Irrigation Timing for Soybean

Key Points

- Soybeans require from 15 to 25 inches of water per acre per year for maximum yield potential.
- Soybeans are most sensitive to moisture stress during the mid to late reproductive stages.
- Even short periods of drought stress during the critical water use period can result in lost soybean yield potential.

Soybean Water Needs

Soybean water use will fluctuate throughout the season (Figure 1). Soybeans require from 15 to 25 inches of water per acre per year from planting through maturity depending on planting date, maturity group, location, and weather. A soybean plant will require significantly more water to produce maximum yield potential than to simply survive. Each time drought stress occurs, yield reductions in some amount may occur. Most soybean crops can benefit from supplemental irrigation at one or more times during the growing season. An understanding of when soybeans require water and how to accurately estimate soil water reserves can help guide more efficient irrigation applications.

Evapotranspiration

Evapotranspiration describes the movement of water through evaporation from the soil and plant surfaces, and transpiration, which is the movement of water from the soil into plant roots, through plant stems and leaves, and back out into the atmosphere. Transpiration is an important concept because yield is linearly related to the amount of water a soybean plant transpires. Factors that can affect evapotranspiration include the crop growth stage, the relative maturity of the crop, weather conditions, soil type, tillage and residue management, and crop population. Crop growth stage and weather conditions have a large impact on evapotranspiration. Daily evapotranspiration is influenced by solar radiation, air temperature, relative humidity, and wind. High air temperatures, low humidity, clear skies, and high winds cause a large evaporative demand. Crops use less water in the early vegetative stages, water use increases sharply in the reproductive stages, and then begins to decline as plants reach physiological maturity.

Scheduling Irrigation

To efficiently schedule an irrigation application it is necessary to know the available soil water holding capacity of the different soil types in your field. Extension services in most states can provide soil water capacity guidelines for most soils. By keeping track of the loss of water from evapotranspiration, you can determine the amount of water remaining for plant use. When soils reach the maximum allowable soil moisture depletion level (MAD) for a crop growth stage, irrigation should be applied. If rain is in the forecast, it may be most economical to leave room in the soil profile for the precipitation instead of applying the full amount of irrigation. Tools such as tensiometers, soil moisture blocks, and accurate records of rainfall can be used to monitor available soil water.

Emergence and Vegetative Stages
During germination, soybeans use only 0.05 to 0.10 inches of water per day. Water demand increases to 0.10 to 0.20 inches/day during rapid vegetative growth. Unless the soil is extremely dry, supplemental irrigation is generally not needed during germination or vegetative growth stages. Irrigation early in the season may be needed for incorporation or activation of pre-emergence herbicides, or when soil moisture is low following double-crop soybean planting. Too much water early in the season can prolong the vegetative growth stage, which can result in flowering delays, increased plant height, and lodging. Limiting early season irrigation encourages plants to develop stronger, healthier root systems that grow deeper.

Reproductive Stages Through Maturity
Soybeans are most sensitive to water stress during the mid to late reproductive stages: pod development (R3 to R4) and seed fill (R5 to R6). An average peak water demand of about 0.30 inches/day begins near the full flowering stage and continues through pod development. Under the hot, dry July and August conditions of semi-arid regions like western Nebraska, peak water demand can reach up to 0.5 inches per day. Water stress during pod development and early seed fill can have the greatest impact on yield potential and result in a reduced number of seeds per pod and reduced seed size. Water may be required during flowering on soils with an insufficient water holding capacity (sandy soils) or when conditions are exceptionally dry. When water is applied during flowering, it is especially important to supply adequate water during seed fill. This is because irrigating during flowering usually increases the number of seeds produced, but subsequent water stress during seed fill will reduce seed size, which can result in greater yield penalties than would have occurred if the crop had not been watered at all during flowering.

As soybeans near maturity, ensure that sufficient moisture is present to allow seeds to achieve their maximum weight. Inadequate moisture at this stage can result in a yield reduction of as much as 10 to 15 bu/acre. If good soil moisture is available when 50 percent of seeds are touching in the pods, no additional irrigation should be needed. However, if soil moisture is approaching the MAD, an additional irrigation may be needed to allow seeds to achieve maximum weight.

Table 1. Example of soybean water use by growth stage

<table>
<thead>
<tr>
<th>Growth stage</th>
<th>Water use (inches/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germination and seedling</td>
<td>0.05 - 0.10</td>
</tr>
<tr>
<td>Rapid vegetative growth</td>
<td>0.10 - 0.20</td>
</tr>
<tr>
<td>Flowering to pod fill (full canopy)</td>
<td>0.20 - 0.30</td>
</tr>
<tr>
<td>Beginning maturity to harvest</td>
<td>0.05 - 0.20</td>
</tr>
</tbody>
</table>


Sources

Individual results may vary, and performance may vary from location to location and from year to year. This result may not be an indicator of results you may obtain as local growing, soil and weather conditions may vary. Growers should evaluate data from multiple locations and years whenever possible. Channel® and the Arrow Design® and Seedsmanship At Work® are registered trademarks of Channel Bio, LLC. ©2016 Monsanto Company. 150315145957 050316CAM