Managing Drought Stressed Corn

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Drought and its effects are often part of growing corn in Pennsylvania. Although we can do little to influence the weather, we can make management decisions that minimize the impact of the drought on the utilization of the crop. Fortunately, our livestock based agriculture means we have many ways to salvage corn in our state. If you're faced with a crop of drought-stunted corn, consider some of the ideas below in managing this kind of crop.

Assessing the situation. The condition and yield potential of the crop should be monitored as the season progresses. This allows you to begin to consider other options for harvesting or meeting feed needs well in advance. Usually droughts in Pennsylvania are short term in nature and the main effects are reduced grain and silage yields. In the most severe cases, however, drought stress can result in the need for an early salvage harvest for silage.

As the drought progresses, consider identifying ways to market your crop as silage, since returns are often greater than harvesting for grain. Check with your Crop Insurance representative or FSA office before harvesting the crop. Livestock producers should begin to assess winter feed inventories and explore opportunities for purchasing corn silage, western hay, or other forages.

Estimating yield potential of drought stressed corn. Yields will be variable depending on the timing and severity of the drought. Drought stress is most severe when it occurs within two weeks before or after silking. A rough estimate of the potential grain yield can be obtained using the kernel count method (see inset). An estimate of wet (70% moisture) silage yield is about 1 ton per foot of height of corn without ears or poorly pollinated ears. This estimate may be high on very short (1-3 foot tall) crops.

Estimating Corn Yields

To make an approximate preharvest estimate of corn yields, count the number of kernel rows on a representative ear. Also count the number of kernels/row. Next determine the number of ears/acre.

Now, multiply the kernel rows by the kernels/row and then by the ears per acre. Divide this number by 90,000 to get bushels/acre.

Repeat this process at several areas in the field to get a representative sample of the crop. The final yield will depend on conditions during grain fill- this estimate is for average sized kernels. Under continued drought stress through grain fill this may overestimate yields.

Example:
16 kernel rows x 25 kernels/row x 25000 ears/A= 10,000,000 kernels/A

10,000,000/90,000 kernels/bu=111 bu/A

For corn fields with no ear development that are losing leaves and not unrolling at night, the yield potential will be likely low- from 0-50 bushel/acre or so. For fields that have a good stand and are exhibit leaf rolling only during the day, there may still be good yield potential if the drought is relieved by mid August. Fields that experience drought well into August often will have lost a significant amount of their top end yield potential, perhaps 50 bushels per acre or more, even if conditions would be perfect from then until the end of the

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season. Fields following soybeans or hay (not double cropped) often will tolerate the drought much better than fields following corn.

Salvaging drought stressed corn for silage. Corn has a remarkable ability to recover from drought stress, so delay a salvage harvest as long as possible. If the corn has tasseled and leaves cease to unroll at night and the tops start to brown out, the plants are probably not going to recover. As browning of the crop continues, the forage quality will decline as the plants are using stored carbohydrates in the leaves and stalk to sustain themselves. If half the leaves were dead or dying it would be a good candidate for evaluating for silage harvest. At this point you should probably consider harvesting it for silage. Delaying harvest will reduce yield and quality and reduce the potential for planting a second crop.

Moisture testing is essential in these situations because corn is often wetter than it appears. If the forage is extremely wet (greater than 75-80%), then harvest should likely be delayed since this will result in seepage and a loss in silage quality. Excessively wet silage like this has caused silos to collapse in some situations. Avoid chopping when the moisture is below 60-63%. If a drought ending rain occurs just before a planned salvage harvest, the moisture content of drought stressed, immature corn will increase, so harvest should be delayed in this situation.

Potential silage quality. Drought stunted corn will likely be higher in protein and some minerals than normal silage and lower in energy. The fiber levels are often higher in silage with less grain content but often the digestibility of that fiber is higher. An example of forage quality from six drought-stunted, 6-7 foot tall corn crops salvaged in mid August is shown in Table 1. Note the elevated crude protein, NDF, nitrate, Ca and K levels compared to normal corn silage. Forage quality differences are less if drought stunted corn develops some grain and is harvested near normal maturity. Without grain, starch concentrations will be very low.

