

Soybean Water Use

Key Points:

- Seasonal soybean water use can range from 20 to 26 inches during the growing season, with over 60% of total water use occurring during the R1 to R6 growth stages.
- The majority of soil water uptake by soybeans occurs within the top 2 to 3 feet of the soil profile.
- Adequate water is most critical during pod development and seed fill (R3-R6).

Evapotranspiration (ET)

Evaporation

- Early in the growing season, water loss from the soil occurs primarily through evaporation from the soil surface.
- As the crop growth and more leaf area shades the soil, evaporation will decline as transpiration increases.
- Crop residue on the soil surface can significantly reduce the amount of water lost through evaporation by reflecting solar radiation and protecting the soil from wind.

Transpiration

- In the process of transpiration, plants take up water from the soil and transport it to the leaves. Small openings in the leaves (stomata) allow water vapor to pass from the plant into the atmosphere, cooling the plant.
- The rate of transpiration increases with higher air temperature, solar radiation, and wind speed.
- High humidity levels reduce transpiration by decreasing the difference in water potential between the leaf airspace and the ambient air.

Soybean Water Use Over the Growing Season

- Daily ET varies greatly throughout the growing season due to day-to-day variability in weather conditions.
- On average, daily ET increases through the vegetative growth stages, peaks during early pod fill, and declines as the crop approaches maturity. (Table 1).
- Over 60% of total water use occurs during the R1 to R6 reproductive growth stages.
- Seasonal soybean water use can range from 20 to 26 inches during the growing season (Kranz and Specht, 2012) compared to a typical range of 21 to 28 inches for corn.

Soybean Rooting Depth and Water Uptake

- Well-developed root systems are essential for soybean water uptake and growth.
- Soybean root systems that are unimpeded by soil factors can reach a maximum depth of over 60 inches, similar to that of corn (Ordóñez et al., 2018).
- The majority of soil water uptake by soybeans occurs within the top 2 to 3 feet of the soil profile (Kranz and Specht, 2012).

Table 1. Average daily soybean water use (ETc), water use per growth stage, and cumulative water use over the course of the growth season.

Growth Stage	Daily Water Use Rate	Water Use Per Stage	Cumulative Water Use
	———— inches ————		
2 nd Trifoliolate (V2)	0.08	0.56	1.00
4 th Trifoliolate (V4)	0.09	0.63	2.19
6 th Trifoliolate (V6)	0.14	0.98	3.17
Beginning Bloom (R1)	0.20	2.00	5.17
Full Bloom (R2)	0.25	1.75	6.92
Early Pod Development (R3)	0.28	1.96	8.88
Pod Elongation (R4)	0.32	3.20	12.08
Early Pod Fill (R5)	0.33	3.30	15.38
Mid Pod Fill	0.32	3.20	18.58
Full Pod (R6)	0.25	1.75	20.33
Lower Leaves Yellowing (R7)	0.15	1.50	21.83
Maturity (R8)	0.10	1.00	22.83

Impact of Water Availability

- Soybeans can typically withstand moderate drought stress during vegetative growth with little effect on yield.
- Excessive rainfall during vegetative stages can cause the plants to put on more vegetative growth that will not necessarily lead to higher yields. Larger plants can be more susceptible to lodging during thunderstorms later in the season.
- Adequate water is most critical to soybeans during pod development and seed fill (R3-R6).
- Ample water during flowering followed by drought stress during seed fill will result in smaller seeds.

Kranz, W.L., and J.E. Specht. 2012. Irrigating Soybean. NebGuide G1367. University of Nebraska-Lincoln Extension. <https://extensionpublications.unl.edu/assets/pdf/g1367.pdf> Ordóñez et al. 2018. Maize and soybean root front velocity and maximum depth in Iowa, USA. Field Crops Res. 215:122-131.

The foregoing is provided for informational use only. Please contact your Pioneer sales professional for information and suggestions specific to your operation. Product performance is variable and depends on many factors such as moisture and heat stress, soil type, management practices and environmental stress as well as disease and pest pressures. Individual results may vary. Pioneer® brand products are provided subject to the terms and conditions of purchase which are part of the labeling and purchase documents. CF210719

Author: Dan Berning
 Vol. 13 No. 18 July 2021