Ethiopian Mustard (*Brassica carinata*) Response to Seeding Rates at Two Locations in South Dakota

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Introduction

- Biofuel production and consumption has increased steadily in the U.S. over the last decade (Energy Information Administration, 2015).
- First generation oilseed crops that have been used for biofuel production include soybean (*Glycine max*), sunflower (*Helianthus annuus*), and rapeseed (*Brassica spp*) (Sindelar et al. 2015). These crops are also used for vegetable oil, raising concerns regarding the "food vs fuel" debate. Additionally, these first generation oil feedstock cannot meet the growing energy demands and are not suited for production in marginal areas.
- Research on second generation oil feedstocks (non-food) such as *Brassica carinata* for biofuel production has expanded in recent years.
- *Brassica carinata* is more heat and drought tolerant than other *Brassica* species; this allows for expansion of biofuel production to semi-arid regions (Johnson et al., 2013).
- The best management practices for the crop remain to be developed in South Dakota.

Objectives

- Evaluate the response, in seed yield and other agronomic traits, of two *B. carinata* varieties to four seeding rates at two locations in South Dakota.

Materials and Methods

- The study was conducted at two locations, Brookings (conventional till) and Pierre (no-till) in South Dakota in 2016.
- The experimental design was a randomized complete block design with 4 replications.
- Treatments included four seeding rates (4.5, 9, 13, and 17.5 kg/ha), and two *B. carinata* cv. ('A110' and 'A120') arranged in a factorial design.
- Planting dates were April 14th and April 26th at Pierre and Brookings, respectively.
- Urea (46 % N) was applied at a rate of 56 kg N/ha was applied to each plot.
- Agronomic traits evaluated included: stand establishment, plant height, lodging severity, oil content, and yield.
- Data analysis was performed using ANOVA in RStudio (The R Foundation, Vienna, Austria- 2016).
    - Pairwise comparisons was done using Tukey's HSD.
    - **Data from Pierre and Brookings were analyzed separately for all agronomic traits.**

