EFFECT OF ROW SPACING ON SOYBEAN CANOPY MICROCLIMATE IN SE MISSOURI

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Justification:

The occurrence of soybean rust in the USA in late 2004 caused Missouri farmers and researchers to consider soybean management strategies to reduce the impact of the disease on soybean yield. Temperature and relative humidity can affect the development of the soybean rust fungus. Soybean leaves transpire (evaporate) large amounts of water. Under some conditions the amount of evaporated water is more than 1/3 inch per day. The water vapor accumulates inside the soybean canopy unless air movement mixes dryer air from outside the canopy with the wetter air inside the canopy. If air temperature around leaves is cooler than the dew point, water condenses on leaf surfaces. High humidity and leaf wetness favor spread of the rust fungus because the fungus spores require several hours of leaf wetness to germinate and infect the plant

Row spacing might affect air movement within the soybean canopy. In the northern soybean belt, some growers plant soybean in 30-inch rows rather than drilled rows to reduce relative humidity and, thereby, reduce the severity of another fungus-caused disease – white mold. However, very few data are available to document the effects of row spacing on air movement within the soybean canopy. The objective of this study is to determine the effects of row spacing on relative humidity and air temperature within a soybean canopy.

Method:

We used the plots described in another research report “Effect of row spacing and population on soybean yield in SE Missouri”. Prior to planting, the plot area was treated with a tank mix of Roundup WeatherMax, Dual II Magnum, FirstRate, and Authority. Pioneer brand 94M70 was planted on 1 May. Each of three row spacings was planted with a different planter. The planter for the 30-inch row spacing was a 4-row planter equipped with double disk openers. We used two planters to plant plots for the 15-inch row spacing. First, two outside (border) rows were planted with a planter with movable row units set 79 inches apart. This was the closest we could move the units. Then, a specially designed planter equipped with John Deere row units was used to plant the center four rows. The distance from the outside rows of this planter to the border rows planted with the first planter was 17 inches. An Almaco heavy duty drill was used to plant the 7.5-inch row spacing. The drill planted eight rows, so each plot consisted of two passes with the drill. Six seeding rates (40000, 75000, 110000, 145000 180000 and 215000 seeds/acre) were used to produce a variety of stand densities. All plots were planted without tillage. Irrigation was supplied with an overhead lateral system.

For this canopy microclimate experiment, we used only the plots that were planted with 180,000 seeds/acre. At approximately R2 stage of development we used Tidbit data loggers to automatically record temperature and relative humidity every 15 minutes. The data loggers were shielded and placed in the center of one of the center rows. After leaf drop, the data loggers were removed and information downloaded into an Excel spreadsheet. We calculated maximum temperature, minimum temperature, maximum relative humidity, minimum relative humidity, and the number of hours relative humidity remained above 75% for each day from July 20 through August 31. Data were analyzed as a randomized complete block for each day. Row spacing was the only treatment.

Results:

Daily maximum air temperatures are presented in Figure 1. Row spacings differed for maximum air temperature on 12 days. On 9 of these days, the 30-inch row spacing exhibited the warmest maximum temperatures, and the 7.5-inch row spacing exhibited the lowest maximum temperatures. The same seeding rate was used for all row spacings, so the number of plants per foot of row in the 30-inch row spacing was four times the number in the 7.5-inch row spacing. Perhaps the denser canopy absorbed more sunlight in the 30-inch row spacing and this increased canopy temperature.

