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Effects of Drought Stress on Soybean Production

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In late July, the hot, dry weather accelerated the maturity of the soybean crop about 8 days ahead of normal. About 85% of the crop had bloomed and 25% had started to form pods.

This publication discusses 1) how drought stress affects potential soybean yields, 2) how to estimate potential soybean yields prior to harvest, and 3) alternate uses of drought stressed soybeans.

Soybeans are more flexible than corn in adapting to periods of moisture stress. As corn matures through tasseling to silking, moisture status becomes critical. In contrast, soybeans respond to moisture stress over a longer period of time and range of growth stages.

Soybean varieties adapted to South Dakota are of the indeterminate type, exhibiting a number of growth stages at the same time. When a plant begins the floral or reproductive stages (R1 to R8) it is still growing (vegetative stage) and can produce more leaves and stems. This wide range in growth stages allows soybeans to compensate for drought when growth has been reduced at other growth stages.

Soybean yield potential is affected by total number of pods per plant, number of beans per pod, and weight per bean (seed size).

The yield component affected depends on the reproductive (R) stage when stress occurs. The most critical stage for yield potential begins as the crop reaches the full pod stage (R4, pod is 3/4 inch long at one of the four uppermost nodes on the main stem with a fully developed leaf).

Drought stress any time from R4 to shortly after R6 (beginning seed, seeds are 1/8 inch long) will reduce yields more than the same stress in any other period of development. Within this period, the R45 (late pod formation) to about R55 (shortly before full seed) is especially critical, because flowering ceases and can no longer compensate for lost pods. The younger pods and stems are also more susceptible to aborting under stress than older pods and seeds.

Yield reductions at this time are mainly the result of a loss in total pods per plant. Should moisture become available after R55, seed size may compensate for yield reductions. However, seed size is genetically limited.

One way of estimating the yield potential of soybeans is:

1) Count the number of plants in a small sample area in the field (1/1000th of an acre).

Randomly select ten areas in each field. The length of row needed to equal 1/1000th of an acre depends on row spacing:

- Measure 74 feet 8 inches for 7-inch rows
- 52 feet 2 inches for 10-inch rows
- 34 feet 10 inches for 15-inch rows
- 26 feet 1 inch for 20-inch rows
- 17 feet 5 inches for 30-inch rows
- 14 feet 6 inches for 36-inch rows
- 13 feet 9 inches for 38-inch rows

Use the number of plants obtained in step 4.

2) Count the number of pods on the 10th plant within the row and on every 5th plant down the row until 20 plants have been counted. Generally, the more plants counted or the more sample locations within the field, the more accurate the field estimation will be.

3) Calculate the average number of pods per plant for each sample area. Use this number in step 4.

4) Bushels per acre is obtained by: \( \text{Bu/A} = \text{number of plants per sample} \times \text{average number of pods per plant} \times 0.4024 \div 60. \)

An estimate of yield potential may only be good for a short time. If drought continues and causes additional pod abortion or prohibits seed filling, the estimate may no longer be valid. Generally, an estimate is more accurate when it is taken closer to crop maturity. An estimate prior to leaf loss may tell whether the
crop should be harvested for grain or forage. A later one may show whether harvesting is justified.

Soybeans can be harvested as either hay or silage, although difficulties in curing the large stems of the plant makes drying hay difficult.

Soybean hay varies widely in forage quality and palatability, depending on leaf/stem ratio, coarseness of stem, and how well it is packaged and stored. A hay conditioner aids in drying the stems.

If used for silage, soybeans should be wilted down to 40 to 50% dry matter before chopping.

The optimum stage of development for harvesting soybean forage is when the pods have formed and the lower leaves are just beginning to turn yellow.

Research data from Ohio State University compared the forage quality of soybean and alfalfa silage (table). Palatability trials indicate that soybean forage is acceptable by livestock, although animals may sort the forage to a greater extent than alfalfa because of the coarseness of the stem. A greater amount of refusal can be expected.

<table>
<thead>
<tr>
<th>Crop</th>
<th>Stage</th>
<th>Protein</th>
<th>ADF 1</th>
<th>NDF 2</th>
<th>P</th>
<th>Ca</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alfalfa</td>
<td>early bud</td>
<td>22.4</td>
<td>31.1</td>
<td>35.2</td>
<td>0.44</td>
<td>1.02</td>
</tr>
<tr>
<td>Soybeans</td>
<td>early pod</td>
<td>16.2</td>
<td>40.6</td>
<td>48.6</td>
<td>0.39</td>
<td>1.30</td>
</tr>
</tbody>
</table>

1 ADF = acid detergent fiber, a measure of digestibility; the lower the ADF value, the higher the digestibility.

2 NDF = neutral detergent fiber, a measure of forage intake; the lower the NDF value, the greater the intake.

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