Drought and Heat Stress in Corn and Soybean

Key Points

• Drought and high temperatures can stress corn and soybean crops.

• If the stress occurs at specific plant growth stages, decreases in yield potential may occur.

• Corn is most sensitive to stress during pollination and also at grain-fill.

• Soybean is most sensitive to stress during the second through the fourth week of seed-fill.

Corn in Drought

Corn plants are most sensitive to drought stress during the pollination process; however, yield loss during grain-fill may be 3.0 to 5.8% per day of stress.\(^2\) Kernel abortion and reduced dry weight accumulation in the kernels can occur after pollination. If temperatures are high and moisture is limited during the two weeks following pollination, developing kernels, especially those near the tip of the ear, can be prone to abortion. The number of cells that have the potential to accumulate starch is determined by cell division that occurs in the endosperm during the first seven to ten days after pollination.\(^2\) Dry weight accumulation is affected after kernels reach the dough stage. When there is limited photosynthate to nourish developing kernels, resulting kernels may be smaller and lighter, also known as “shallow kernels”.

If corn plants experience moisture stress during grain fill, there is an increased chance of leaf death and plant lodging, as well as a shortened time period for grain fill. Premature formation of black layer during high temperature periods also reduces grain fill because further kernel development is terminated.

Corn in Heat Stress

High temperatures, even in conjunction with sufficient moisture, can cause a high degree of stress on the plant. Both daytime and nighttime high temperatures can have an effect on corn yield potential. Iowa State University reports that a 1% corn yield loss can occur after four consecutive days of temperatures at 93° F or greater.\(^3\) On the fifth day, another 2% yield loss can occur, and on the sixth day, another 4% can be expected. A heat wave lasting a week or more often results in the firing of leaves and lowered yield potential expectations, especially when the heat wave coincides with silking. High temperatures stimulate respiration causing sugars that could have been stored in grain to be burned up. This occurs when nighttime temperatures remain high and sugars are being used while no photosynthesis takes place. Thus, high nighttime temperatures can reduce yield without plants showing visible signs of stress.\(^8\) Furthermore, high humidity can compound problems associated with high daytime temperatures by slowing the cool-down that occurs in the evening.

Management of Corn

Management decisions for the remainder of the season should be made based on the success of pollination. If kernel set is good, the crop has some potential to produce grain. However, if remaining yield potential is less than 25 bushels per acre, harvesting for silage or hay may be the best option.\(^4\) Corn for silage is generally preferred over hay, and plants should have 65 to 75% moisture. Fields that are stressed to the point that plants have lost some bottom leaves, and the top leaves have browned or turned white may be candidates for silage or hay. It is important to note that drought stressed plants 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 the cutting height should be at least six to eight inches above the ground to help avoid nitrate toxicity. It is strongly recommended to test the hay for nitrates before feeding. The level of nitrates in corn can be estimated by a test kit purchased from an Extension office or online. Samples may be taken before harvest or in the corn after ensiling.\(^9\) If kit results indicate high levels of nitrate, additional samples can be sent to a lab for further analysis.
Soybean in Drought

Moisture stress occurring during the soybean reproductive stages can cause floral abortion, reduced pod number, fewer seeds per pod, and reduced seed size. Moderate drought stress can significantly reduce or halt nitrogen fixation, disrupting seed development. From the second through the fourth week of seed fill, a 39 to 45% 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 R4 through R6 (full pod through full seed).

Soybean in Heat Stress

It can be difficult to separate the effects of high temperature from the effects of water stress in soybean plants. These stresses often occur together and magnify the effects of one another. Extension Soybean Specialist Jim Dunphy, North Carolina State University, indicated that “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.”

Management of Soybean

Drought effects are generally expected to be less damaging to soybeans as compared to corn. 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.

Drought Monitor

The U.S. Drought Monitor is a tool that can help track local drought conditions and can be accessed with the following website:

http://droughtmonitor.unl.edu/

The U.S. Drought Monitor is produced through a partnership between the National Drought Mitigation Center at the University of Nebraska-Lincoln, the United States Department of Agriculture, and the National Oceanic and Atmospheric Administration.

Sources


Web sources verified 5/30/16. 140602060604

For additional agronomic information, please contact your local seed representative. Individual results may vary, and performance may vary from location to location and from year to year. This result may not be an indicator of results you may obtain as local growing, soil and weather conditions may vary. Growers should evaluate data from multiple locations and years whenever possible.

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