ROW SPACING AND NITROGEN FERTILIZATION EFFECT ON ARCHITECTURAL TRAITS AND YIELD LOSS OF DRY BEAN VARIETIES UNDER DIRECT HARVEST

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INTRODUCTION

Higher levels of plant available nitrogen (N) have resulted in increases in the number of dry bean pods per plant, number of seeds per pod, seed weight, and consequently, a yield increase (Fageria and Santos, 2008). However, in order to achieve optimum seed yield at a low cost, N fertilization should be appropriately managed. For a yield goal of 1,700 kg ha^{-1} (North Dakota's mean yield) it is recommended that 84 kg ha^{-1} total nitrogen (soil N plus fertilizer) be applied (NDSU, 2003). However, in ND, MN, and other regions, farmers usually correct the available N to a level of 112 kg ha^{-1} and some even go beyond. Row spacing is another important factor affecting plant architecture and consequently, seed yield (Grafton et al., 1998). The effect of row spacing on dry bean yield and plant architecture appears to be different for the variable amount of applied N (MAFRI, 2007). Given the recent increases in fertilizer costs, it is important to find the optimum growing conditions that maximizes yield and reduce production costs. The objective of this study was to evaluate the effect of N fertilization and row distances on yield performance and yield loss due to direct harvesting of new upright pinto varieties.

MATERIALS AND METHODS

This study was conducted at Carrington and Prosper, ND, in 2008. The experimental design was a RCBD in a split-plot arrangement with three replicates where row spacings were the main plot and a factorial of N levels and genotypes were the subplots. The genotypes tested were the new Lariat and Stampede pinto beans (Type II), and Maverick pinto bean as a control (Type III). The study had three row spacings: solid seeded, narrow rows, and wide rows (30, 46, and 76 cm row spacings, respectively). Two nitrogen availability levels: 56 kg ha^{-1} N (soil N) and 112 kg ha^{-1} N (soil N + fertilizer N) were used with all row spacings and varieties. Characteristics evaluated included plant height, pod distribution, seed yield, harvest loss, and seed weight. The varieties were planted in plots 7.62 m long at recommended seeding rates. A Hege 125B plot combine was used to direct harvest. Harvest losses, in each plot, were estimated by counting the seeds on the ground, in two samples, within an area bounded by a square metal hoop (0.21 m^2), and then converted to seed weight to calculate yield loss.

RESULTS AND DISCUSSION

Analysis across the two locations showed a significant genotype x environment interaction. Both locations have similar average rainfall, but different soil type which makes the environments very contrasting. Therefore, results are shown by location. Pod distribution of the three genotypes was significantly different, especially for Maverick which had the greatest number of pods in the lower third of the plants (Tables 1 and 2). Pods in the medium third did no vary across genotypes, and in Prosper, Lariat and Stampede tended to have greater number of pods in the upper third compared to Maverick. When pods are located closer to the ground, there is a higher chance of being cut and lost during the direct harvesting. Nitrogen did not affect how pods were distributed on the plants in

most cases, or over other architectural traits evaluated. In the same way, increases in N did not show a direct effect in seed yield across varieties, although Lariat showed to be more responsive than the others. Row spacing had different effects on the architecture of the plants. In Carrington for example, pod numbers in the lower third were greater in the wider row spacing (due to less competition among plants). In Prosper, differences were found for pods on the medium and on the upper thirds of the plants, with greatest number of pods in the intermediate row spacing. Plant height was not affected by N levels or row spacing, but was significantly different across genotypes. Preliminary conclusions show that Lariat was the highest yielding when direct harvested and also had the lowest seed loss. However, yield potential of Lariat and Stampede were similar. There was no significant difference in yield and yield loss between N levels. Yield was increased with narrower to intermediate row spacing in Prosper (30 and 46 cm apart), whereas intermediate to wider row spacing appears to be the best in Carrington (46 and 76cm apart). This study will be repeated in 2009 to obtain more accurate information across more environments.

Table 1: Means of the main effects (Genotypes, N level, and row spacing) of agronomic and architectural traits evaluated in Prosper, ND, in the 2008 season.

Location: Prosper	**Genotypes**			**Nitrogen Levels**		**Row Spacing**		
Trait	Lariat	Stampede	Maverick	50	100	76	46	30
Yield (kg ha^{-1})	2,312	2,025 B	1,249 C	1,830	1,894	1,640	2,082	1,865
Yield Loss (kg ha^{-1})	172 C	243 B	246 A	225 A	215 A	240 A	208 A	213 A
Yield Potential (Yield + Yield	2,484	2,269 B	1,496 C	2,056	2,109	1,880	2,290	2,078 A
Hundred seeds weight (g)	40.23	35.91 B	34.52 C	36.53	37.24	36.36	36.87	37.44 A
Plant Height (cm)	40.16	44.27 A	33.20 C	39.07	39.36	39.58	38.37	39.69 A
Number of pods on the lowest third	3.37 B	4.44 B	5.95 A	4.58 A	4.60 A	4.23 A	4.56 A	4.97 A
Number of pods on the medium	6.88 A	7.65 A	6.97 A	7.29 A	7.04 A	6.22 B	8.01 A	7.27 AB
Number of pods on the upper third	11.93	12.52 A	9.75 B	11.37	11.42	9.23 B	13.12	11.84

Table 2: Means of the main effects (Genotypes, N level, and row spacing) of agronomic and architectural traits evaluated in Carrington, ND, in the 2008 season.

Location: Carrington	**Genotypes**			**Nitrogen Levels**		**Row Spacing**		
Trait	Lariat	Stampede	Maverick	50	100	76	46	30
Yield (kg ha^{-1})	1,080	888 B	678 C	855 A	909 A	970 A	928 A	747 B
Yield Loss (kg ha^{-1})	196 B	294 A	301 A	263 A	264 A	252 A	260 A	279 A
Yield Potential (Yield + Yield	1,276	1,182 A	979 B	1,119	1,173	1,223	1,188	1,027
Hundred seeds weight (g)	33.97	31.97 B	29.83 C	31.44	32.41	31.32	31.80	32.65
Plant Height (cm)	45.70	41.09 B	40.00 C	42.09	42.44	43.38	42.37	41.04
Number of pods on the lowest third	2.05 C	2.98 B	4.05 A	3.01 A	3.04 A	3.06	3.38 A	2.63 B
Number of pods on the medium	7.02 A	7.25 A	7.86 A	7.44 A	7.31 A	7.27 A	7.75 A	7.11 A
Number of pods on the upper third	7.88 A	6.70 A	7.13 A	6.91 A	7.57 A	7.94 A	7.62 A	6.16 A

Only letters in the same row within genotypes, nitrogen level or row spacing should be compared. If letter behind number is similar the numbers are not significantly different at $p<0.05$.

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