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THE INFLUENCE OF SOIL TEMPERATURE ON SOYBEAN SEED EMERGENCE

D. B. Egli, J. L. Hatfield, J. Hill, and D. M. TeKrony

The best way to obtain adequate soybean stands is to plant high quality seed in an optimum soil environment. But this year many farmers may not be able to obtain enough high quality soybean seed and some acreage may be planted with seed of lower than normal quality. Thus it will be even more important to have an optimum soil environment.

Depth of planting, soil compaction or crusting, soil moisture, and soil temperature are all part of the soil environment and all influence the ability of the seed to germinate and emerge. Planting seed deeper than 2 inches can reduce emergence, as can heavy soil crusts and too much or too little moisture. And soil temperatures that are too high or too low can slow down germination and growth and increase the chances that the seed will be attacked by pathogens and fail to emerge. This is particularly true for low quality seed.

To study the influence of soil temperature on the growth of soybean seedlings, measurements were made of the rate of hypocotyl elongation of seedlings at temperatures ranging from 50 to 104 degrees F in a growth chamber. The seedlings exhibited essentially no growth at 50 degrees and 104 degrees and a maximum rate of growth at approximately 86 degrees. It was found that the rate of hypocotyl elongation was also dependent upon the length of the hypocotyl; the longer the hypocotyl, the faster the growth rate at a given temperature. These data were incorporated into a computer model that "grows" the hypocotyl at a rate dependent upon the temperature supplied to the program and upon the hypocotyl length until the length equals the planting depth, at which point emergence has occurred. Since the average growth rate of a large number of seeds is used in the model, the model predicts the time necessary for 50 percent emergence. The model was evaluated against a number of emergence tests in greenhouses and fields and was found to predict within 10 percent of the actual values.

The days to 50 percent emergence for various temperatures as predicted by the model are shown in Figure 1. For this data a planting depth of 1 inch and a diurnal temperature range of 18 degrees F were supplied to the model. At 60 degrees it takes approximately 20 days to get 50 percent emergence, and this time interval drops rapidly as the temperature increases. The optimum temperature range for soybean emergence is between 75 and 90 degrees, and the time required is about 5 days. The emergence times increase as temperatures increase above 95 degrees because these high temperatures are injurious to the growth processes. However, it is unlikely that soil temperatures this high would be encountered in Kentucky soils during the planting season.

Average soil temperatures occurring during past planting seasons at seven locations in Kentucky were supplied to the model to determine emergence time under normal climatic conditions (Table 1). Mean weekly soil temperatures averaged over a 5-year period and adjusted to 2 inches under bare soil were used and a diurnal range of 20 degrees F was assumed. The planting depth was 2 inches. Seed planted on April 5 required from 18 to 32 days to emerge while seed planted on May 3 required only 7 to 12 days to emerge. Planting in mid-May when soil temperatures were approximately 70 to 75 degrees reduced the emergence to 5 to 7 days. The time to emergence was always shorter at the locations in western Kentucky and increased for locations farther east and north.

The data in Table 1 were derived from soil temperatures averaged over a period of years. Since the soil temperature in a given year will probably be different from the average, the best guide in deciding when to plant is the actual soil temperatures. Daily soil temperature observations are available as part of the agricultural weather service in Kentucky, or a farmer can easily measure the soil temperature in his fields himself.

For best results, soybeans should not be planted until the soil temperature is 65 degrees or above, and if seed of questionable quality is used, it should not be planted until soil temperatures are above 75 degrees. Soil temperatures above 75 degrees will insure rapid emergence and better chances for obtaining a good stand.

TABLE 1. Days to 50 percent emergence of soybeans using average soil temperatures and assuming a 2-inch planting depth.

Planting Date*	Days to 50 Percent Emergence						
	Mayfield	Greenville	Henderson	Glasgow	Somerset	Lexington	Williamstown
April 5	18	20	23	25	24	32	32
April 26	9	10	11	12	12	15	16
May 3	7	8	9	10	10	12	12
May 10	6	6	8	8	8	10	10
May 11	6	6	6	7	7	8	8
May 24	5	5	6	6	6	7	7
June 7	4	5	5	5	5	6	6
June 21	4	4	5	5	5	5	5

*Planting dates are based on a 5-year average and are only an approximate guide. Actual soil temperatures should be determined before planting.

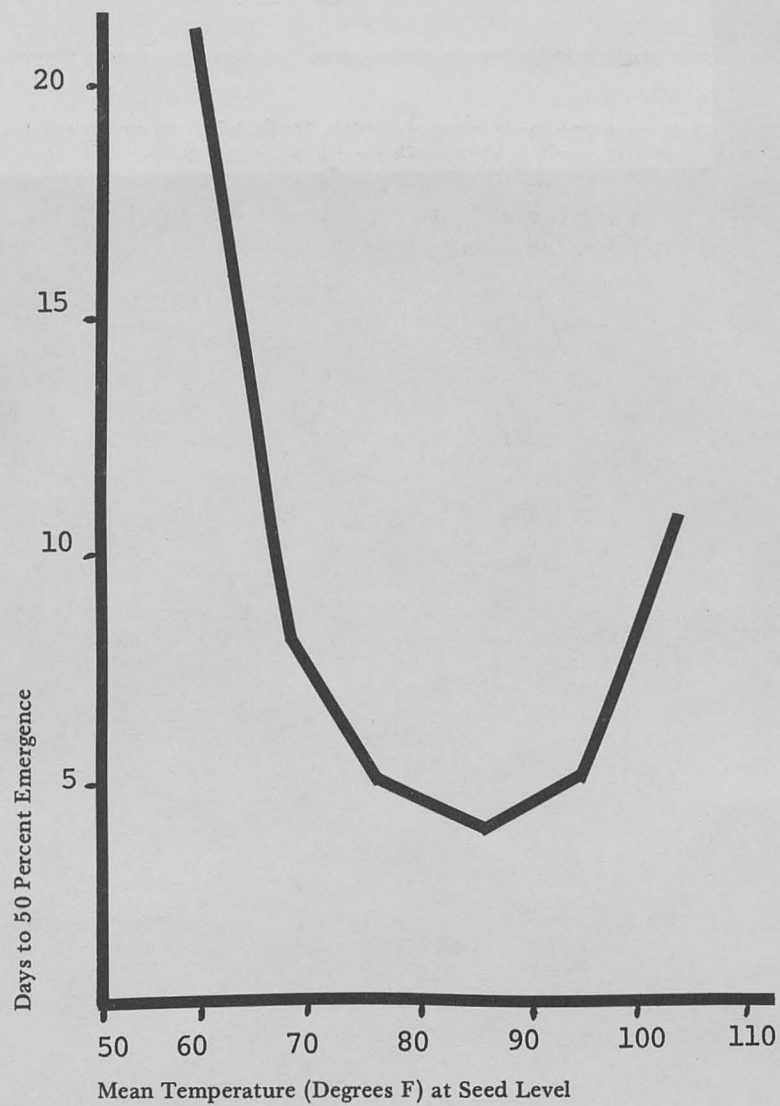


FIGURE 1. Days to 50 percent emergence at Various Soil Temperatures