When drought stunted corn is allowed to reach maturity and has some grain formation, forage quality will be impacted as well. In Table 2, forage quality values are shown for the same hybrid produced on the same farm in 1998 (normal rainfall) and 1999 (drought). The drought-stunted corn was about 6 feet tall with 6-inch long ears. Note that crude protein, NDF, Ca and K levels are elevated in the drought year as well but not to the degree that occurred in the immature corn in Table 1. Notice also that the lignin levels are also reduced in the drought-stunted corn and that the digestibility is similar for the two years despite the reduced starch in the 1999 crop. The drought-stunted crop also had moderate damage from European corn borer in the ears and some evidence of ear molds.

When feeding drought stressed corn silage, be sure to get a forage test so that you can have rations adjusted effectively. Drought-stunted, low grain corn silage also tends to be less dense- as a result; truck and silo capacities are often lower. Because of the lower grain content, drought stressed corn will be less responsive to kernel processing.

Table 1. Forage analyses of drought stunted corn obtained in Lancaster County in 1999.

Farm	CP	NDF	NEL	Ca	P	Mg	K	Nitrate-N
	%	%	Mcal/lb	%	%	%	%	ppm
1	9.1	56.8	0.62	0.44	0.22	0.13	1.34	1053
2	9.6	53.3	0.63	0.31	0.23	0.13	1.59	1263
3	11.3	53.3	0.67	0.44	0.27	0.12	1.40	947
4	10.1	50.1	0.66	0.21	0.26	0.12	2.04	1474
5	10.7	52.0	0.66	0.38	0.25	0.12	1.99	1684
6	8.4	49.6	0.70	0.27	0.22	0.12	1.06	737
Normal	8.1	45.0	0.73	0.28	0.26	0.17	1.20	

Table 2. Forage analyses from the same hybrid grown in a normal year (1998) and drought (1999) year in Lebanon County.

Year	CP	NDF	IVDMD	Ca	P	Mg	K	Lignin	Starch
	%	%	%	%	%	%	%	%	%
1999	8.4	41.1	74.5	0.29	0.27	0.26	1.65	1.8	32.9
1998	7.8	38.3	74.9	0.18	0.30	0.20	1.10	2.0	39.5

Nitrate concerns. Elevated nitrate concentrations are common in drought stressed corn crops. The potential is greatest for high nitrate levels in young plants, especially in the stalks and especially in heavily manured fields. Typically elevated nitrate levels are common in Pennsylvania but only occasionally at toxic levels. The potential is generally greatest for 3-4 days following a drought ending rain, but can be a problem anytime.

Leaving a 12-inch stubble in the field can reduce nitrates but this would also reduce yields and may not be desirable unless a forage test confirms the presence of high levels of nitrates. Because the nitrate potential can be reduced through ensiling, grazing and green chopping drought stressed corn are not desirable harvesting alternatives. Even though nitrates are a concern, experience from testing and feeding past drought stricken crops indicates that excessive nitrate levels (>1700 ppm NO_3-N) are not that common and that with good management most nitrate related problems can be avoided with careful feeding management.

High nitrates can contribute to animal feed problems and deadly silo gas. Be especially cautious when filling silos with these suspect crops. Silo gas is produced during the first 4-5 days after silo filling when nitrates are converted to oxides of N (NO, NO_2, and N_2O_4). Of these, NO_2, or nitrogen dioxide is the most common and is a yellow orange gas with a bleach-like odor. This gas is heavier than air and can form in the silo and then escape down the unloading chute into the barn, endangering both humans and cattle. Exposure to silo gas can cause immediate death or severe lung injury due to the formation of nitric acid in the lung. To avoid exposure to silo gases, keep the door between the feed room and the barn closed,

ventilate the silo by running the blower for at least 20 minutes before entering the silo and learn to recognize the bleach –like odor and yellow-orange color as signals of silo gas.

