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Soybean Response to Drought

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Abstract

Although drought typically is an infrequent occurrence in Iowa, 2012 has been an exception to the rule. Winter, spring and early summer precipitation has been below long-term average, and soybeans in some areas of the state are experiencing periodic water stress due to inadequate available water content in upper soil depths. Farmers have asked whether drought stress early in the season can influence yield if precipitation levels approach long-term average later in the season.

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Soybean Response to Drought

By Andy Lenssen, Department of Agronomy

Although drought typically is an infrequent occurrence in Iowa, 2012 has been an exception to the rule. Winter, spring and early summer precipitation has been below long-term average, and soybeans in some areas of the state are experiencing periodic water stress due to inadequate available water content in upper soil depths. Farmers have asked whether drought stress early in the season can influence yield if precipitation levels approach long-term average later in the season.

Soybean is susceptible to yield loss from water deficit, drought stress, at two key developmental stages, germination and reproduction-seed development. Soybean must imbibe about 50 percent of its weight in water to germinate and begin to develop the radicle and hypocotyl, the primary root and shoot tissues. Seed planted into dry soil, or not placed into the soil, will be unable to imbibe water at all until adequate precipitation has occurred. Soybean can respond to water deficit as early as two days after germination. Water deficit at this time results in poor hypocotyl elongation, while root elongation may be unaffected. Drought stress at later vegetative stages of development has similar results: shoot growth is decreased or stopped, but roots can continue to grow. This evolutionary response in soybean allows the plant to search for additional soil water while having an overall low water use rate. Assuming adequate rainfall occurs again, soybean have the ability to reinitiate shoot growth, and shoot growth rate may be greater than that observed prior to the onset of drought stress. This is called compensatory growth.

Short-term, moderate drought stress during vegetative growth stages generally does not impact soybean yield. Conversely, longer-term severe drought stress can cause irreversible plant cell death causing low growth yield.

Soybean yield is most sensitive to water deficits during reproduction. Soil water deficits during reproductive growth phase results in increased flower abortion, reduced pod number, reduced seed per pod, and small seed. Nitrogen fixation is a key biochemical pathway for soybean yield and nitrogen fixation can be severely limited or completely halted by even moderate drought stress. Once nitrogen fixation has been stopped, substantial precipitation and soil water accumulation is required to reinitiate the process. Compensatory reproductive growth rarely will occur in soybean under moderate drought stress at reproductive growth phases.

Management practices that leave low amounts of residue on the soil surface or cause compaction can reduce soil water infiltration rate. Excessive or poorly timed tillage can cause soil compaction and increase water runoff from high intensity storm events. Reduced compaction and increased water infiltration rate can increase soil water content, nitrogen fixation, and soybean yield, particularly during growing seasons with less than adequate precipitation.

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