EARLY-SEASON DROUGHT STRESS IN CORN

While the greatest need for water in corn occurs during the later vegetative stages, the impact of early-season drought stress on corn can cause impacts that last the entire year. Drought conditions in the early season can hamper emergence, causing uneven stands, and can negatively impact ear length, overall leaf area, and root growth and development.

Impact on Germination[1]

Dry conditions within the seed zone at planting can lead to uneven germination and emergence across the field. This is particularly true when the seeding depth is variable, and some seeds are not placed in an area of adequate moisture for imbibition to occur. Corn seeds must absorb about twice their weight in water to initiate the germination process. Drastic differences in emergence can lead to later-emerging seedlings to essentially become weeds and be out-competed for resources to the extent that their contribution to yield is significantly reduced. (Figure 1)

Figure 1. Uneven development from variable emergence.

Impact on Roots[2,3]

Corn in the V3 stage is beginning to make the switch from relying on resources provided by the seed to relying on developing leaves and nodal roots. The first root system, the seminal roots, do provide early water and nutrient needs, but stops growing once the coleoptile emerges from the soil. The nodal root system is beginning to provide some resources at V3 and is the dominant source for soil resources by V6. Under an extremely dry soil surface, hot air temperatures (above 80°F) can result in the soil temperature reaching a level that causes death of the developing roots. In cases where the entire whorl set of roots is killed, moisture uptake by the nodal system must be delayed until another whorl set becomes established. Roots killed in this manner take on a “roasted” or burnt appearance. This may lead to what is referred to as “floppy corn” (Figure 2). As the name implies, the plant is without the anchoring system of the nodal roots, thus it relies on the strength of the mesocotyl to keep it upright. Winds can result in breaking or bending the mesocotyl so the plant simply flops over.

Figure 2. Floppy corn syndrome.

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Once the plant has lodged, there is not much that can be done. However, there are some steps that can be taken to help prevent floppy corn syndrome. Ensure that seeding depth is at least a 1 inch, preferably 1.5 inch, at a minimum. Try to eliminate soil compaction by not tilling fields that are too wet or planting when soil conditions are not fit. Make sure that the seed slot is completely collapsed at planting and not open (Figure 3).

Figure 3. Planting under wet conditions can result in an open seed furrow.

Impact on Leaves[4,5]

Early season development, up to V8, determines the size of the overall plant and the size of each leaf. Drought stress at this critical time period will reduce plant and leaf size (Figure 4). A small reduction in leaf size will not have a significant impact on yield, but the more the leaf size is reduced the less photosynthetic area will be available to contribute to yield. Extended drought that results in burned leaves and leaf death can significantly reduce yield potential. A common sight when corn is experiencing drought stress is leaf rolling. Four consecutive days of leaf rolling can result in a 5 to 10% yield reduction.

Figure 4. Drought-related stunting.

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Impact on Ear Length and Kernel Row Number [4,5,6]

Drought stress that occurs between V6 to V8 can impact the number of kernel rows. While this trait is genetically controlled, it can be modified by the environment. If the corn product is genetically predisposed to have 18 kernel rows but ends up having less than that, it is most likely due to some stress that occurred between the V6 to V8 growth stages. In an ear that has 16 kernel rows around, one kernel row equates to about 5 bushels per acre with an average plant population.

In addition, the kernel number per row is established as early as V5 and continues to be determined through pollination and grain fill. Thus, early-season drought stress may reduce the number of rows and the number of kernels within a row.

Sources:

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