SeedSCOOP

DROUGHT EFFECT ON POD FILL IN SOYBEANS

Introduction

The impact of drought on soybean yield potential can be difficult to predict. Not only can yield production be drastically affected but nodulation and nitrogen fixation can also be reduced if high temperatures and low moisture persist, further inhibiting growth.[1] If heat and drought occur during the reproductive phases, soybean plants can abort flowers and pods (Figure 1). Overall, the greatest yield reductions in soybean from drought stress occur between R4-R6 (full pod through full seed) growth stages.[2]

Figure 1. Aborted soybean seed pods.

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Drought Loss Potential in Soybeans

As previously mentioned, the greatest risk for potential yield loss due to drought stress in soybean occurs during the R4 through R6 growth stages. When drought persists during these growth stages, soybean flowering stops, and plants are unable to compensate for lost pods. Research has shown that from the second through the fourth week of seed fill, a 39 to 45% yield decrease can occur when there are four days of visible moisture stress.[3] Drought stress during seed fill can also reduce the number of seeds per pod and seed weight.[4] Understanding the differences between how indeterminate and determinate soybeans react to dry growing conditions may help in the formulation of drought management decisions.

How a Soybean Flowers Can Affect Drought Stress Management

Drought stress can affect indeterminate and determinate soybeans differently.

Indeterminate soybeans

Indeterminate soybeans continue growing upward at the tip of the stem for several weeks after flowering begins on the lower stem. Flowering will progress up the stem, and plants will continue to flower for six to eight weeks depending on the maturity and growing conditions. Most northern commercial varieties are indeterminate. Indeterminate soybeans usually grow taller and do well in regions with short growing seasons. Indeterminate flowering type soybeans can recover from a short-term drought during the flowering growth stages by producing flowers and pods over a longer period. An indeterminate flowering growth habit should be advantageous to recovery from drought stress.[5]

Determinate soybeans

By contrast, determinate soybean plants complete their growth in height and then produce all the flowers at about the same time. They are also usually one-half to two-thirds as tall as indeterminate varieties. Most southern soybean varieties are determinate. Drought during this shorter flowering period it can negatively affect a higher percentage of the blooms and ultimately yield potential. Severe drought can have a devastating effect on yield potential because flowering stops and plants cannot compensate for lost pods.

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How Heat and Drought Stress Effect the Soybean Plant

Drought Effects

Drought stress can cause floral abortion, a reduction in pod number, seeds per pod, and seed size. Moderate drought stress can substantially reduce or stop nitrogen fixation, disrupting seed development.1 If adequate rainfall occurs and photosynthates become available after R5, the plant may compensate for earlier losses by producing larger seeds (within its genetic capacity).2 Once the plant reaches R6, pods are not normally aborted.

If soybean plants are drought stressed to the point of losing leaves, it is time to decide whether to leave the plants in the field or cut them for hay. This decision depends on the stage of growth and condition of the plant along with the producers need for soybean hay or the market for this type of hay. Plants with 30% of the leaves still attached, may be considered for hay. These plants can produce 0.75 to 1.25 tons dry matter per acre with 13% protein and 48% in-vitro dry matter digestibility.[6]

Heat Effects

It can be difficult to distinguish the effects of high temperature from the effects of water stress on soybean plants. Often these stresses occur together and magnify the effects of each other. Temperatures above 95° F can severely stress soybean plants and has been shown to substantially decrease pod set and potentially increase leaf loss. Very high soil temperatures of 90°F or above can cause decreased nodulation and nitrogen fixation to occur in soybeans. High soil temperatures are most likely to occur in later planted beans (like double crop production) due to the reduced canopy cover and on coarse textured soils. While flower production of indeterminate soybeans can occur for 30 to 40 days or more under good conditions, moisture stress and high temperatures can shorten the flowering period.[7]

Problems to Consider When Harvesting a Drought-Stricken Soybean Crop.

- Smaller seed size. Combines should be adjusted to keep harvest loss of small seeds to a minimum.
- Green seeds. Soybean plants that senesce before maturity due to stress may produce green seed that can result in dockage at the elevator.
- Green stems. Plants that die prematurely due to drought may have green stems at harvest that can slow harvest.
- Pod shattering. This is especially problematic if there are weather cycles of wetting and drying before harvest.
- Sprouted seed. Drought weakened pods can allow moisture to infiltrate the pod and reach the seeds. This can result in seeds sprouting while still in the pod.
- Poor grain quality. Drought stricken soybean pods are more susceptible to invasion by fungi, which can result in reduced grain quality.[8]

Management Decisions

Managing stress from insect, disease, or nutrient sources can also help reduce the overall stress load on the plant and potentially limit drought stress associated yield losses. When drought stress becomes severe, a management decision to keep the crop or harvest the soybeans for hay should be made when leaves start to curl and defoliate. This decision should be based on the crop condition and growth stage but also on hay need or hay markets.

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Any producer that is considering using the production from a drought stressed soybean crop for planting next year's crop should understand that seed produced under severe drought stress, especially during the reproductive grow stages, may exhibit reduced germination and vigor.[9]

Sources

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