stalks hold considerable moisture, much as do the cobs of the ears. In marketing this soft corn, it is well to shell in the frozen condition and haul to market in the frozen state. Inasmuch as a premium is paid in soft corn years, as well as in other years, for the most mature, hardest corn, it is well to sell that, and feed up the soft ear material at home, unless, of course, conditions do not warrant home feeding. It is surprising how much water in a frozen condition this ear corn can carry in the grain. Even tho not frozen, we have seen corn in the year 1916 that ran 35 per cent moisture, shell surprisingly good.

## 6. FEEDING

The feeding of soft corn is the most logical method of disposition. In general, however, there are two very essential precautions, which are best mentioned at the outset:

Early feeding of the soft corn, while its quality is still good, is in order. Feed often—three, four and more times per day. With swine and cattle, self-feeding ofttimes is in order, especially with the former.

Moldy feed is dangerous for horses particularly and young sheep. Cattle are usually quite immune. Hogs can be trusted to cat what they will usually. In case of doubt try the moldy feed out on a couple of head of the least valuable animals of the particular stock you are contemplating feeding, and if it does not hurt them proceed on the general herd with caution. But keep moldy feed away from horses and sheep, young lambs especially. It is surprising, the, how well cattle and hogs, under certain conditions, convert moldy corn into cash meat products.

#### MOLDY CORN

Concerning the utilization of moldy corn R. E. Buchanan of the bacteriology section of the Iowa Agricultural Experiment Station says:

<sup>47</sup>Moldy corn has often been suspected of poisoning cattle and hogs. Investigations carried on in recent years seem to indicate, however, that this rarely, if ever, occurs. The diseases or sicknesses of cattle which were once supposed to be due to mold poisoning have since been found to be due to infection with hemorrhagic speticemia or other diseases which have nothing whatever to do with mold on corn. It seems therefore that there is no good reason why corn showing more or less mold cannot be safely fed to cattle and hogs.

"The molds which appear are sometimes blackish, sometimes bluish, greenish, or pinkish in color. If these molds are not present in excessive amount, that is, if the corn is not actually rotten or matted together by the mold, it is not probable that cattle and hogs will be injured by eating it.

<sup>7</sup> What has been said above, however, should not be used as justification for feeding moldy corn to horses. Many instances are on record of horses being killed by eating moldy silage, moldy corn, and moldy forage of other types. Whether or not it is the mold itself or some other organism growing in the moldy corn that causes the trouble is at present uncertain."

## SWINE FEEDING ON SOFT CORN

Swine are preëminently adapted to the handling of soft corn. Having a simple digestive tract, they are enabled to strain the water out at a very rapid rate and use the remaining dry matter for gains.

It is a very good practice to allow tankage in a self feeder, or oil meal, or preferably both, allowing the pigs to have access to the same all of the time. Another addition which is good is corn oil cake meal which must be mixed in with an equal weight of meat meal tankage and fed "freechoice" style.

The relative values of new sample grade and No. 3 good old corn for fat-

tening pigs is indicated in some experimental results last fall at the Iowa station. In conjunction with Russell Dunn the author fed two lots of shotes averaging 146 pounds at the beginning. Group I was fed shelled corn in one self-feeder, 60 per cent protein meat meal tankage in another, rock salt in still another, and charcoal in still another. Now Group II was fed the same but with the exception that new corn was allowed instead of the old, this new corn being of sample grade mostly; in other words being a product of the soft corn year—it had a number of spoiled kernels in it, that is, the kernels were black but not really rotten. The moisture percentage during the trial in this new corn started out running 25.6 per cent, and then dropped down to about 19 per cent after about 60 days' feeding, the experiment itself lasting 108 days. The old corn checked against started out at 13.9 per cent moisture and ended up at 12.8 per cent. The old corn, 13.8 per cent.

Now here are the results: The old corn pigs weighed 311 pounds after 108 days' feeding, making an average daily gain of 1.53; whereas the new corn pigs weighed a little more or 316.7 pounds, making an average daily gain of 1.57. There is a shade of difference, therefore, in favor of the sample grade of corn.

