



Mid-Vegetative Soybean Flooding and Water-Logging

Soybean fields flooded during mid-vegetative development can have a reduction in root and shoot growth, nodulation, photosynthesis, and ultimately yield potential.

What to Consider

Soybeans can be at a variety of growth stages during midseason. Partially submerged plants have an increased chance of survival compared to completely submerged soybean plants. Water-logging, where roots are flooded without plant submergence, is also common. Several factors influence potential soybean damage:

- Growth stage during flooding/ponding
- Length of time plants were flooded/ponded
- Temperature (soil and air)
- Drying rate and soil type

Yield Impact

Yield loss results from reduced root growth, shoot growth, nodulation, nitrogen (N) fixation, photosynthesis, biomass accumulation, stomatal conductance, and plant death from disease and physiological stress.

- Soybeans completely submerged for 48 to 96 hours generally survive.^{1,2}
- Flooding for four (or more) days delays plant growth, shortens plants, and reduces node number.
- Flooding for six days or more is expected to have a negative effect on yield.
- A week of flooding may result in significant or 100 percent stand loss.¹
- Wide range of yield loss may be experienced depending on environmental conditions and soil types (Table 1). In cooler temperatures, submerged plants are expected to live longer with slowed respiration. Warm temperatures increase respiration and oxygen is consumed quickly.³
- Potential soybean yield loss from water-logging could be 17 to 43 percent during vegetative stages and 50 to 56 percent during reproductive stages.²
- Presence of soil borne diseases and differences in soil texture affect the response of plants to flooding.

Table 1. Soybean yield loss at V4 and R1 growth stages waterlogged under two soil types.

Soybean Stage	Yield Loss per Day of Flooding (bu/acre)	
	Clay Soil	Silt Loam Soil
V4 (Fourth Node)	1.8	0.8
R1 (Beginning Bloom)	2.3	1.5

Source: Stahl, L., Coulter, J., Naeve, S., and Fernandez, F. 2018. Flooded fields and saturated conditions impact crops. University of Minnesota Extension. <http://blog-crop-news.extension.umn.edu/>



Figure 1. Partially submerged plants have an increased chance of survival compared to completely submerged plants.

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Nitrogen. Soybean growth and development depends on nitrogen (N) availability as the nutrient is in high demand, especially during seed development. The N₂ fixation process is sensitive to lack of oxygen and flooding can lead to reduced fixation. Fields with low soil organic matter experiencing dry conditions in August and September are expected to have a response to midseason flooding. Regions in the United States with midseason flooding and insufficient rainfall later in the season have developed low protein crops. Actual yield loss would be difficult to calculate; however, low protein levels are an indication of yield loss in fields.¹

Management

- Supplementing flooded soybean crops with N has not been shown to be an economical practice.
- Farmers with a soybean crop replanted after July 1st could experience a potential yield loss of 0.5 bu/acre per day.¹ Therefore, a replant should be considered before mid-July to get a harvestable crop.
- Consider the remaining soybean stand. When 80,000 to 100,000 living plants per acre remain in uniform distribution, the field may approach full yield potential.²
- Living plants should be scouted when soils are getting dry enough for equipment to drive on. Darkened or soft growing points indicate a dead plant. Stems can be split lengthwise for inspection, as plants may have been simply covered with mud or residue from receding water.
- There may be genetic variability in soybeans for flooding tolerance in maturity groups II and III.² Soybean products that have demonstrated good yield potential during flooding could be selected for frequently water-logged low areas of fields.



Figure 2. Water-logged plants are also common in fields experiencing submerged plants. Root health should be evaluated after waters have receded.

- Disease tolerance should also be noted as *Phytophthora*, *Pythium*, *Fusarium*, and *Rhizoctonia* can infect surviving plants. Where certain diseases prevail, a new lineup of soybean products may be necessary.
- Weeds may take over a drowned-out area especially if a pre-emergence herbicide was washed away. Cover crops could be an alternative to replants after insurance dates have passed.

In summary, fields should be evaluated after water recedes for plant survival and disease. Fields with adequate stand counts may achieve near normal yield potential. Disease pressure and soybean product tolerance influences the health of plants for the remainder of the growing season.

Sources:

- ¹ Stahl, L., Coulter, J., Naeve, S., and Fernandez, F. 2018. Flooded fields and saturated conditions impact crops. University of Minnesota Extension. <http://blog-crop-news.extension.umn.edu/2018/07/flooded-fields-and-saturated-conditions.html>.
- ² Conley, S. 2018. Assessing flood damage to soybean. University of Wisconsin. Integrated Pest and Crop Management.
- ³ Jean, M., Thelen, K., and Steinke, K. 2017. Managing corn and soybean fields submerged by recent, heavy rains. Michigan State University. Web sources verified 8/18/18

Performance may vary, from location to location and from year to year, as local growing, soil and weather conditions may vary. Growers should evaluate data from multiple locations and years whenever possible and should consider the impacts of these conditions on the grower's fields.

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