NATIONAL CORN HANDBOOK

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Utilizing Drought-Damaged Corn

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Drought occurs in some corn growing area of the United States almost every growing season. When drought occurs, farmers need to know how severely their crops are stressed and how the stress will affect yield. They also need to know what to do with crops that are drought-damaged. This publication explains the effect of drought stress and how to identify it and also describes alternatives you can consider when severe drought stress has occurred. Included are tables to help estimate the value of drought-stressed corn silage.

IDENTIFICATION OF DROUGHT STRESS AND EFFECT ON CORN GROWTH AND YIELD

Inadequate moisture during any period of growth can result in reduced grain yield. Nutrient availability, uptake, and transport are impaired without sufficient water. Plants weakened by stress are also more susceptible to disease and insects. Severe moisture stress is indicated by leaf wilting that is alleviated only when the plants receive additional water.

Four consecutive days of visible wilting can reduce potential corn yield by 5 to 10% during the vegetative growth stage. And, during silking and pollination, yield reduction after 4 consecutive days of wilting can be as much as 40 to 50% (see Table 1). Moisture stress during this period can result in a lack of synchronization between pollen shed and silking at pollination, because pollen grains may not remain viable and silking may be delayed.

Within 1 to 3 days after a silk is pollinated and fertilization is successful, the silk will detach from the developing kernel. Thus, you can carefully remove the husk leaves from an ear shoot, shake the cob, and estimate the degree of successful fertilization by observing how many silks shake loose from the cob.

Another method to determine whether drought-stressed corn plants have been pollinated and fertilized is to look for small white blisters on the ear 7 to 10 days after pollen shed. To identify the blisters, take ears from several areas in the field and break them in half. Using a knife, dig out several kernels on each ear. If you find kernels that resemble blisters on the ears, you can assume that kernel fertilization occurred. It you are unsure whether fertilization has occurred, observe the kernels again in 5 to 7 days. If the kernels were fertilized, the blisters will have rapidly increased in size. If fertilization did not occur, the kernels will not have increased in size. It is also possible to tell it fertilization has occurred by slicing the kernels longitudinally through the embryo side and looking for the young embryo. Only fertilized kernels will produce embryos. Most kernels that have been fertilized will continue to develop and mature if the plants get water.

If a plant has tasseled and shed pollen but no blisters have appeared, it will be barren. A common result of prolonged moisture stress or moderate moisture stress during late pollination is the production of ears with barren tips. This occurs because the tip kernels were not pollinated or were aborted after pollination.

Drought stress prior to tassel and silk appearance may result in small ear size. From the 10-leaf to the 12-

Table 1. Effects of Drought on Corn Yield.

Stage of development	Percent yield reduction*
Early vegetative	5-10
Tassel emergence	10-25
Silk emergence, pollen shedding	40-50
Blister	30-40
Dough	20-30

Source: Classen, M.M., and R.H. Shaw. 1970. Water deficit effects on corn. II. Grain components. Agron. J. 62:652 -655.

* From 4 consecutive days of visible wilting.

leaf stage (V10 to V12), potential kernel row number is determined in the corn plant. From the 12-leaf to the 17-leaf stage (V12 to V17), potential kernel number per row is determined. Moisture stress during these vegetative periods may reduce both ear length and the number of potential kernels on each ear. If ear size is reduced during this period, it cannot be corrected by relieving the moisture stress later in the season.

Drought stress after pollination and fertilization will result in aborted kernels or poor kernel fill, causing iow test weight and reduced yield. It may also predispose the plants to development of stalk rots.

POSSIBLE REVENUE SOURCES IF YOU ARE AFFECTED BY DROUGHT

Crop Insurance

If you are covered either by the Federal Crop Insurance Program or by a private insurance company, check with your insurance agent before harvesting a drought-damaged crop for either grain or silage. Inspections should be made to determine the difference between actual anticipated yield and the amount covered by the policy. Insurance settlements are based on this difference.

Agricultural Stabilization and Conservation Service (ASCS)

If you are expecting severe yield reductions due to drought, report this to your county ASCS office before the crop is harvested. If the drought is widespread, there may be the possibility of emergency or low-interest loans.