The feed required for 100 pounds of gain, all corn figured down to 14 per cent moisture, with the old corn pigs was 426 of shelled corn, 20.8 of meat meal tankage with just a little rock salt and charcoal, not enough hardly to record, making a total grain requirement of 446.8 pounds for each 100 pounds of gain. The new corn pigs required a little less corn or 397.2 pounds; they ate, however, more tankage or 32.2 pounds or really about 50 per cent more than where old corn was given, and very little salt and charcoal; but there is a total of some 429.5 pounds feed required for a 100 pound gain or 17 pounds less than with the hard No. 3 mature corn almost No. 2. It took less dry matter in the form of new corn to produce 100 pounds of gain than it did of old corn, but on the other hand it took a greater amount of tankage with the new corn, which is quite an item.

It is surprising how well pigs like soft and immature corn. They may root out a few spoiled kernels now and then; but when the self-feeders are closed down somewhat, they even eat the most of these.

#### CATTLE FEEDING WITH SOFT CORN

Cattle can also use the soft corn, but of all grades and classes of cattle, the stockers, the springers, the light milking cow, the wintering steer which is being prepared for grass, and similar non-fattening animals, can handle the soft corn to greatest advantage.

This does not mean that fattening cattle can not use soft corn, but that it had best be fed early in the feeding period and the cattle later finished on harder, more mature corn. However, if the corn does not run over 25 to 35 per cent moisture, it can be used with much satisfaction in the finishing of cattle if fed often enough and providing it is of good quality.

The hogs which are following the cattle receiving the soft corn will not do as well as those following cattle receiving hard matured corn, for the reason that not so much appears in the droppings.

That cattle can be fattened on soft corn, there is not any question, if the soft corn is of good quality and is fed in sufficient quantities and for a long enough time.

The amount of supplement to feed with soft corn, we usually recommend as somewhat less than with mature corn, this being particularly true if immature corn silage is used. Generally speaking, allow about 10 to 20 per cent more supplement, or about 2½ to 3½ pounds to a 1,500pound steer, as compared to the usual allowance of 3 pounds. The standard recommendation is to feed 2.5 pounds of cottonseed or linseed oil meal per 1,000 pounds of steer daily, when the steer is receiving a carbohydrate ration largely, such as silage, timothy hay, corn fodder, corn, oat straw, and the like. If the roughage, tho, is made up entirely of alfalfa or red clover, but little high protein supplement will be required. In 1902-03 at the Iowa Station two-year-old steers, weighing approximately 1,100 pounds, ate somewhat more of medium soft corn (containing 35 per cent moisture at the beginning of the test, and running down at the end of the period to a 16 per cent basis in moisture), than of old, hard, matured two-year-old corn, running a little over 11 per cent moisture. This indicates that more soft than hard corn must be fed; it also indicates that to feed often is in order.

The cattle gained practically as well on the somewhat soft corn as on the hard two-year-old mature corn.

The dry matter in the somewhat soft corn, whatever is there and that is the main rub, is equally if not more efficient than the dry matter in the hard, mature, two-year-old corn. The quality of this soft corn in 1902-03 was good. There was actually required for 100 pounds of gain, less of the new corn than of the old; but this may be explained primarily because of the softness of the corn—the steers thus being able to masticate it more thoroly and thus less of it was voided in the droppings undigested. When we remember that two-year-old hard corn was used, in truth a very hard corn, or else it would not have run as low as 11 per cent moisture, we can readily see that the steers would void considerable of the kernels, because of the hardness, which would discourage thoro mastication and digestion.

The cattle finished well on the somewhat soft corn. The shrinkage enroute to market was practically identical, but slightly in favor of the old corn fed steers.

In cattle feeding if the corn is not too soft, good results may be expected from its use. The quality must be looked to, and one must not expect damaged, heated, sour, soft corn dry matter to be as efficient as high quality, old corn dry matter.

#### SHEEP FEEDING ON SOFT CORN

In sheep feeding, soft corn has been fed to advantage. It is, however, a good plan to allow some good, dry hay, such as alfalfa or red clover, in conjunction with the corn, this being true whether the corn is soft or mature, because there is likely to be less loss when such legume is fed. Emphasis should be placed upon this point: Make all changes gradually. Teach the sheep to eat new corn, taking plenty of time to get them on a feed of it. Any sudden change in the sheep lot may be instrumental in throwing the sheep off feed, and thus possibly cause their loss.

Moldy corn, of course, is not best for sheep, and due precaution should be taken in the feeding of it; the more moldy the corn, the greater the general risk.