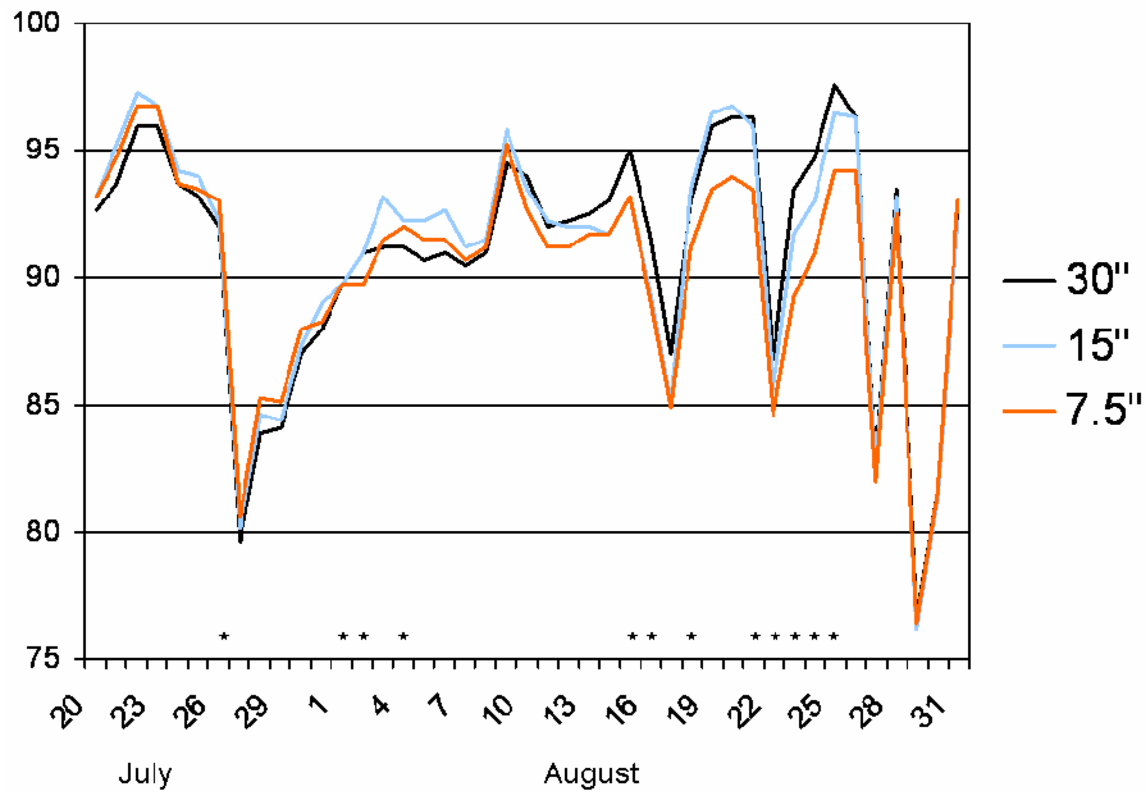

Figure 1. Effect of row spacing on the daily maximum air temperature in soybean canopies. "*" indicates row spacing were different on that specific day.

Daily minimum air temperatures are presented in Figure 2. Row spacings differed for minimum air temperatures on 18 days. On every one of these 18 days, the 30-inch row spacing exhibited the coolest minimum temperature and the 7.5-inch row spacing exhibited the warmest minimum temperature. In other words, the soybean canopies of the drilled rows cooled more slowly at night than those of the 30-inch row spacing. This may be an indication that air movement was less in the 7.5-inch row spacing and this resulted in less air mixing.

