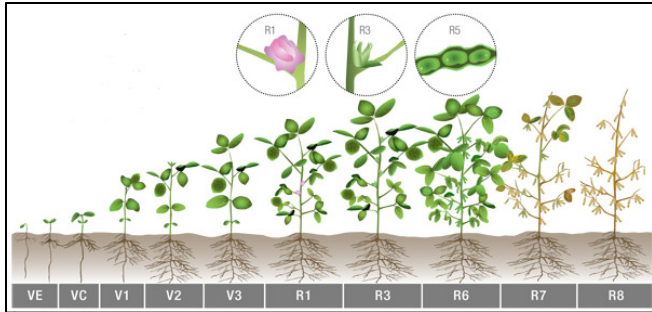


Soybeans at Growth Stage R3 Benefit from Ample Water

By Lyndon Kelley, MSU/Purdue Extension Irrigation Educator



Irrigating soybeans at crop growth stage R3 provides the greatest potential yield advantage. (Refer to p. 119 of *Corn and Soybean Field Guide-2016 Edition* (ID-179) for description of soybean growth stages)

Places in the country like western Nebraska have found that if there is a limited water supply, irrigating soybeans at R3 or beginning pod fill stage will give the greatest return of the water

used. The second most effective use of water is at pod fill (R5). Most of the irrigated areas of Indiana and Michigan are blessed with ample water supplies, but the research on water efficiencies in irrigated soybeans out west can help local growers understand the importance of irrigating soybeans here in August.

Most irrigation scheduling programs show that soybeans at the R3 stage use 110-120% of the reference evapotranspiration (based on 6" tall grass), which translates to a need in soybean fields for as much as 2" of water per week. Dr. Shaun Casteel, Purdue Extension Soybean Specialist, defines R3 or beginning pod fill stage as any pod that is about 3/16 inch long and is on one of the four uppermost nodes of the main stem.

Reference evapotranspiration (rET) for an average summer day during early August is 0.19" per day or 1.3" per week. To determine water use by a growing crop (crop ET), one needs to multiply rET by a crop coefficient value (Kc). The week that soybeans reach R3 (pod elongation stage), soybeans use 120% of the rET or a Kc of 1.2. That results in a crop ET of about 0.23" per day (1.6" per week). A cool cloudy week would result in soybean water use of 1.4" and a hot dry week would result in water use of 2.0".

Indiana producers may use data from their own ET gauge station or rET data from Purdue's ag center weather stations. Then take that number and multiply by 1.2. Multiply that result by 7 (days) to determine the estimated soybean water use per week.

Michigan producers and those Indiana producers in counties adjacent to Michigan can have daily rET data sent to them by email or text by signing up for the service at the MSU Enviro-Weather website (<https://secure.enviroweather.msu.edu/login.php>). Messages are sent each day at 5:30 a.m. providing rET data for the previous five days and estimates of projected rET for the following seven days from any of the 87 networked stations. Estimates of rET can also be found by going to the *Enviro-weather* web site at (<http://www.enviroweather.msu.edu/>), clicking on a crop type or location, then following the link to "[Potential Evapotranspiration](#)" under the "Water-use tools" heading.



To make the best use of irrigation water, producers should try to provide 5 to 6 days worth of crop water use per application, typically 0.8" to 1.0" of water. These applications of more irrigation water increase the amount of effective water available to the crop by reducing the water lost from evaporation in the soybean canopy and on the residue and soil surface (about 0.1" per application, regardless of the amount applied). For example, a producer making two 0.5" applications effectively provides 0.8" of water, compared to a producer making a single 1.0" application that effectively provides 0.9". Irrigators with center pivots that apply water faster than the soil can infiltrate are forced to use smaller applications (less than 0.5") to avoid runoff of irrigation water.

By the time that soybeans develop to R3 stage, the plant has achieved all of its effective rooting to a depth of about 2½ feet. A reservoir of soil moisture to a depth of 2 ½ feet can hold as little as 2.4” on sands to as much as 5.5” on loam soils. Our most typical irrigated soils, sandy loams, hold between 3.2” and 3.8” in 2½ feet of soil. But even with the low water-holding capacity of sandy soils, a well-timed application of 0.8”-1.0” rarely results in the loss of water below the root zone.

Sensors are not needed to evaluate soil moisture, although they can help to better understand how water moves through the soil in a given field. The most valuable information can be obtained by simply digging to the depth of the wetted front about 12 hours after irrigating. Ideally, at least every other application should wet the soil down to 15” or half of the soybean rooting depth on coarse textured soils. At peak water use, soybeans that are inadequately watered will dry out the lower portion of the rooting zone to the point that it can reduce nutrient uptake.

Differences in water-use efficiency between daytime vs. nighttime irrigation are almost non-measurable in Indiana and Michigan. “The important issue is keeping up with the water needs of soybean plants to avoid stress-related yield reductions,” says Lyndon Kelley, Irrigation Educator with Michigan State University and Purdue Extension.

Visual signs of water stress in soybean plants occur too late to use field observation as a good irrigation scheduling method without lowering yields. The soybean plant has a natural defense mechanism that rotates the leaves to expose the silver/gray fuzzy underside of the leaf to the sunlight causing it to reflect more light and reduce water use. During extremely hot days, soybeans may flip their leaves over due to the plants’ inability to pull water from the soil fast enough. A good indication of “under” watering is when a soybean field still appears silver/gray into the evening hours. This symptom, especially in the absence of hot sunlight, indicates moisture stress and will likely reduce potential yield. Compacted areas or sandier parts of field can be monitored for leaf rolling, providing an early warning of the field’s moisture status for the rest of the field.

Many of the irrigation systems in Indiana and Michigan do not have the pumping capacity to keep up with the peak water use of all of the crops grown. That results in the crop drawing down the soil moisture reserves. Irrigation systems with a pumping capacity of 5 gallons per minute per acre of irrigated land can provide 1” water every 4 days or 0.25”/day, if run continuously. Irrigation systems with less capacity to deliver water, or when crop water use is greater than 0.25”/day, rely on soil moisture reserves to provide water or yield loss can occur.

As the second half of August approaches, soybean water use slows and the chances of rainfall providing enough water increases, making it important for growers to leave enough room in the soil profile to hold a 1” rainfall. “It benefits both the farm’s bottom line and the environment to make use of all of the rainfall you are blessed with,” says Kelley.

For more information on irrigation water use and when to irrigate, see irrigation fact sheet #3 “Irrigation Scheduling Tools” at:

http://msue.anr.msu.edu/uploads/235/67987/FactSheets/3_IrrigationSchedulingTools5.14.pdf

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