Drought and Heat Effects on Corn and Soybean

- Drought and high temperatures occurring at specific growth stages can reduce corn and soybean yield potential.
- Managing stress from insects, disease, and nutrient deficiencies can reduce the degree of overall stress.
- Corn is most sensitive to stress during pollination and grain fill, while soybean is most sensitive during the 2nd—4th week of seed-fill.

Corn and Drought

Moisture stress during corn grain fill increases the chance for leaves to die and plants to lodge while reducing kernel weight and potentially shortening the time period available for grain fill. Corn is most sensitive to drought stress during the pollination process where delays in silk emergence and elongation relative to the shed of viable pollen can result in poor pollination success or even complete plant barrenness, leading to significant loss of yield potential. However, kernel abortion and reduced dry weight accumulation in the kernels can occur after pollination. Yield loss during grain-fill may still be 3.0 to 5.8 percent per day of stress. Developing kernels, especially those near the tip of the ear, can be prone to abortion if temperatures are high and moisture is limited during the two weeks following pollination.

The potential number of cells that can accumulate starch is determined by cell division that occurs in the endosperm during the first seven to ten days after pollination. Dry weight accumulation is the yield component that is affected after the kernels have reached the dough stage. Limited amounts of photosynthate to nourish the developing kernels can cause kernels to be smaller and lighter, also known as “shallow kernels”. Premature formation of black layer during high temperature periods can also reduce grain fill because further kernel development is terminated.

Corn and Heat Stress

Even with sufficient moisture, high temperatures can cause a high degree of stress on the plant. Both high day and night temperatures can have an effect on corn yield potential. Iowa State University reports that a one percent corn yield loss can occur after four consecutive days of temperatures at 93° F or greater. On the fifth day of these high temperatures, another two percent yield loss can occur, and on the sixth day another four percent can be expected. A heat wave that lasts longer than six days often results in firing of leaves and lower yield potential may be expected, especially when the heat wave coincides with silking.

High temperatures stimulate respiration, and sugars that could have been stored in grain are burned up. This can be especially true when nighttime temperatures remain high and sugars are being used while no photosynthesis takes place. Thus, high nighttime temperatures can reduce yield potential without plants showing visible signs of stress. High humidity can compound problems associated with high daytime temperatures by slowing the ability of the plant to cool down in the evening.

Corn Management

Future management decisions should be made based on the success of pollination. If kernel set is good, the crop has some potential to produce grain. However, if potential yield is less than 25 bushels per acre, harvesting for
silage/hay may be the best option. Corn for silage is preferred over hay, and plants should have 65 to 75 percent moisture.

Fields that are drought stressed to the point that plants have lost some bottom leaves, and the top leaves have browned off or turned white may be candidates for silage or hay. However, plants that do not grow normally can have high nitrate levels, especially in the lower portion of the stalk. Haying high nitrate corn will not reduce the level of nitrates, and cutting height should be at least six to eight inches above the ground to help avoid nitrate toxicity. It is strongly recommended that the hay be tested for nitrates before feeding. The level of nitrates in corn can be estimated by a test kit purchased on the internet or from Extension offices. Samples can be taken before harvest or in the corn after ensiling. Additional samples can be sent to a lab for further analysis if kit results indicate high levels of nitrate.

**Soybean and Drought**

Moisture stress during the soybean reproductive stages causes floral abortion, reduced pod number, fewer seeds per pod, and reduced seed size. Moderate drought stress can significantly reduce or irreversibly stop nitrogen fixation, disrupting seed development. From the second through the fourth week of seed fill, a 39 to 45 percent yield decrease can occur when there are four days of visible moisture stress. Soybean flowering stops, and plants cannot compensate for lost pods when drought stress occurs during the R4 through R6 (full pod through full seed).

**Soybean and Heat Stress**

It can be difficult to separate effects of high temperature from the effects of water stress in soybean plants. Often these stresses occur together and magnify the effects of each other. Extension Soybean Specialist Jim Dunphy, North Carolina State University, indicated, “when temperatures get above about 95° F, soybean plants simply can’t pump enough water to keep up with transpiration and evaporation. The plants close the stomates in their leaves and water can’t get out. That also means carbon dioxide can’t get in, and the plants can no longer get the carbon they use to make the sugars that fuel everything that goes on inside the plant.”

**Soybean Management**

Effects from drought are expected to be less on soybean plants compared to corn plants. If adequate rainfall occurs and photosynthate is available after R5, the plant may compensate for earlier losses by producing larger seeds (within its genetic capacity). Once the plant reaches R6, pods are not normally aborted. Managing stress from insects, disease, or nutrient sources can help reduce the overall stress load on the plant and potentially limit yield losses.

**U.S. Drought Monitor**

![Image of U.S. Drought Monitor map]

Figure 2. The U.S. Drought Monitor is a partnership between the National Drought Mitigation Center, United States Department of Agriculture, and National Oceanic and Atmospheric Administration. Map courtesy of NDMC-UNL.9

**Sources:**


For additional agronomic information, please contact your local seed representative.