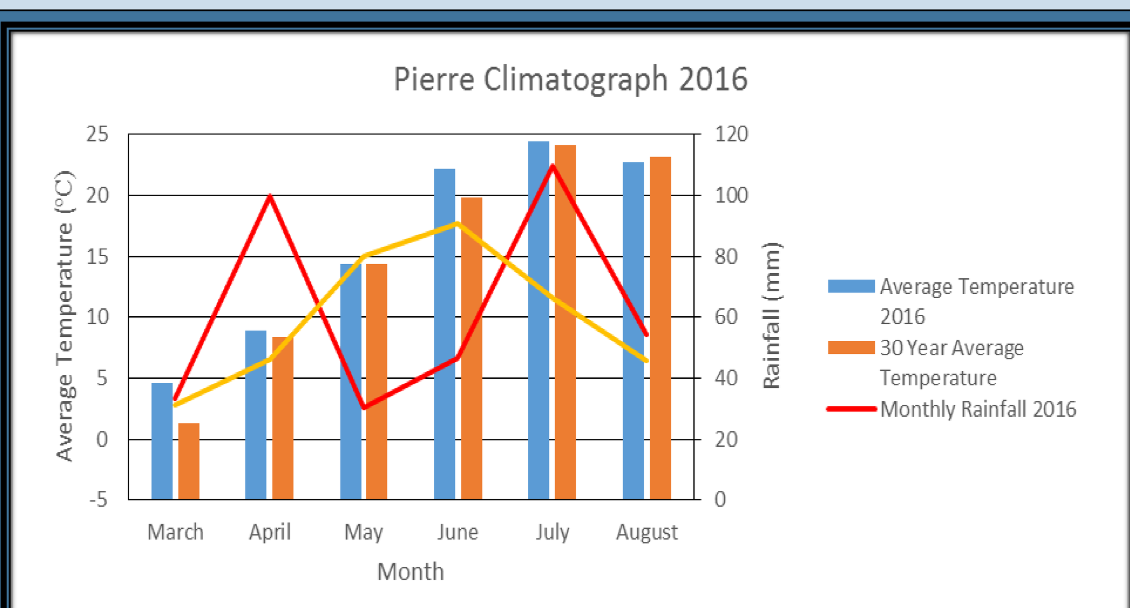

Figure 1. Pierre Climatograph 2016

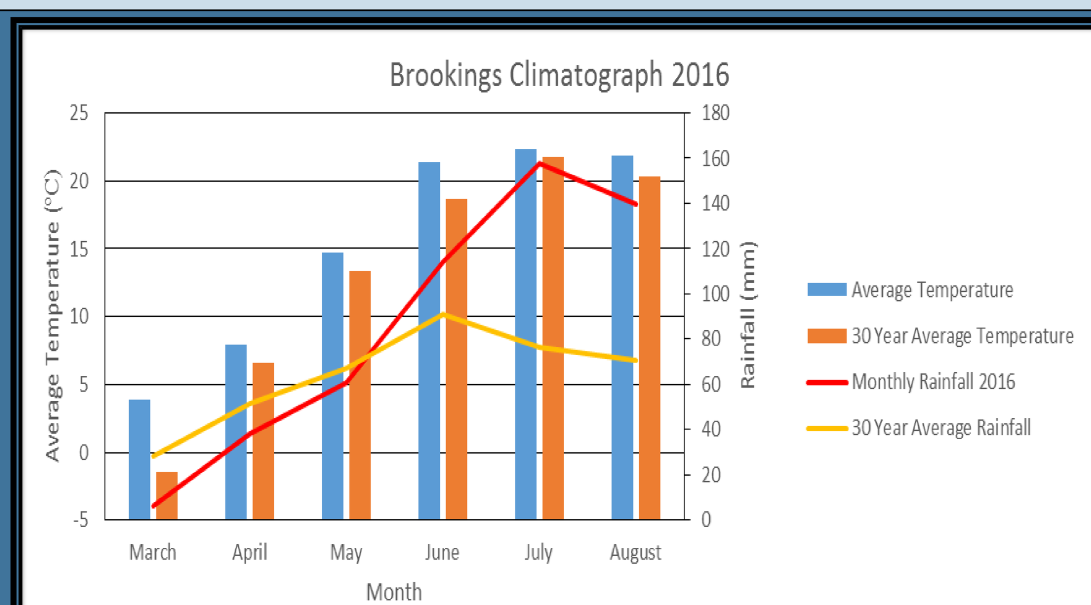

Figure 2. Brookings Climatograph 2016

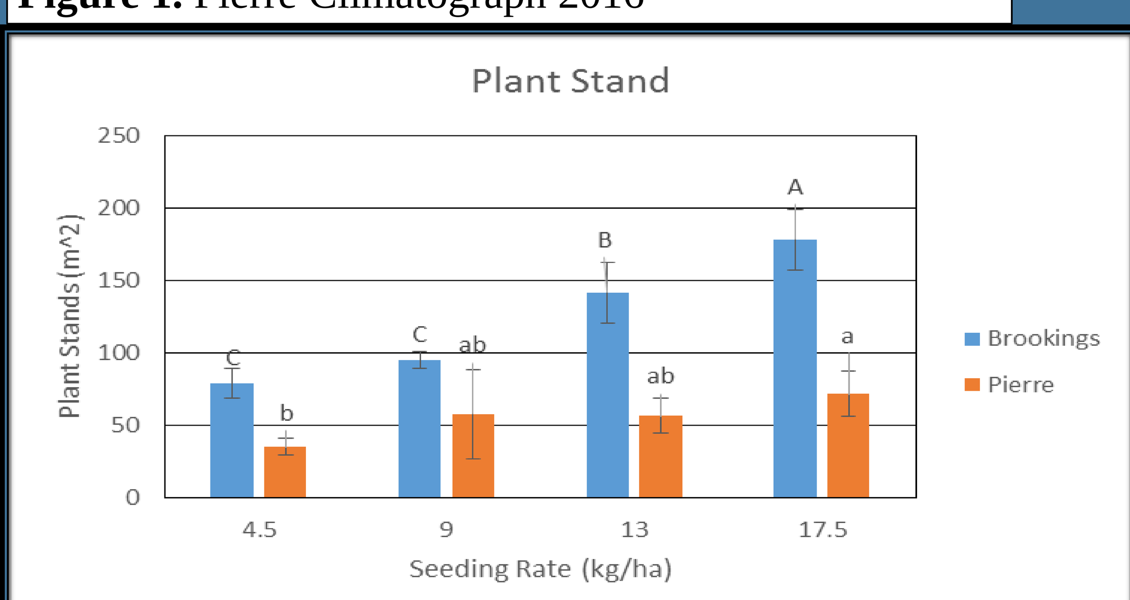

Figure 3. Plant Stand in Response to Seeding Rate

