Effect of plant population and row spacing on physiology, water use efficiency, and yield of no-till dryland soybean

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Soybean acreage has been steadily increasing in North Dakota including in the western part of the state, which has exceptionally drier climate (<13 inches of rain) than the eastern part. Drought is the main abiotic stress affecting soybean yield in western ND, and there is a lack of a soybean production management guide suitable for this region. It is a well-established fact that an optimum planting geometry for a given niche ensures higher radiation, water, and nutrient use efficiency resulting in enhanced per acre crop yield and quality.

Objectives

To find out suitable dryland soybean plant population and row spacing that has (a) higher grain yield, quality, and farm income, (b) favorable morpho-physiological traits such as greater NDVI, canopy temperature depression, and biomass, and (c) higher water use efficiency.

Materials and methods

A RR2Y soybean variety (LS03R22) with a maturity group of 0.3 was planted at WREC on May 30, 2018 using a SRES (Seed Research Equipment Solutions) precision planter. Row spacings of 7½, 15, 22½, and 30 inches were maintained as main plots and plant populations of 90, 120, 150, and 180 thousand per acre were considered as sub-plots. Canopy temperature and normalized difference vegetation index (NDVI) were measured weekly with a FLIR® E60 Thermal Imaging camera and a modified NDVI Sony camera; respectively. Soil moisture was recorded from each plot using a neutron moisture meter.

Results and discussion

The trial received heavy rain, wind and hailstorms that damaged the crop and adversely affected yield (June 23: wind speed=46 mph, precipitation = 1.53”; June 28: wind speed = 61 mph, precipitation = 0.94”, hailstorm; July 9: wind speed = 48 mph, precipitation = 1.67”).

Figure 1. Effect of row spacing on biomass.

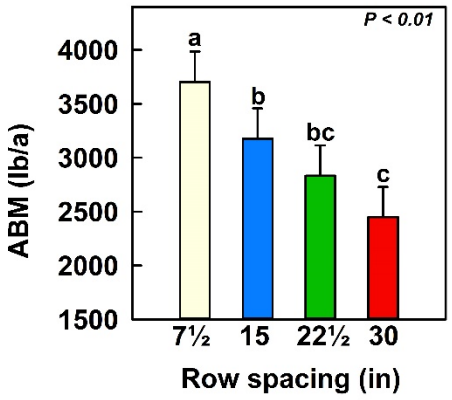
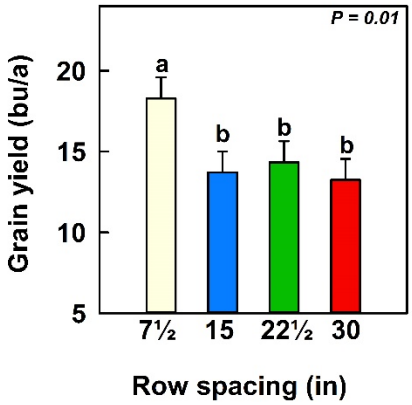


Figure 2. Effect of row spacing on grain yield.



There was no effect of plant population and row spacing on plant height and test weight. The plant height and test weight, averaged across plant population and row spacing, was 17 inches and 58 lb/bu, respectively. There was no effect of plant population on the above ground biomass (ABM) and grain yield, however, a significant effect of row spacing was evident. The 7½ inches row spacing produced about 3700 lb/a of biomass, which was 525 to 1200 more pounds of biomass than wider row spacing (Fig. 1). The row spacing of 7½ inches had the highest grain yield of 23 bu/a, which was 4 to 5 more bushels of grain than the wider row spacing (Fig. 2).