Effect of moisture stress and high temperatures on soya bean yields

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Soya bean yield losses are most likely to ensue when moisture stress occurs during germination and reproduction. Inadequate soil moisture during germination causes uneven and spotty emergence. This is why soya bean agronomists recommend placing soya bean seed into at least 1,3cm of moist soil at planting.

Excess soil moisture at planting was a problem for most areas of Michigan during May and early June 2018. However, soya beans that were planted later in June or early July may have germinated under marginal soil moisture conditions.

Soya beans can tolerate moisture stress relatively well during the vegetative stages. Stress at this time reduces shoot growth, but not root growth. These conditions diminish water use by the plants and increase their ability to extract water from the soil.

High soil temperatures

Planting early is a recommended tactic to mitigate the adverse effects of moisture stress. This is because the plants will have deeper roots for extracting soil moisture and a larger crop canopy, which shades the soil and reduces soil moisture losses due to evaporation.

This tactic seems to be working in 2018 as the early-planted fields are tolerating the moisture and high temperature stress better than the late-planted fields.

Very high soil temperatures (32°C) can cause decreased nodulation and nitrogen fixation to occur in soya beans. High soil temperatures are most likely to have occurred in late-planted beans, due to the reduced canopy cover, and on coarse-textured soils.

Producers can evaluate nodulation by digging up some plants and inspecting the nodules. Well-nodulated soya beans should have seven to 14 nodules on the tap root at flowering. Nodules that are actively fixing nitrogen will be pink to red when cut open. Research has shown that supplemental nitrogen applications to drought-stressed soya beans are not profitable.

Flower production

At this time, most soya bean fields are in the R2 (full bloom) growth stage. Soya bean plants respond to drought in this growth stage by aborting flower blossoms, and lower leaves are dropped in severe cases.

While flower production can occur for 30 to 40 days under good conditions, moisture stress and high temperatures will shorten the flowering period. A reduction in moisture stress any time during this period will enable the plants to produce and retain new blossoms to compensate for those aborted during R2.

During the R3 growth stage (one pod 0,5cm long on the upper four nodes on the main stem having an unrolled leaf), drought-stressed soya bean plants will abort both flowers and pods. Temperatures above 35°C have been shown to significantly decrease pod set. Leaf loss can also occur in severely stressed plants. If the moisture stress ends, soya beans will produce new flowers and pods up to the R5 stage (beginning seed).

Soya bean yield losses will be greatest when moisture stress occurs between the middle of the R4 growth stage (beginning seed swell in any pod on the plant) and the middle of the R5 growth stage (full seed in any pod on the plant).

Number of pods and seeds

Stress at this time reduces the number of pods per plant as the plants are no longer able to produce new blossoms and pods. This is the major source of the lost yield. However, the number of seeds per pod and the size of the seed can also be reduced at this time. Leaf loss will continue in severely stressed plants.

Moisture stress occurring at the R6 growth stage (one pod having green seed that completely fills the pod on one of the upper four nodes on the main stem having an unrolled leaf) is largely due to a reduction in seed size.

A reduction in pod number per plant can occur, but is much less likely after R6. Stress occurring after the R7 growth stage (one normal pod on the main stem has reached its mature colour) does not affect yield.

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