SeedSCOOP

Corn Grain Fill During Drought Stress

The yield potential of corn is perhaps most at risk to drought and heat stress during pollination and grain fill. In many situations, drought stress is compounded by heat stress as these two stress components commonly occur simultaneously.

Pollination and Drought Stress

Drought impacts corn during pollination in two ways. Silks are mainly composed of water, so drought can reduce the growth rate and emergence from the ear tip. Corn that is water stressed will usually curl the leaves, thus reducing photosynthesis. Reduction in photosynthesis lowers the amount of nutrients provided to the developing kernels. Reducing the amount of sugars to the developing kernels during the week before and the week after pollination is critical in maintaining the kernel numbers. It is of the upmost importance to ensure that silks are available during pollen shed to obtain maximum yield potential.

Under severe drought stress, several days of wilting as evidenced by leaf rolling, silk elongation can be severely reduced. Silking begins with the ovules at the butt end of the ear and moves up the ear as the process continues. Under drought conditions the silks may be delayed in emerging and miss the pollen or desiccate to the point where they are not receptive to pollination resulting in completely barren ears. If moisture alleviates drought conditions during pollination, some ears may be partially filled. Additionally, drought stress can accelerate pollen shed, leading to increased potential for a lack of synchronization.

Figure 1. Drought stressed corn.

Image courtesy of G.J. Holmes, Strawberry Center, Cal Poly San Luis Obispo, Bugwood.org

If the plant is under significant drought stress with continual wilting for two weeks prior to silk emergence, yield potential can be reduced 3 to 4% per day. If the stress continues during silking and pollen shed, a yield reduction of 8% per day could occur. If the stress continues after silking for a two-week period, yield potential could be reduced up to 6%.[1]

Pollination and Heat Stress

Like drought, heat can significantly impact silk and tassel synchrony. If silking is delayed, most of the pollen may have already been shed, particularly when heat is combined with water shortage. If the silks begin to desiccate, then viability decreases, and the pollen tube can not grow, and pollination will not occur. This is particularly true if the high temperatures occur when humidity is low.

Pollen production and viability can be reduced with daytime temperatures above 95° F. Reduced kernel set can be the result of excessive heat during pollination, particularly in stress-prone areas of the field.

Figure 2. Poorly filled ear as result of heat stress.

R.L. Croissant, Bugwood.org.

Corn Grain Fill During Drought Stress

While excessive temperatures can reduce pollen production and viability, pollen shed usually occurs in the morning before temperatures become excessive. Additionally, pollen is produced over a period of about two weeks; hopefully allowing for temperatures to moderate. Heat stress alone will not usually negatively impact pollination if soil moisture levels are adequate.[1,2]

The Impact on Grain Fill

The ideal temperature range for corn is between 86° F for daytime and 50° F for nighttime temperatures. When daytime temperatures are high, photosynthetic capacity is reduced, so less sugars are produced. Coupled with high night time temperatures the respiration rate is increased using the reduced amount of sugars produced impacting the number of kernels set and filled.

Kernel abortion can occur when successful pollination is followed by drought or heat stress and is usually more frequent at the ear tip. Drought or heat stress during the first 2 weeks after pollination is the most critical in determining if abortion will occur. Aborted or poorly filled kernels will be small, shrunken and an off-white color. Kernel abortion may not always be the result of heat or drought stress, lack of nitrogen, excessive foliar disease reducing photosynthesis, or even several days without adequate sunshine can also result in kernel abortion.

Corn can be vulnerable to reductions in kernel weight through full maturity (R6 growth stage). Stalk weakness or lodging can result from severe heat or drought stress as the plant moves resources from the stalk to developing kernels. Premature death can occur under severe drought or heat stress. Yield losses will be greater when plant death occurs at stages at R5 or earlier. Premature death can also result in higher grain moisture content.[3]

Sources

[1]Nielsen, R. Drought and Heat Stress Effects on Corn Pollination. Purdue University Extension. https://www.agry.purdue.edu/ext/corn/pubs/corn-07.htm.

[2]Hoegemeyer, T. 2011. How Extended High Heat Disrupts Corn Pollination. University of Nebraska. https://cropwatch.unl.edu/how-extended-high-heat-disrupts-corn-pollination-0.

[3]Nielsen, R. 2018. Effects of Severe Stress During Grain Filling in Corn. Purdue University Extension. https://www.agry.purdue.edu/ext/corn/news/timeless/GrainFillStress.html.

Legal Statements