Pricing Silage. Often the price is influenced by local supply and demand. The Dairy and Animals Science Department at Penn State maintains a spreadsheet with current estimates of feed and forage prices at:
http://www.das.psu.edu/pdf/feedprices.pdf

Values of drought stunted corn will vary but in one recent scenario of prices, drought stunted corn with few ears was worth about 91% of normal silage, while drought stunted corn with no ears was worth only 66% of the value of normal corn silage. When pricing corn silage be sure to consider harvesting and hauling costs as well as the moisture content of the silage.

Ear molds. Hot, dry conditions associated with drought years are generally not thought to be conducive to growth of typical Fusarium molds that are common in Pennsylvania, but if European corn borer damage to the ear is significant, Fusarium molds can develop. Fusarium molds often appear as white or pink molds on the ear and are responsible for most of the mycotoxins we encounter in Pennsylvania. The presence of the mold does not indicate that mycotoxins will be present, however. The only sure way to determine if mycotoxins are present is through testing. Many forage testing laboratories can run a mycotoxin assay. In most cases mycotoxin analyses are warranted only if a problem is suspected.

Hot, dry conditions are conducive for the development of Aspergillus fungi, which is sometimes reported in Pennsylvania. Some species of Aspergillus can result in aflatoxin. The Aspergillus fungus is a greenish yellow mold that appears on the ear.

Common Smut is another common fungus that frequently appears during drought. Smut produces large gray smut galls on the ears, tassels or at the nodes. Smut does not produce mycotoxin so smut contaminated for is generally considered safe to feed.

Standability. Frequently drought stressed grain crops will have lower than average resistance to stalk rots. This results because the plant uses carbohydrates reserves from the stalk to fill the grain during periods of late season stress. It may pay to scout fields during the early fall to determine if any are at risk for stalk lodging problems. Typical symptoms will include some broken stalks and light and hollow stalks pink coloration in the inside of the stalk or some discoloration at the nodes inside the stalk. Fields with these symptoms would be good candidates for early harvest.

Economics of harvesting. Usually is still worthwhile to harvested drought stricken corn, but on some of the most drought stressed fields it may be a tossup. The variable costs such as fuel, labor and repairs, associated with chopping a light corn crop are in the $15 to $25/acre range, so if producers can harvest at least one ton of silage per acre valued at perhaps $20/ton they will break even. To achieve this yield may require corn about two feet tall.

Replanting options following corn. This will depend on the herbicide program used for corn. Generally, sorghum-sudan grass may be the most viable option if planting can be achieved by early August. Small grains, annual ryegrass or soybeans are also alternatives in some

situations, but dry weather may make atrazine carryover high which will damage the more sensitive crops like oats and soybeans. Of the small grains, rye has the most tolerance to atrazine. Spring grains such as oats can provide fall growth but oats is the most sensitive to atrazine. Check herbicide labels for replanting restrictions-for example small grain crops are not registered to be cropped until the year after application of atrazine. If corn fields are unsatisfactory for planting fall forage crops, small grain stubble fields could be used to establish a fall small grain or annual ryegrass emergency forage crop. For highest fall forage yields consider using a spring grain in this situation.

Planning for the future. Drought stress on corn is not uncommon in Pennsylvania, although it varies from farm to farm depending on rainfall and the soil water holding capacity. Generally, shallow or shaly soils are most prone to risk from droughts over the long term. In situations where drought stress is common it is often wise to consider whether growing any corn is good idea. Often other crops may be more profitable than corn grown for grain. One solution is to reduce the amount of corn in the rotation and substitute soybeans or barley in the rotation. This provides some diversity in crops that can tolerate stress better and also results in corn that can tolerate stress better because it is grown in a rotation. We know that corn following corn often fares poorly in a drought. A second strategy might be to only grow corn for silage and purchase the corn grain needed on the farm. A third strategy might be to increase the amount of storage for corn silage on the farm to help cover lower yields during drought years. Another strategy might be to consider using crop insurance to cover losses during the occasional drought year.