There we have it folks. The 2004 soybean season has come to a closure!

Last night s frizzing temperature will likely put an end to soybean s growth and development across the Badger state. Fortunately, the usually warm September we just enjoyed allowed most Wisconsin soybean fields to reach or pass the R7 development stage. However, a large number of Wisconsin soybean fields had not yet reached maturity. These immature fields will likely sustain frost damage (Table 1) and require special management.

Table 1. Soybean Response to Freeze Damage

Growth Stage	Yield Reduction
R4 – Full Pod	70%-80%
R5 – Beginning Seed	50%-70%
R6 – Full Seed	15%-30%
R7 – Beginning Maturity	0%-5%
R8 – Full Maturity	0%

Source: Saliba et. At. Kansas State University, 1982

Specific damage characteristics will depend on stage of development. Frost during flowering (R1 and R2) and pod set (R3 and R4) will reduce soybean yield mostly through flower and pod abortion. Frost during beginning seed fill (R5) will reduce soybean yield mostly through seed abortion (within the pods) and/or reduced seed size. Frost damage at full seed (R6) will reduce soybean yield through seed size only.

One needs to realize that we grow indeterminate soybean varieties in Wisconsin. Typically an indeterminate soybean plant beginning to fill seeds or mature will likely have pods at various stages of development along the main stem. The three pictures below depict soybean pod development on each plant node at stages R5, R6, and R7 respectively.

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Stage R5 – Beginning to Seed

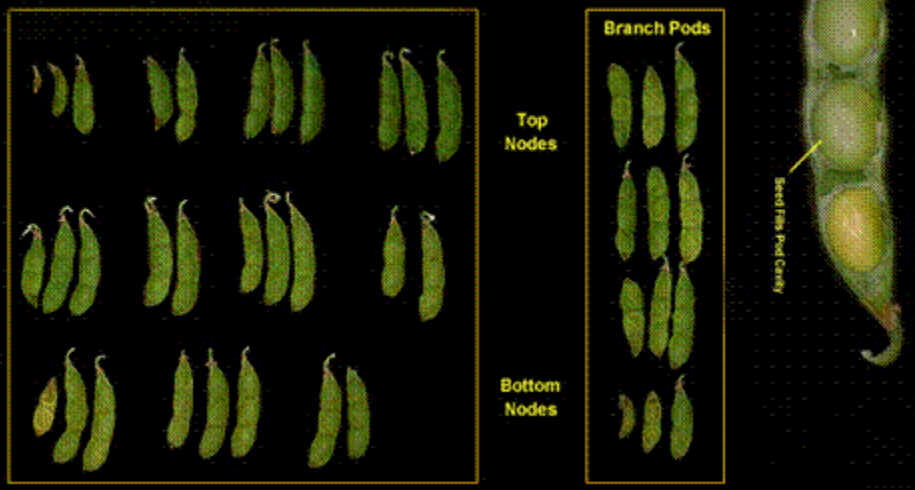
Seed 1/8 inch long at one of the four uppermost fully developed node on the main stem

Pods Organized In Picture Left-To-Right To Represent Node Positions From Top To Bottom On Main Stem