# DRY MATTER VALUES OF CORN AT DIFFERENT STAGES

The yield of important dry matter in corn at different stages on the acre basis as figured from Indiana results of Jones and Huston on basis of 100 as final mature yield is given herewith:

Stage of Growth	Corn plus cob (ear)	Stalks, blades, husks, etc. (stover)	Entire corn plant
Four feet high, July 24. First tassels, Aug. 6 Silks drying, kernels forming, Aug. 28 In the milk, Sept. 10 In the glaze, Sept. 24 Well dented, Oct. 1 Ready to shock, Oct. 8	$ \begin{array}{r} 14.56\\43.73\\74.56\\89.19\\100.00\end{array} $	$\begin{array}{c} & & & & \\ & & 90.21 \\ & & 92.41 \\ & 100.28 \\ & & 101.84 \\ & & 100.00 \end{array}$	7.76 23.85 48.53 65.59 86.11 94.87 100.00

In the early kernel stage, less than 15 per cent of the dry matter found at maturity is yet laid down in the ear, and only 44 per cent in the milk stage. If frost comes when the milk still shows plainly, the yield is approximately half in dry matter, as compared to the normal matured yield. The stover (without ears) contains more than 90 per cent of the total possible dry matter as early as the milk stage, this demonstrating that in frosted corn the greatest damage in yield is to the ears, which are really "nipped in the bud," and not allowed to develop.

The chemical feed constituents in 100 pounds of dry matter of the ear corn, cob and all, at the different stages as figured from Indiana results (Bull. Ind. Agr. Expt. Sta. 175), of Jones and Huston are given herewith:

Stage of Growth	Moisture in ear when husked	Protein	Carbohydrates, starches, sugars, etc.	Crude fiber	Fat	Minerals	Pounds fat form- ers with every pound of protein
Four feet high, July 24 First tassels, Aug. 6 Silks drying, kernels forming, Aug. 28 In the milk, Sept. 10 In the glaze, Sept. 24 Well dented, Oct. 1 Well oct. 0 shock. Oct. 8	84.40 68.89 55.15 50.23 43.99	$\begin{vmatrix} 13.47 \\ 11.10 \\ 8.94 \\ 9.73 \\ 9.49 \end{vmatrix}$	62.72 72.67 77.20 77.83 77.65	3.03 3.61 3.62 3.49 3.98	.19 .75 1.83 1.93 2.41	.49 .69 .76 .77 .82	$6.30 \\ 8.07 \\ 10.54 \\ 9.60 \\ 9.92$

The protein is lowest in the glazing stage, and the ratio of protein to carbohydrates (or fat formers) is widest at that time. Corn ears frosted in the glazing stage require more supplement, such as meat meal, oil meal or others, when fed to the live stock than when mature. The protein tends again, apparently, to proportionately increase at maturity. In practice, we find that swine naturally eat more tankage with new, immature, soft corn than with old, mature, hard corn. Such corn is low in germ quantity, hence the addition of corn oil cake meal to the tankage supplement is in order.

How does the feeding value of soft corn of varying degrees of moisture compare with the feeding value of mature corn? On the dry matter basis, we find that there is a wonderfully big difference between ear corn that contains 10 per cent moisture in both the grain and the cob, and that which contains 60 per cent in the grain and 65 in the cob. To be more specific, it will take 230.46 bushels of the higher moisture corn (60 per cent in grain) to furnish the same amount of dry matter as 100 bushels (7,000 pounds) of the 10 per cent moisture corn.

The relative dry matter and moisture contents in ear corn, as shown in data compiled with assistance of II. D. Hughes and Mr. Stanfield, of Farm Crops and Soils Section, Iowa Agricultural Experiment Station, is given below:

Moisture in corn grain (per cent)	Moisture in corn cob at corre- sponding time	Bushels (70 pounds) of the ear corn required to have the same amount of dry matter as a hun- dred of 10 per cent standard
60	65	230.46
50	60	187.65
35	55	148.92
25	45	127.42
20	35	116.92
15	22	107.5
10	10	100.

Note that it takes 230.46 bushels of ear corn (70 pounds), the grain of which runs 60 per cent water, to furnish equivalent dry matter of 100 bushels (70 pounds) that carries the very, very, dry grain with 10 per cent.