UTILIZING DROUGHT-STRESSED CORN

If you determine that plants have not been pollinated and kernels have not been fertilized (no blisters) and therefore no grain will be produced, you can pursue several alternatives, depending upon your geographical location. In the northern U.S., the two best alternatives are either to feed the forage to livestock or to prepare for winter wheat planting. In the southern U.S., additional options include planting late grain sorghum or soybeans or leaving the damaged crop in the field until fall and then converting the field to pasture.

Using Drought-Stressed Corn for Livestock Feed

Harvesting for silage. Ensiling stressed corn is preferred to chopping or grazing because of the potential for nitrate toxicity. The potential for nitrate toxicity is practically eliminated during the fermentation process. If nitrate toxicity is a concern, testing for nitrate should be done after the forage has gone through the ensiling process. Other management practices that will reduce the chance of nitrate toxicity include:

- Diluting high-nitrate feeds with low-nitrate feeds, such as grain or legume hay.
- Raising the cutter bar to leave 10 to 12 inches of the stalk in the field. Nitrate tends to accumulate in the lower portion of the stalks of drought -stressed corn.
- Introducing drought-stressed corn forage slowly so the rumen bacteria can adapt to it.

Ensiling high-nitrate forage can result in production of various nitrogen oxide gases. These gases are highly toxic to humans and livestock. The danger of silo gas can exist from ensiling time to 4 weeks later. During this period, do not enter a silo without first running the blower for 15 to 30 minutes. It is also recommended that a hatch door be opened just above the level of the forage when running the blower and that a self-contained breathing apparatus be worn if you must enter any silo during the first 4 weeks after filling it. Any person exposed to silo gas should seek immediate medical attention to combat delayed poisoning symptoms.

For silage, moisture concentration should be between 55 and 70%. Green barren stalks contain between 75 and 90% moisture but will dry down rapidly if weather remains hot and dry. Most states have Extension bulletins available on the subject of corn silage, and farmers can refer to these, as well as to NCH-49, "Corn Silage Harvest Techniques," for more information.

Feeding drought-stressed corn silage. Before making and feeding silage, be sure that all pesticides applied to the crop are cleared for silage use. The interval between final application and allowable harvest may differ for silage and grain. Be sure to check the label of any chemical that was applied.

Before drought-stressed corn is chopped for silage, test moisture percentage. Even though lower leaves may be brown, plants can contain 75 to 90% water, which is too wet for acceptable silage fermentation. If drought -stressed corn has pollinated, it is best to delay harvest as long as some green leaf and stalk tissue remains and the black layer has not formed on kernels. Rainfall and subsequent relief of moisture stress can increase grain dry matter and silage quality.

The feed value of silage made from drought-stressed corn is between 90 and 100% of that of silage made from well-earned corn, based on equal dry weights of the two feeds. Crude fiber and crude protein will be somewhat higher and TDN (total digestible nutrients) lower than with normal silage, because ears from drought -stressed corn may contain 50% or more cob compared to 20% cob on normal ears. Drought -stressed silage should be tested for moisture percentage and feed value. Shelled corn from drought -stressed plants contains between 90 and 100% of the feed value of normal shelled corn. Test weight will be lower. Market discounts on low test -weight corn -are often greater than the reduced feeding value, so this shelled corn is a good buy for a livestock producer.

Selling drought-stressed silage. Yields: For moisture -stressed corn, you can expect to harvest about 1 ton of silage per acre for each 5 bushels of corn grain per acre that could be harvested. For example, if you expect a grain yield of 50 bushels/acre, you can expect 10 tons/acre of 30% dry matter silage. If very little or no grain is expected, a rough pre-harvest estimate of yield can be made by assuming that 1 ton of 30% dry matter silage can be obtained for each 1 foot of height of plant material, excluding the tassel.

Dollar Value: The dollar value of corn silage depends on the value of harvestable grain, the cost of purchasing other feed substitutes, and the cost of harvesting, Well-eared, high-yielding corn will have 6 to 7 bushels of No. 2 dry shelled corn per ton of 30% dry matter corn silage.