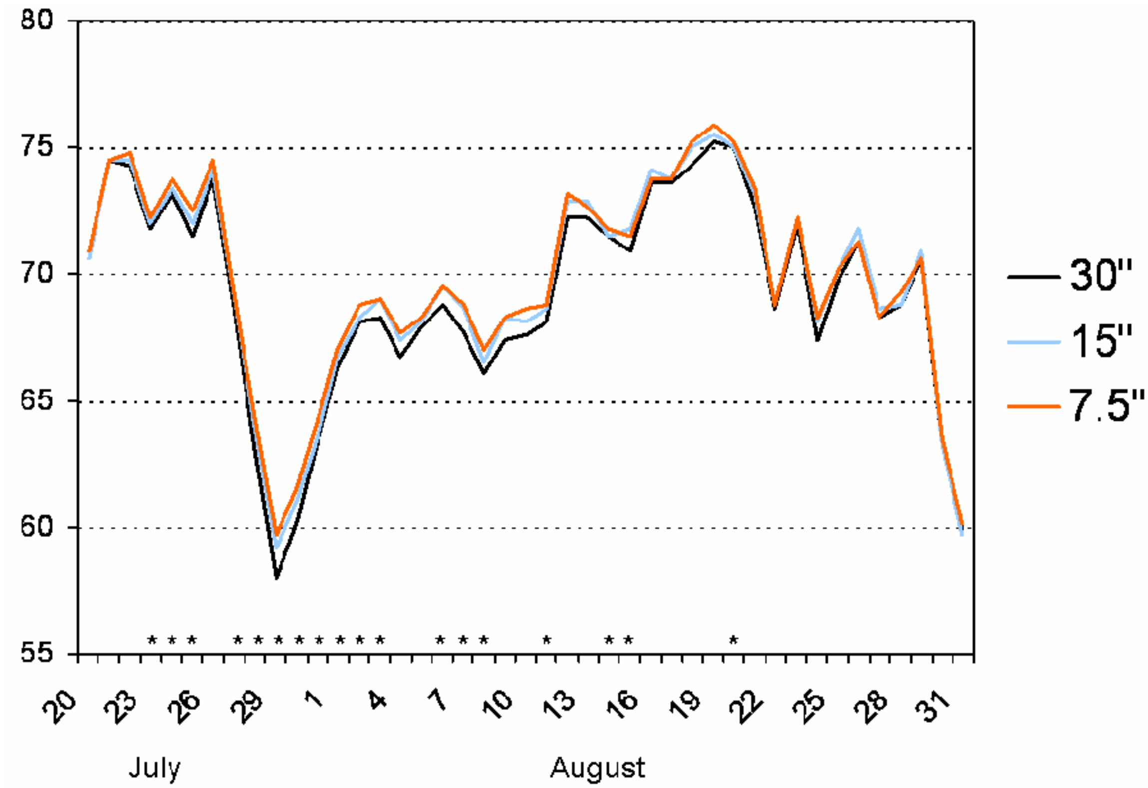

Figure 2. Effect of row spacing on the daily minimum air temperature in soybean canopies. "*" indicates row spacing were different on that specific day.

Regardless of row spacing, maximum relative humidity was 100% on all but one day during the period in which data loggers were in place, so maximum relative humidity information is not presented in this report. Daily minimum relative humidity values are presented in Figure 3. Row spacings differed for minimum relative humidity on six days. For days 22, 23, and 24 August, the 7.5-inch row spacing exhibited the highest minimum relative humidity. However, for days 28 July, and 3 and 5 August the 7.5-inch exhibited the lowest relative humidity. It is not obvious why these two sets of days differed for row spacing effect.

We calculated the number of hours during the 24-hour day that relative humidity was greater than 75%. This level of humidity is not related to requirements for germination of rust spores. It was a more or less arbitrary figure used to estimate the length of time humidity remained moist in the canopy. These data are presented in Figure 4. Row spacings differed for this characteristic on seven days. On five of those seven days, the 7.5-inch row spacing exhibited a greater number of hours of high relative humidity. These days all occurred in the third week of August. At this time it would be difficult to spray soybean fields with a fungicide, but the plants are still vulnerable to yield loss from this and other diseases.