84 DAP ?

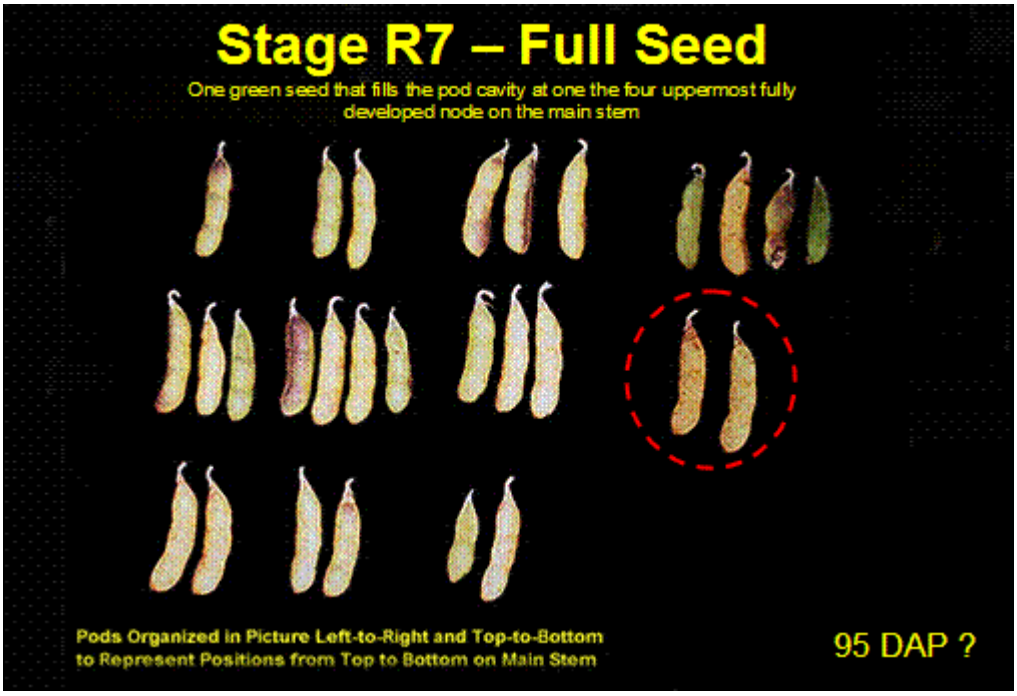
Stage R6 – Full Seed

One green seed that fills the pod cavity at one the four uppermost fully developed node on the main stem



Pods Organized in Picture Left-to-Right and Top-to-Bottom to Represent Positions from Top to Bottom on Main Stem or Branches

95 DAP ?



Pods closer to the top of plant tend to be further behind in their development compared to pods at the bottom third of the plant. A soybean plant typically starts flowering and podding at the 5th or 6th node and works its way up and down the stem. Consequently, pods at the 5th or 6th node will likely reach maturity and loose moisture earlier than pods further up or down on the main stem. The further the development, the higher the solid to water ratio in the grain. Higher concentration of solids in solution will lower the grain s freezing point and reduce frost damage. A hard frost will freeze the entire plant regardless of its stage of maturity. However, grain damage is unlikely after an individual seed has achieved physiological maturity (R7 - about 60 percent moisture and has lost the green color). Immature seeds (not plants) killed by frost will cease accumulating dry matter and begin loosing moisture. Frost damaged seed will likely be deformed (elongated, wrinkled seed coat), be discolored (greenish or brownish), and have lighter density, germination, and vigor. It also important to realize that frost damaged seed is typically wetter than indicated by a moisture meter (seed damage causes the moisture meter to read low).

Check the reference below for a generic description of frost damage on soybeans at various reproductive stages. It also sites data collected in Wisconsin.

Duane R. Berglund. Assessing Frost Damage in Soybeans. NDSU Extension.

http://www.ag.ndsu.edu/coping/frost/frostsoybeans.htm

Let frost damaged soybeans drydown in the field whenever possible. Field drydown often helps green seeds to turn yellow and minimizes the need for forced drying. Excessive percentage of green seed can cause dockage. The two references below discuss issues related to harvesting, drying and storing frost damaged soybeans.

This fact sheet contains technical advice and tips on harvest and post harvest management of frost damaged soybeans. This article was reviewed by Charles P. Woloshuk, and Richard Stroshine, both of Purdue University, and Bill Wilcke, University of Minnesota. The authors also received input from: Bob Nielsen, Purdue University; Ellsworth Christmas, Purdue University; Ralph Gann, Indiana Agricultural Statistics Service; Marvin Paulsen, University of Illinois; Charles Hurburgh, Iowa State University; Bill Wilcke, University of Minnesota; Gary Hoette, University of Missouri.

Dirk E. Maier and Samuel D. Parsons. Harvesting, Drying, and Storing Frost-Damaged Corn and Soybeans. 1996. Purdue University. Fact sheet #27.
http://www.ces.purdue.edu/extmedia/GQ/GQ-27.html

This fact sheet contains some good info about color change and storage respiration rate of soybeans killed by frost before reaching maturity.

Marvin R. Paulsen. Frost-Damaged Green and Immature Soybeans. 1995. University of Illinois. Grain Quality Fact Sheet No. 1.
http://www.stratsoy.uiuc.edu/~stratsoy/expert/paulsen.html

Wisconsin soybean growers should also consider feeding frost damaged soybeans (please check the two articles listed below).

Bill Casady. Immature soybeans have a place in pork and beef diets. 2000. University of Missouri , Integrated Pest & Crop Management Newsletter Vol.10, No. 23.
http://ipm.missouri.edu/ipcm/archives/v10n23/ipmltr1.htm

Dan Loy and Palmer Holden. Using frost-damaged soybeans in livestock rations. 1993. Iowa State University Extension. Publication Recovery-28.
http://www.extension.iastate.edu/Publications/DR28.pdf

The references listed here just happened to be technical discussions on frost damage on immature soybeans that I became familiar with over the years. Please fill free to suggest other sources of information about this issue.