Drought -stressed corn may have about 5 bushels of corn grain per ton of silage. At the minimum, each ton of silage is worth about 5 times the current price per bushel of shelled corn plus 50 cents to cover the added cost of harvesting and storing corn silage rather than grain. If the buyer harvests and stores the silage, $2 to $2.50 per ton should be subtracted because the seller will pay nothing to harvest the crop. Another way to value the silage is based on feed value. On this basis, 1 ton of 30% dry matter corn silage will substitute for about one-third of a ton of alfalfa hay. This is a rough approximation based on energy with no adjustment for protein differences.

Selling Price: Table 2 presents dollar values calculated for drought -stressed corn silage over a range of corn grain and alfalfa hay prices. Find the current prices for corn grain and alfalfa hay in this table. The silage values based on the prices for the two commodities represent the range of bid prices you can ask for your drought -stressed silage. You should receive at least the minimum price determined by the table, or you might as well harvest and market it as grain. Table 3 lists prices for drought -stressed corn silage based on both energy (TDN) and crude protein (CP) content for a range of corn grain and soybean meal prices. These prices were calculated assuming 30% dry matter corn silage with 65% TDN and 10% CP. The actual exchange price for drought-stressed corn silage will vary by area, depending on the relative supply and demand.

Harvesting for green chop. If drought -stressed corn is green-chopped, it should be tested for nitrate concentration prior to feeding. When drought conditions prevent normal plant growth, the corn stalk may contain abnormally high levels of nitrate, which, if fed in excessive amounts, can cause animals to go off feed or die. Under most feeding situations, the nitrate level in feed must be over 2% to cause a problem. Nitrate testing of feed is especially important if high rates of nitrogen fertilizer or manure were applied or if the soil has a high organic matter content. A return to non-stressed conditions following substantial rainfall should decrease nitrate accumulation, but chopping should be delayed for 3 to 5 days.

Table 2. Dollar Value of Drought-Stressed Corn Silage, Based on the Price of Either Corn Grain or Alfalfa Hay.[1]

Price of corn grain	Silage value[2]	Price of alfalfa hay	Silage value[3]
per bushel	per ton	- - - per ton - - -	
$1.20	$6.00	$40.00	$13.33
1.40	7.00	50.00	16.67
1.60	8.00	60.00	20.00
2.00	10.00	70.00	23.33
2.20	11.00	80.00	26.67
2.40	12.00	90.00	30.00
2.60	13.00	100.00	33.33
2.80	14.00	110.00	36.67
3.00	15.00	120.00	40.00

Find the current prices for corn grain and alfalfa hay. The silage values based on the prices for the two commodities represent the range of bid prices you can ask for your drought-stressed silage.

[2]Value equals 5 times the price of corn grain.
[3]Value equals 1/3 the price of alfalfa hay.

Table 3. Value of Drought-Stressed Corn Silage, Based on Corn Grain and Soybean Meal Prices.*

Price of soybean meal ($/cwt)	1.80	2.00	2.20	2.40	2.60	2.80	3.00
		Price of corn grain ($/bu)					
		Value of corn silage ($/ton)					
6.00	16.97	18.54	20.11	21.68	23.24	24.81	26.38
6.50	17.21	18.77	20.34	21.91	23.48	25.05	26.62
7.00	17.44	19.01	20.58	22.15	23.72	25.29	26.86
7.50	17.68	19.25	20.82	22.39	23.96	25.53	27.09
8.00	17.92	19.49	21.06	22.62	24.19	25.76	27.33
8.50	18.16	19.72	21.29	22.86	24.43	26.00	27.57
9.00	18.39	19.96	21.53	23.10	24.67	26.24	27.81
9.50	18.63	20.20	21.77	23.34	24.91	26.47	28.04
10.00	18.87	20.44	22.01	23-57	25.14	26.71	28.28
10.50	19.10	20.68	22.24	23.81	25.38	26.95	28.52
11.00	19.34	20.91	22.48	24.05	25.62	27.19	28.76
11.50	19.58	21.15	22.72	24.29	25.86	27.42	28-99
12.00	19.82	21.38	22.96	24.52	26.09	27.66	29.23
12.50	20.06	21.62	23.19	24.76	26.33	27.90	29.47
13.00	20.29	21.86	23.43	25.00	26.57	28.14	29.71

* Find the current price for corn grain in the row at the top of the table and the current price for soybean meal in the far left-hand column. You will then find the value of silage at the intersection of these prices.