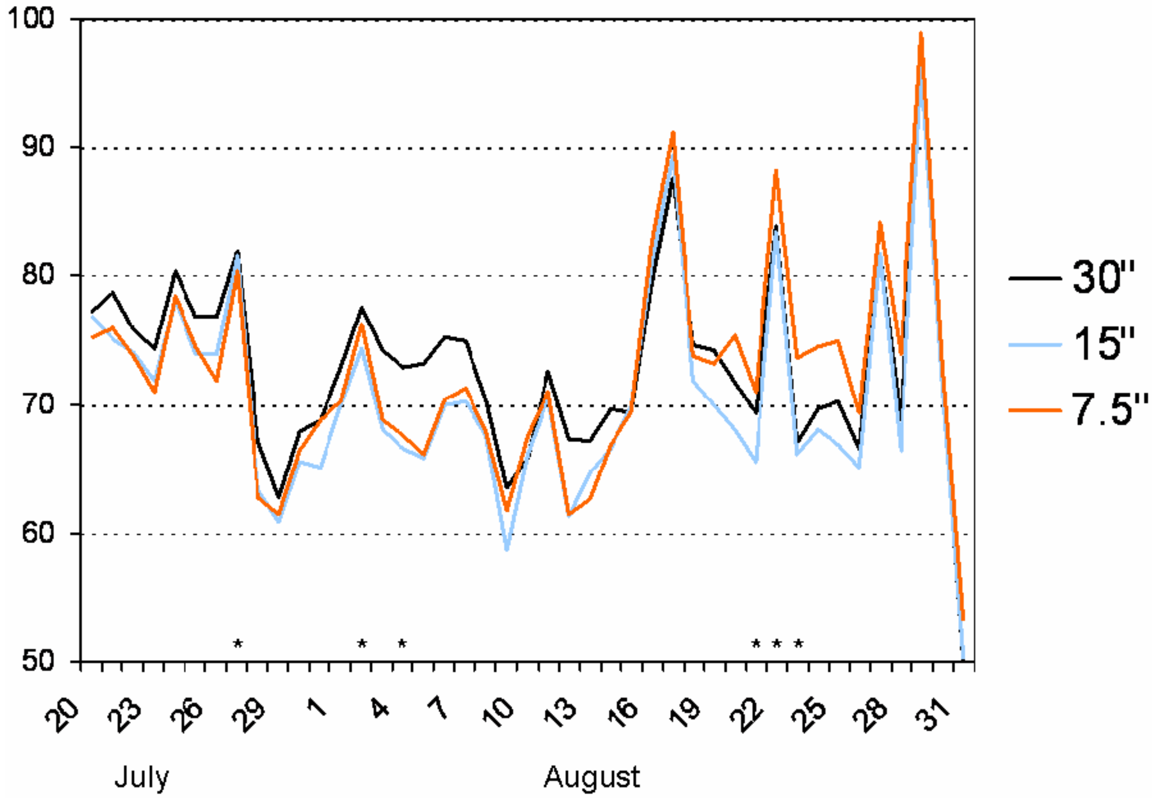

Figure 3. Effect of row spacing on the daily minimum relative humidity in soybean canopies. "*" indicates row spacing were different on that specific day.

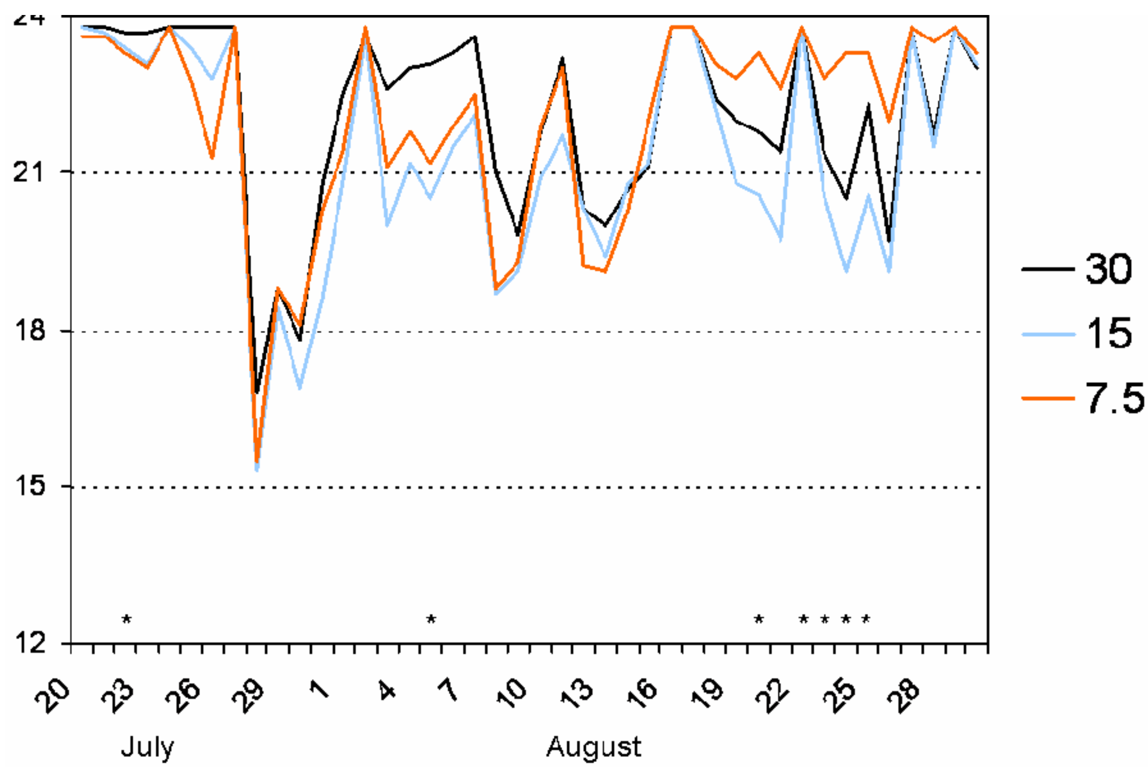

Figure 4. Effect of row spacing on the number of hours per day relative humidity in soybean canopies was above 75%. "*" indicates row spacing were different on that specific day.

Conclusions:

1. Row spacing can affect the temperature and relative humidity components of the microclimate within soybean canopies.
2. On most days for which row spacings differed for canopy air temperatures, the 30-inch row spacing exhibited the warmest maximum temperature and the 7.5-inch row spacing exhibited the warmest minimum temperature.
3. We found some evidence that air mixing within canopies of the 7.5-inch row spacing was less than in the 30-inch row spacing and this led to more hours of high humidity in the narrows on few, but, potentially important days.