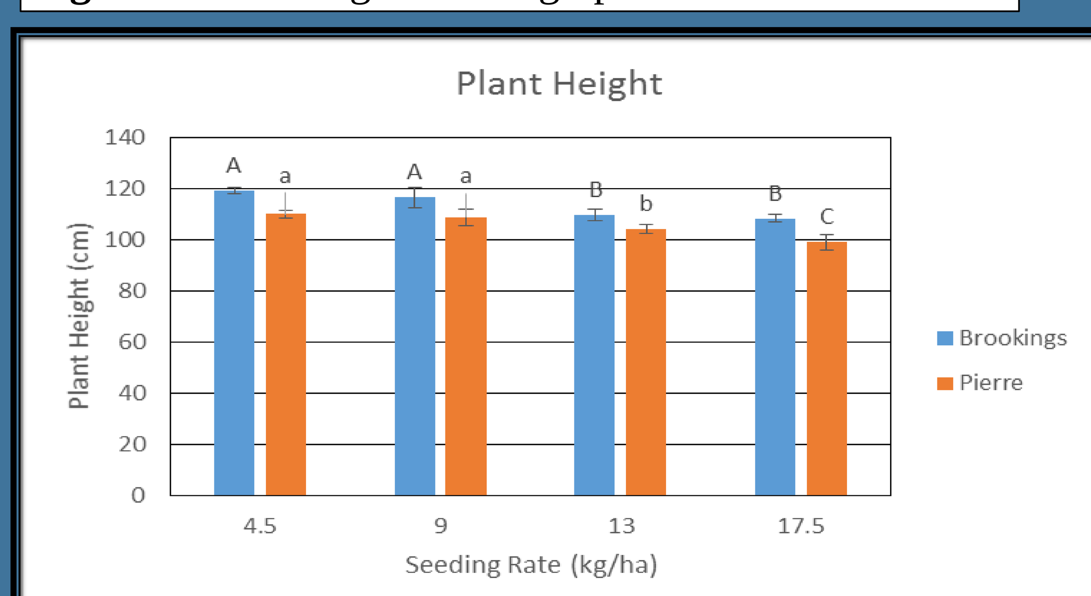

Figure 4. Plant Height in Response to Seeding Rate

Figure 5. *B. carinata* Plot at Flowering (Brookings 2016).

Figure 6. *B. carinata* Plot Showing Lodging after Severe Storm (Brookings 2016).

