Seeding Dryland Grain Sorghum in Clumps to Decrease Tillering and Increase Grain Yield

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2. Objectives: Grain sorghum is a major crop in the Texas High Plains for dryland producers. As irrigation acreage declines because of depleting groundwater and increasing energy costs, grain sorghum acreage is expected to increase. The yields of dryland grain sorghum vary greatly among years because of insufficient and highly variable precipitation amounts. Grain sorghum is seeded in the Texas High Plains during early summer when the probability of rainfall is high. In nearly all years, grain sorghum plants have adequate water during germination and the early vegetative growth stages. Because of these favorable early season conditions, each grain sorghum plant generally produces from 1 to 3 tillers that utilize water and nutrients. As the season progresses, water becomes more and more limiting, particularly during the reproductive and grain filling growth stages. Consequently, many of the tillers produce little or no grain.

Recent field studies (Varaprasad Bandaru, B.A. Stewart, Louis Baumhardt, and Alan Schlegel; unpublished data) have shown that growing grain sorghum in clumps of four plants every meter in 75 cm rows greatly reduces tillering when compared to growing the same number of equally spaced plants in the rows. The reduced number of tillers resulted in considerably less water use and biomass production during the vegetative growth stages so that more water was available later during the reproductive and grain filling stages. This resulted in slightly lower biomass production, but significantly higher harvest index values and increased grain yields. Grain yields from the clump treatments were more than double those of equally spaced plants in 2003 when water was severely limited during the latter part of the growing season. In 2004, there was a range of water conditions because of treatment and location differences. Plants grown in clumps yielded about 50% more grain than equally spaced plants when the yield levels were in the 2,000 kg ha^{-1} yield range, about 25% more in the 3,500 kg ha^{-1} yield range, and similarly when yields were in the range of 5,000 kg ha^{-1}. It is important to note, however, that grain yields of the clump treatments were never lower than the treatments with equally spaced plants. The numbers of tillers decreased and harvest index values increased in the clump treatments at all grain yield levels.

The objective of the proposed study is to determine how close together plants need to be to significantly decrease tillering, and if large differences occur between cultivars. Observations in the field suggested that tillering occurred even when plants were as close as 2 cm, but very little or no tillering occurred when the plants were immediately adjacent to each other. This information is vitally needed for developing suitable mechanized methods for establishing clumps under large field conditions. A second objective is to determine the effect of water stress on tiller formation during the early vegetative growth stage.

3. Methods: The study will be conducted at West Texas A&M University under greenhouse conditions. Approximately six cultivars of grain sorghum will be selected following consultation with Texas Agricultural Experiment Station scientists working with grain sorghum germplasm. Four seeds of each cultivar will be seeded in approximately 25 cm diameter greenhouse pots. The spacing of the four plants per pot will vary from having the four plants in a clump to others separated by 2 cm, 6 cm, and 10 cm in square patterns within the pot. The water content of the soil in half of the pots will be maintained at a high level by adding water as needed so that the plant available soil water content is always higher than 75% of the maximum value. The other half of the pots will not have water added until the soil water content drops to 25% of the maximum plant available water content.

Water use by the various treatments will be determined by recording all water additions to the pots. The number and dates of all tillers will be recorded. At time of harvest, aboveground biomass will be determined and if the plants are grown to maturity, grain yields and harvest index values will be determined.

4. Anticipated results: The focus of the study is to determine how close dryland grain sorghum plants must be to each other to prevent or significantly reduce tillering. Field results from 2003 and 2004 at Bushland, Texas and Tribune, Kansas are promising that growing dryland grain sorghum in clumps will result in fewer tillers and less water use during the vegetative growth stages so that more water will be available during the reproductive and grain filling stages. This results in a higher harvest index and increased grain yields, particularly during drier than normal years. An equally important finding was that there was no decrease in grain yield for the clump treatment during a very wet year when dryland grain yields exceeded 5,000 kg ha^{-1}. The proposed study will provide vital information needed for developing methodologies for establishing clumps with mechanized equipment on large fields. Studies have shown shading reduces light interception of plants and lowers the ratio of red to far-red light at their bases which causes reduced tillers. This suggests that the plants in clumps must be immediately adjacent to one another to control tillering and this is supported by field observations in 2003 and 2004 that indicated plants as close as 2 cm to one another still produced tillers. The findings will be used for designing equipment and developing methodologies for seeding dryland grain sorghum in clumps in the event that additional field studies show that growing dryland grain sorghum in clumps is a feasible practice.