Early Drought Stress in Soybean

While the major impact of drought on soybean yield potential occurs during pod set and pod fill, drought may also impact soybean yield when it occurs at earlier growth stages.

Impact on Germination and Early Growth[1,2,3]

Soybean seed must imbibe 50% of its weight to initiate the germination process. Therefore, drought conditions or uneven moisture levels in the seedbed can impact final stand. Water stress can impact hypocotyl elongation as early as 2 days after germination. While hypocotyl elongation can be inhibited, root elongation can continue to occur.

In most cases, dry conditions coincide with high temperatures and dry soils can experience much higher soil temperatures, in some cases well above 100° F. These conditions can result in an injury referred to as heat canker. Soybean seedlings that are emerging and seedlings up to the V2 growth stage are at risk for this injury. The hypocotyl cannot tolerate high temperatures and when it comes into contact with the soil it can be killed under these conditions. The hypocotyl may exhibit a ring or spot that will turn dark and look sunken or pinched. This injury is usually fatal to the seedling. If heat canker has killed the seedling, the root system will remain the normal white color, helping distinguish the cause of death between heat canker and some seedling diseases. Normally, this injury is sporadic across the field.

Impact on Nodulation

Nodulation, the infection of the roots by nitrogen-fixing rhizobia bacteria, can be reduced under drought conditions, particularly when accompanied by high soil temperatures. Nodulation begins shortly after emergence and continues to increase until R5. Under mild drought conditions nodulation is unaffected; however, under severe drought conditions nodules can be reduced.[4]

High temperatures appear to be more detrimental to nodulation than water deficit. High soil temperature (86° F and above) can reduce nodulation by directly killing rhizobia and altering the root hair growth and absorption of the rhizobia.[5]

Impact on Vegetative Stages[6]

Water stress after emergence can reduce vegetative growth in that plant height and leaf size are reduced, but root growth tends to increase as available resources are shifted from above ground growth to root growth. This response to moderate drought stress is common in many plants and enables the roots to grow deeper in search of additional moisture. If adequate moisture returns, vegetative growth will resume, but if severe drought conditions continue, flowering may occur earlier. Flipped leaves is the common soybean response to drought stress. Under severe drought the trifoliates will clinch together, resulting in a sandwiched center leaflet. Both symptoms result in less photosynthetic activity, reducing available energy to the plant.

Mitigating the Impact of Early-Season Drought[7]

Planting Depth. When dry conditions are expected, increasing planting depth to 1½ inches from ¾ inch will help ensure that all seeds have adequate moisture to germinate; this is particularly true with conventional tillage systems. Additionally, seeds placed at that depth may be protected from extreme temperatures as well.

Maintain Soil Nutrients and pH at Optimal Levels. The impact of drought on soybean can be increased when soil nutrient levels are low, and

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pH is below 5.5 or above 6.5. Nutrient deficiencies are usually an additive effect to drought stress and low levels of essential nutrients can restrict growth, furthering the impact of drought.

Tillage. Tillage of course-textured soils can result in water loss to the extent that it impacts soybean growth. Tillage during periods of drought only increase the risk of water stress on soybean. No-till cropping systems helps to minimize water loss from the seedbed and maintain a cooler soil temperature.

Row Spacing. Soybean planted in a narrow row (<30 inches) system will be more insulated from the influence of drought as the crop canopy will close quicker reducing water loss from the soil from solar evaporation. Additionally, soybean in narrow rows tend to have a higher yield potential.

Weed Management. Competition from weeds only exacerbates the impact of drought on soybean. Using a weed management plan that creates a weed-free seedbed and provides control until canopy closure can help lessen the impact of drought.

Spider Mite Management. Hot and dry conditions foster spider mite outbreaks and are usually first observed near field margins. Precipitation usually will stop a mite outbreak, but if a miticide is needed, ensure that the product chosen will not result in a flair up of the population.

Sources:

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