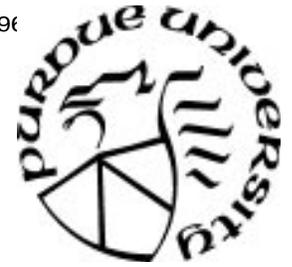


CROP AND LIVESTOCK



Update

Frost Risk of the 1996 Indiana Soybean Crop

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The July 1, 1996 Indiana Crop Report indicated that 90 percent of the state's intended soybean acreage had been planted. Unplanted areas were mostly in southern Indiana. The portion of the soybean crop reported as planted on July 1 should be safe from a normal frost. Two excursions across Indiana, excluding the southeastern portion of the state, indicate that 10 to 15 percent of the crop is at risk. Extremely late planted fields were observed in several locations but appeared to be the exception rather than the rule. However, a significant acreage of the 1996 soybean crop was planted during the last week to safely plant soybeans to avoid a normal frost.

A number of people have requested guidance in assessing the stage of development of soybeans and the

potential of frost injury. Ellsworth Christmas, professor in Purdue's Department of Agronomy, provides this update. Table 1 gives the average number of days required for the soybean plant to move from one reproductive stage of development to the next. The exact number of days will vary from year to year depending on environmental conditions such as soil moisture, day and night temperatures, and other stresses.

Table 2 (on page 2) lists the average number of days required for the soybean plant to reach physiological maturity (R7) from growth stages R2 through R6, assuming normal growing conditions.

Table 1. Number of days required for a soybean plant to develop from one reproductive stage to the next.

Reproductive Stage Description	Avg. Number of days one R stage to next	Range in No. of days
R1- beginning flower, a flower on the main stem		
R2- full bloom, a flower at one of the upper 2 nodes	R1 - R2 3	0-7
R3- a 3/16 inch pod at one of the four upper nodes	R2 - R3 10	5-15
R4- a 3/4 inch pod at one of the four upper nodes	R3 - R4 9	5-15
R5- a bean 1/8 inch in diameter in a pod at one of the four upper nodes	R4 - R5 9	4-26
R6- a bean that completely fills the pod at one of the four upper nodes	R5 - R6 15	11-20
R7- physiological maturity, one pod on the main stem that has reached its mature pod color	R6 - R7 18	9-30
R8- 95 percent of the pods have reached their mature pod color	R7 - R8 9	7-18

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Table 2. Number of frost free days, assuming normal growing conditions, required to reach physiological maturity from a given reproduction stage of growth.

Stage of Growth	Number of days to R7
R2	61
R3	51
R4	42
R5	33
R6	18

The information presented in Table 3 summarizes fall frost date information by crop reporting district and projects the number of frost free days remaining on a weekly basis beginning with September 16. The last four columns give the stage of growth necessary on a given date to avoid frost injury. Notice that these frost dates are averages for each crop reporting district and that cold spots exist within districts which may result in frosts up to five to seven days earlier than the average date given in the table. The 30 degree Fahrenheit temperature is presented because little physical injury occurs at this temperature but, significant injury will occur between 29 and 28 degrees Fahrenheit. Environmental conditions at the time of a frost will influence the severity of injury. For example, with low soil moisture, injury will tend to be more severe. Soybean fields that are at the stage of growth given in the table on the date listed, should not be injured by a normal frost, assuming normal growing conditions for the balance of the growing season.

Another concern is the potential yield losses resulting from frost injury. Research at Wisconsin indicates that soybeans frosted at early R5 will suffer a 70-80 percent yield loss, while midway between R5 and R6 the yield losses will be 50-60 percent. By the R6 stage of development, a frost will result in a 20-40 percent reduction in yield. If frost occurs between R6 and R7, yield losses will be in the range of 10 to 20 percent. Yield losses at the early R5 stage result primarily from a reduction in the number of seeds while reductions between R5 and R6 are a combination of reduced numbers of seed and reduced seed size. A reduction in seed size is the primary cause of yield losses between R6 and R7.

In addition to a reduction in yield, premature killing of the soybean plant by frost will result in green and shrunken seed. These are considered to be damaged seed and will result in an increase in dockage and a reduction in price. Elevators may reject some lots of

soybeans if the level of green beans is too high (7 percent in 1995 at some elevators). Unlike corn, frosted soybeans will reach harvestable moisture in about the same amount of time as unfrosted soybeans.

The lack of a general rainfall across Indiana placed the 1996 soybean crop under a considerable amount of stress. As moisture stress increases in severity, the soybean plant makes certain adjustments in an attempt to survive. With the younger plants (R4 to R5), the adjustment is most likely to be expressed as pod abortion. From reproductive stages R4.5 to R5.5, individual seeds will cease development resulting in a significant number of one and two bean pods. If moisture stresses continue beyond R5.5, seed size will be reduced. The net result of any one of these adjustments by the soybean plant will result in a reduced yield. In some areas of the state, soybean plants growing on soils with low water holding capacity are beginning to turn yellow, indicating a premature maturity or death of the plants. Adequate soil moisture will be required by most of Indiana's soybeans at least through mid September.

Rainfall on September 7 and 8 brought welcomed relief to much of Indiana, with most of the state receiving at least .5 inches. The southern one half of the state appears to have received from one to four inches. These rains will not

Table 3. The normal 30° F fall frost date, average number of frost free days after a given date, and the reproductive growth stage required on a given date to avoid significant frost injury.

Indiana Crop Reporting District	Date of first 30° F frost, 30% probability	Days remaining to first frost from				Stage of growth to avoid injury from			
		9/16	9/23	9/30	10/7	9/16	9/23	9/30	10/7
Northwest	October 10	26	19	12	5	R5.5	R6	R6.4	R6.7
North central	October 10	26	19	12	5	R5.5	R6	R6.4	R6.7
Northeast	October 10	26	19	12	5	R5.5	R6	R6.4	R6.7
West central	October 15	31	24	17	10	R5.1	R5.6	R6.1	R6.4
Central	October 15	31	24	17	10	R5.1	R5.6	R6.1	R6.4
East central	October 10	26	19	12	5	R5.5	R6	R6.4	R6.7
Southwest	October 20	36	29	22	15	R4.7	R5.3	R5.7	R6.2
South central	October 20	36	29	22	15	R4.7	R5.3	R5.7	R6.2
Southeast	October 20	36	29	22	15	R4.7	R5.3	R5.7	R6.2

improve yields, but only stop the decline in yield that was occurring because of dry weather. Additional rain is needed within the next week to take the soybean crop to maturity. The next chance for rain appears to be late in the week of September 9. The forecast is calling for cooler temperatures for the balance of the week of September 9 with temperatures at night approaching 50 degrees. Cool nighttime temperatures will result in a slowing of the development process and could add a few days to the length of time required for the soybean plant to reach maturity.

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