

How drought impacts soybean yields

By **ANDY LENSSEN**



WIDESPREAD drought across an entire state rarely occurs in the Midwest. However, the 2012 growing season is one of those rare years. Normally there is more concern with draining excess water. This year has put more focus on conservation of water for crop production.

Precipitation has been below-normal for much of the Midwest, and extraordinarily high daytime and nighttime temperatures have put many corn and soybean plantings at risk for below-normal yields.

Soybean plants are most susceptible to yield loss from drought stress at two key developmental stages: germination and reproduction/seed development.

For germination to occur in soybeans, seed must imbibe 50% by weight in water. Seed coat swelling occurs during imbibition, causing the coat to rupture. If soil water is insufficient for radicle (root) and hypocotyl (shoot) development and emergence, the plant will die.

When seeds are planted in dry soil, or not placed into soil, germination is not initiated. As long as seed coat integrity is maintained, seed can survive until adequate moisture is received. Recently germinated seedlings can undergo drought stress as early as two days following imbi-



DRINK OF WATER: This field of beans near Keokuk, in the southeast corner of Iowa near the Mississippi River, had an irrigation rig running in July on a 103-degree day.

tion. Water deficit at this time results in poor hypocotyl growth, but root growth and elongation may be unaffected. This evolutionary response in soybeans allows the seedling to search for additional soil water while having overall low water use, promoting survival and development.

Soybeans in the Midwest may undergo relatively short-term drought stress at planting, but typically, adequate rainfall occurs shortly thereafter, and the soybean plant responds to reinitiate shoot growth. Shoot growth after short-term drought stress can occur at a faster rate than what

was observed prior to the stress. This is called compensatory growth.

Moderate, short-term drought stress during vegetative growth stages does not typically impact soybean yield.

When crop is most vulnerable

Soybean yield is most impacted by drought stress during reproductive phases. Soil water deficits during reproduction increase flower abscission, abortion of embryos and reduced pod number; surviving seeds are smaller.

Nitrogen fixation is a key biochemical

pathway for soybean yield, and N fixation can be severely limited or stopped during moderate drought stress. Soybean is an annual plant, and unlike related perennial legumes such as alfalfa, N fixation is rarely reinitiated once it stops. Halting N fixation in the soybean plant essentially fixes yield to the N previously stored in roots, stems and leaves for subsequent seed development. The large impact of available stored water in soil on N fixation and subsequent yield in soybean cannot be understated.

Numerous research studies have tried to replace or augment N fixation by applying N fertilizer. However, fertilizer N use by the plant requires adequate water for root uptake. Water uptake simply is inadequate during periods of drought stress, and fertilization will be ineffective unless rainfall is very timely and substantial, and soil water infiltration rate is adequate.

Manage to conserve moisture

At this point in time, there are few options for soybean farmers to improve available soil water status for the current crop, unless irrigation systems are already in place. However, soil management decisions to improve available soil water content should be carefully considered by soybean farmers following this year's harvest. High-intensity tillage systems are not a solution to improve soil water content.

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