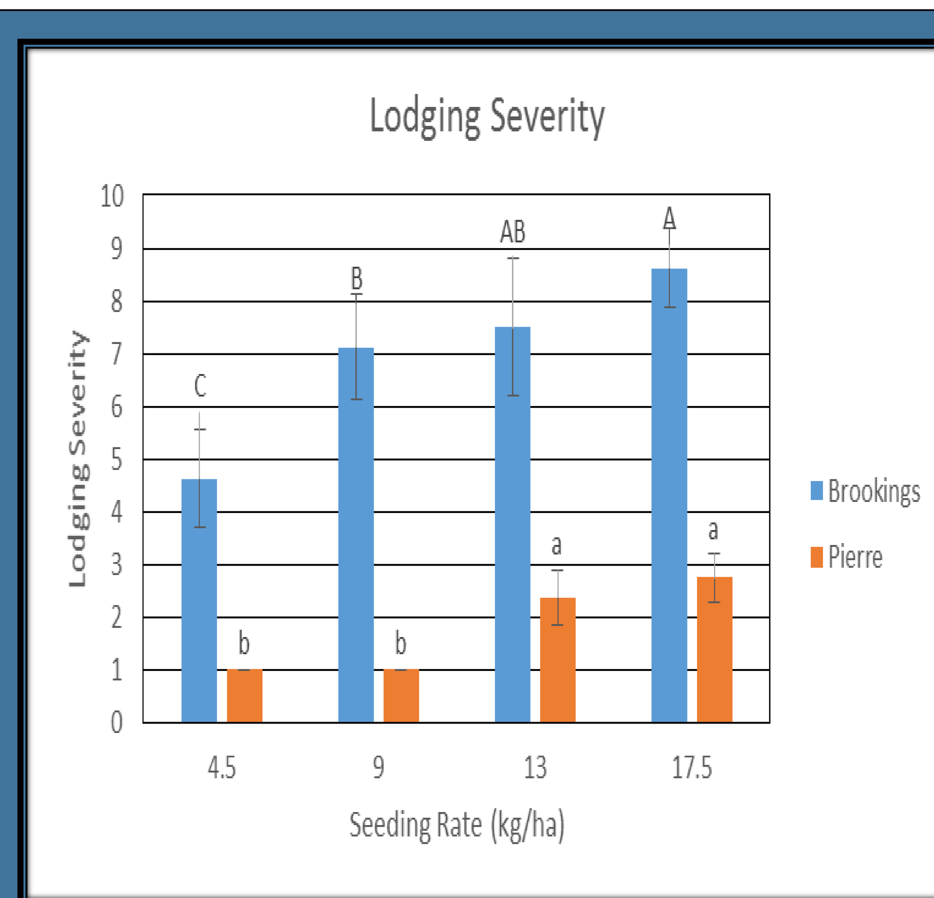

Figure 7. Lodging Severity in Response to Seeding Rate (0= no lodging, 9=completely lodged)