Harvesting Drought-Stressed Corn for Grain

The decision to harvest low-yield grain should be based partly on whether the value of the harvested grain covers the harvest cost. If only a localized area is stricken by drought-even an area as large as a single state-you cannot expect a significant increase in corn price, which could compensate for low yields. If the drought is widespread–t hat is, if it affects the major corn producing areas in the United States–then harvesting a low-yield crop may be profitable because the market price will likely increase.

Because the ears on moisture-stressed plants will probably be small, some combine adjustments will be necessary. Consider making the following adjustments:

- Review the operator's manual for suggestions on harvesting a light crop.
- With short or lodged corn, run the gathering snouts and chains low. Watch for stones, and be sure stone -protective devices are working.
- Drive carefully and at normal or lower speeds to avoid excessive harvest loss and machine damage from stones.
- For small ears, set stalk rolls and snapping plates closer than normal to snap off a higher percentage of ears. Don't attempt to snap off barren cobs.
- If clean shelling is a problem, increase cylinder speed slightly and, if necessary, decrease cylinder -concave clearance. With a rotary machine, check rotary-concave clearance. Avoid excessive damage to kernels from good ears.
- If cleaning losses are high, open the chaffer and chaffer extension slightly.
- Initially decrease the amount of air from the cleaning fan. If cleaning becomes a problem, either increase the fan blast and close the lower sieve slightly, or clean the corn out of the combine as it is put in the bin.
- Be alert to changes in weather and crop conditions and make adjustments as necessary.
- Excessive fines or "bees wings" can result from harvesting drought-damaged corn. These fines can build up in the center of a storage bin as it fills, attracting moisture and causing storage problems. Be aware of possible storage problems with drought-damaged grain.

SWITCHING TO ANOTHER CROP

Winter Wheat

If you choose to plant winter wheat, you must be sure that your herbicide program permits wheat planting. With most corn herbicides, except atrazine or simazine, there should be no residue problems for planting wheat as long as recommended rates were applied. If the corn crop was adequately fertilized with nitrogen, there may be sufficient nitrogen remaining to eliminate a fall application to wheat. Most residual nitrogen will be converted to nitrate and may be lost by leaching, so spring nitrogen application to wheat should not be reduced.

Grain Sorghum or Soybeans

Before deciding to replace a drought -stressed corn crop with either grain sorghum or soybeans, you must consider the herbicides used on the corn and the potential of injury to sorghum or soybeans from herbicide carryover. You should carefully check herbicide labels and contact your local Extension Service before risking loss of another crop to herbicide injury. If, after you have reviewed the herbicide risk, grain sorghum and soybeans are still viable alternatives, several other factors should be considered. These include availability of a market, your potential of producing a break-even yield (a yield high enough at your anticipated price to pay for all variable costs of production), compliance with ASCS set-aside and other government program provisions, and the date of your decision relative to optimal planting dates for your area.

REDUCING THE RISK OF DROUGHT STRESS

The only sure method to avoid drought -stressed crops is to use irrigation. Other management practices, however, can help reduce the risk of drought stress in many years.

- **Early planting.** By planting early, you increase the chance of having pollination completed before the driest part of the season.
- **Optimum fertilization.** Proper fertilization will promote healthy plant growth and efficient moisture utilization, essential for high yields in both normal and dry years.
- **Planting corn hybrids of varying maturities.** Planting a range of hybrid maturities may spread out the risk of moisture stress at pollination.
- **Adequate weed control.** Weeds compete with crop plants for water, so controlling weeds will provide more water for the crop.
- **Residue management.** By maintaining a cover of residue through conservation tillage or no-till, you can reduce the amount of evaporation from the soil surface and conserve water for the crop's use

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