Planting geometry effects on sorghum productivity in water limiting conditions

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Introduction

Grain sorghum is well-adapted to limited water on marginal lands. Increasing grain productivity with limited water can boost regional economies. Prior studies indicate clumped planting can increase grain sorghum yield up to 45% under semi arid conditions possibly by reducing tiller number, increasing radiation use efficiency, and preserving soil water for grain fill.

Objectives

The objective of this study was to evaluate effects of planting geometry on sorghum grain yield formation.

Materials and Methods

The field study was conducted in a split plot design at Colby, as a factorial design at Tribune and Garden City, KS (four growing environments—two planting dates at Colby).The experiment had early and early-medium sorghum hybrids, four populations, and uniform or clumped planting geometries. Crop responses included leaf area index, light transmittance, radiation use efficiency, biomass harvest, and components of yield. Grain yield and yield components (number of culms and panicles, grain mass and 200 seed mass) were calculated from one meter row samples. Yield advantage of clumped planting was determined by plotting yield of clumped – yield of uniform vs yield of uniform data. Yield data were analyzed as a randomized complete block experiment design using SAS Proc GLM.

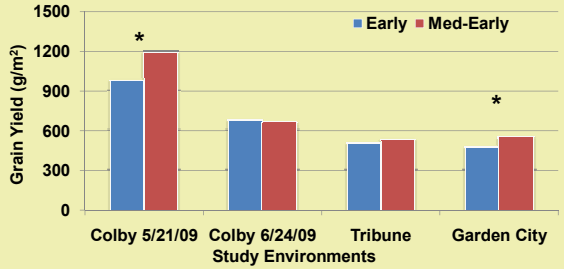

Figure 1. Effects of hybrid maturity and planting date on grain yield

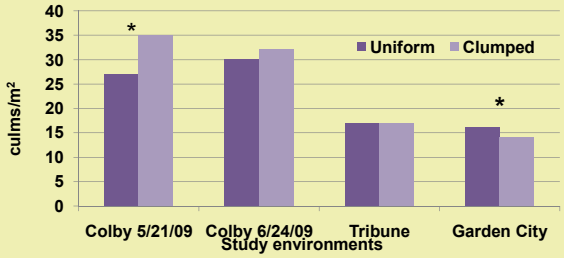

Figure 2. Effects of planting geometry on formation of culms

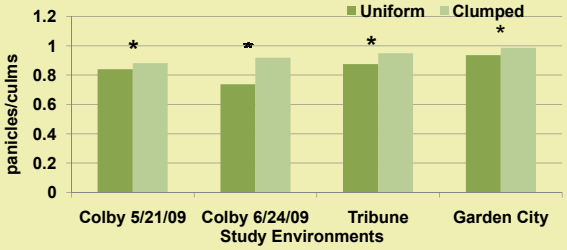

Figure 3. Effects of planting geometry on formation of fertile culms

* Indicates the mean values are significant at P< 0.05.
The environments are not statistically compared

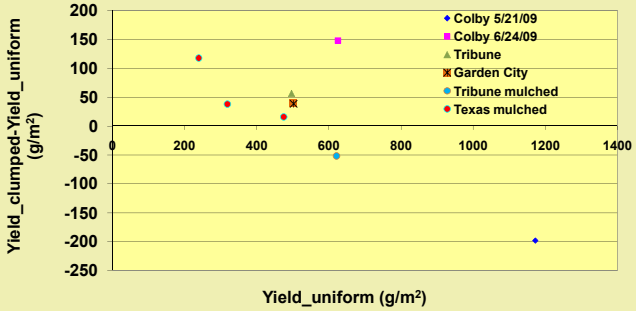

Figure 4. Yield advantage of clumped planting geometry over uniform planting geometry. Data for Tribune mulched and Texas mulched taken from Bandaru et al. (2006)

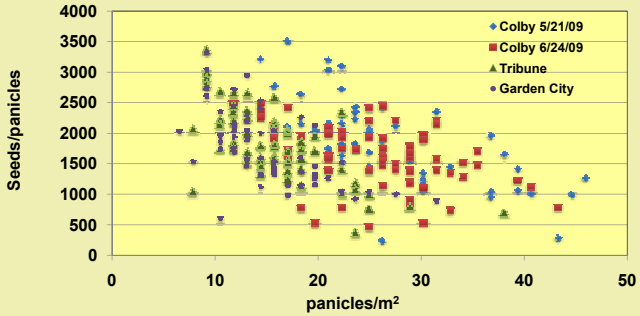

Figure 5. Effects of number of panicles on number of seeds per panicle

Results and Discussion

- These results summarize the primary treatment effects on yield and components of yield, averaging over secondary interacting treatment effects.
- Delayed planting decreased yield 39%; a later maturing hybrid increased yield, by 11 %, relative to an early hybrid, when yield potential exceeded 900 grams m^{-2} (Fig. 1).
- Clumped planting reduced the number of culms m^{-2} by 12% (at Garden City) but increased culms m^{-2} 29% when yield potential exceeded 900 grams m^{-2} (Fig. 2).
- Clumped planting increased the fraction of fertile culms (culms which formed panicles) from 5-14% (Fig. 3).
- Clumped planting had yield advantage of 7-11% when yield potential was less than 600 grams m^{-2}; However, yield decreased up to 16% when yield potential was more than 900 grams m^{-2} (Fig. 4).
- Seeds per head and seed weight generally compensated for differences in panicles m^{-2} which resulted from planting population (Fig. 5).
- Aiken et al. (2009) reported panicles m^{-2} and seeds $panicle^{-1}$ were primary variables affecting sorghum yield.
- Clumped planting offers advantage to panicle formation and yield components under semi arid conditions; results support findings of Bandaru et al. (2006).

Conclusion

- .Clumped planting geometry increased the fraction of culms which formed panicles.
- The yield advantage of clumping exhibited an inverse relation to yield potential.

References

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