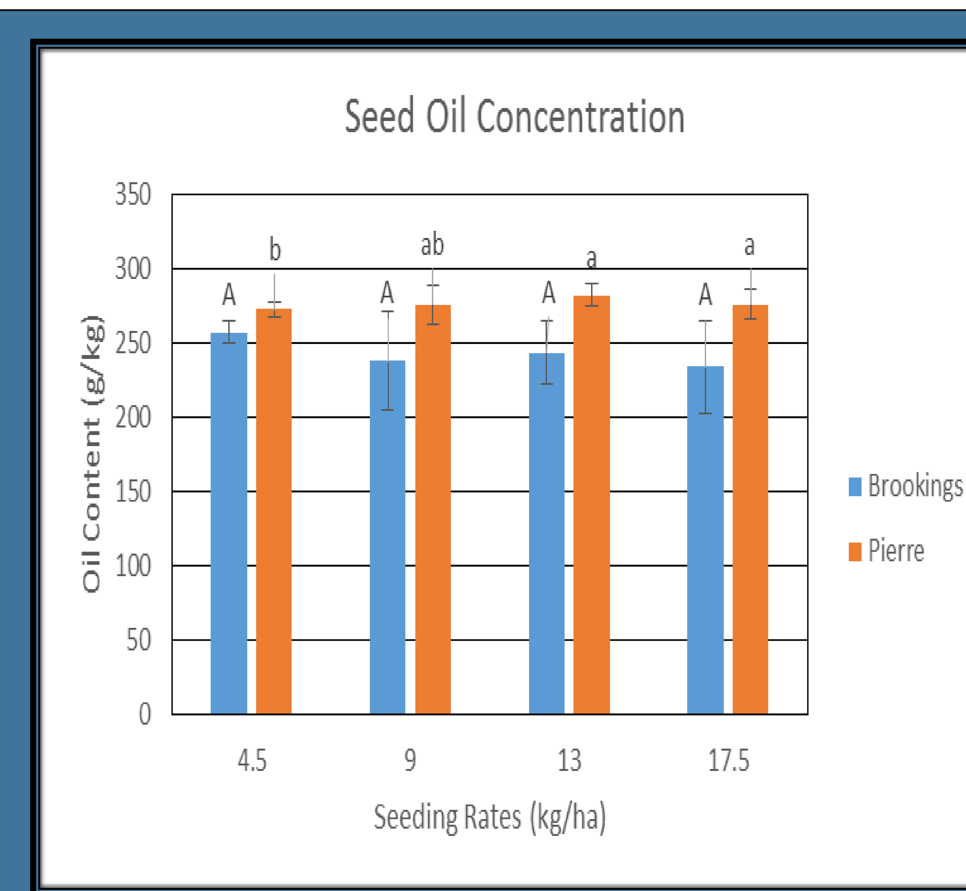

Figure 8. Seed Oil Concentration in Response to Seeding Rate

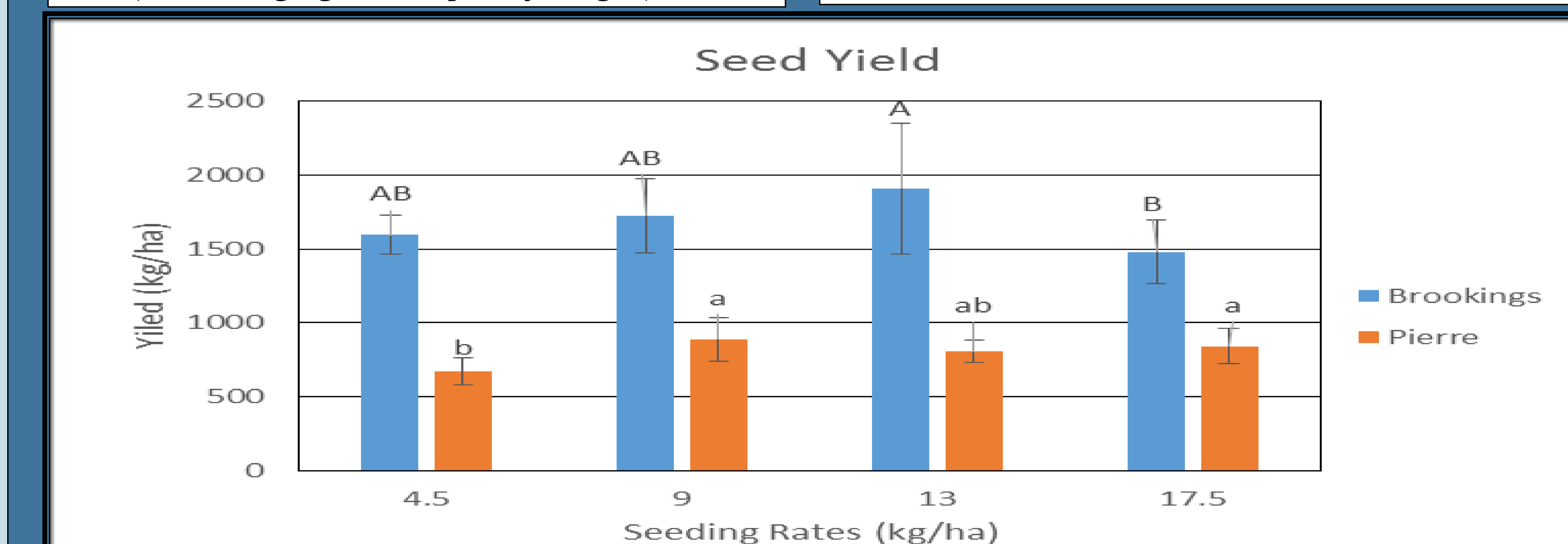

Figure 9. Seed Yield in Response to Seeding Rate

Results and Discussion

- Weather data shows periods of drought at Pierre during flowering (Fig. 1). In addition, periods of high rainfall and severe storms during flowering and seed-fill occurred at Brookings (Fig. 2).
- At both locations, plant stands increased in response to higher seeding rates; plant stands were greatest at 17.5 kg/ha and lowest at 4.5 kg/ha (Fig. 3). Pierre experienced greater seedling mortality than Brookings.
- Plant height decreased in response to higher seeding rates at both locations; plants were shortest at 17.5 kg/ha and tallest at 4.5 kg/ha (Fig. 4).
- Lodging was more severe at Brookings and most likely due to several severe wind storms (Fig. 5 and 6). Lodging increased in response to higher seeding rates (Fig 7).
- Seed oil concentration was not influenced by seeding rate at Brookings; however, optimal seed oil concentration was achieved at seeding rates between 9 and 17.5 kg/ha at Pierre (Fig. 8).
- Yield increased with increasing seeding rates at both locations (Fig 9). At Brookings the greatest yield (~1750 kg/ha) was obtained at a seeding rate of 13 kg/ha but this yield was not significantly greater than yields at seeding rates of 4.5 and 9 kg/ha. At Pierre, the greatest yield (~800kg/ha) was obtained at a seeding rate of 9 kg/ha but this yield was not significantly greater than yields at seeding rates of 13 and 17.5 kg/ha.

Conclusions

- These preliminary results suggest that higher seeding rates should be used in no-till systems compared to conventional till to compensate for increased seedling mortality.
- *B. carianta* has tremendous plasticity, allowing for low plant populations to compensate substantially by producing more branches and more pods.
    - Periods of extended drought conditions have negative impacts on yield potential.
- The study will be repeated in 2017.

Acknowledgement

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