EVALUATION OF DRY BEAN GENOTYPES FOR PHOSPHORUS USE EFFICIENCY IN TROPICAL ACID SOIL

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Abstract

Dry bean is an important legume for South American population and phosphorus deficiency is most yield limiting nutrient for crop production in South American soils. A greenhouse experiment was conducted with the objective to evaluate influence of P fertilization on dry matter and grain yield of 30 dry bean genotypes. The P levels used were 0 mg P kg^{-1} and 200 mg P kg^{-1} soil. Dry matter and grain yield were significantly influenced with P as well as genotype treatments. The P X genotype interaction was also significant for these traits, indicating different responses of genotypes at two P levels.

Introduction

Dry bean is an important legume for the population of South America, including Brazil. Due to high protein content of dry bean seeds (H"20%), it is good dietary food crop for all section of population along with rice. Yield of dry bean in all South American countries is low. For example, in Brazil average yield of dry bean is less than 1000 kg ha^{-1}. Low yield of this crop is associated with biotic and abiotic stresses (Fageria et al. 2011). Biotic stresses include diseases, insects and weeds. Abiotic stress like nutrient deficiencies and water stress are mainly responsible for low yield of dry bean in South American soils (Fageria, 2002). Use of P efficient genotypes along with adequate P rate can be an important strategy in improving dry bean yield in these soils. The objective of this study was to evaluate responses of 30 dry bean genotypes to P fertilization.

Materials and Methods

A greenhouse experiment was conducted to evaluate responses of 30 dry bean genotypes to P fertilization grown on a Brazilian Inceptisol. Chemical properties of the experimental soils before application of P treatments were pH 5.6, P 2.2 mg kg^{-1}, Ca 6.7 cmol$_c$ kg^{-1}, Mg 1.1 cmol$_c$ kg^{-1}, K 156 mg kg^{-1}, Cu 3.7 mg kg^{-1}, Zn 3.8 mg kg^{-1}, Fe 160 mg kg^{-1}, Mn 130 mg kg^{-1} and organic matter 21 g kg^{-1}. Experiment was conducted in plastic pot with 7 kg soils in each pot. Phosphorus levels used were low (0 mg kg^{-1}) and high (200 mg kg^{-1}). Thirty genotypes used were taken from the breeding program of National Rice and Bean Research Center. These genotypes were most promising and advanced lines of the breeding program. Experimental design was randomized complete block in a split plot arrangement. The P levels were in the main plots and genotypes in the sub-plots. Treatments were replicated three times. There were four plants in each pot. Each plot received 100 mg N kg^{-1} with urea and 200 mg K kg^{-1} with potassium chloride at sowing. In addition, 100 mg N kg^{-1} was also top-dressed one week before flowering.

Results and Discussion

Dry matter yield of straw and grain yield were significantly influenced by P as well as genotype treatments (Table 1). The P X genotype interactions was also significant for these two traits, indicating different responses of genotypes at two P levels. Straw yield varied from 1.03 g plant^{-1} produced by genotype BRS Valente to 2.13 g plant^{-1} produced by genotype BRS Pontal, with an average value of 1.58 g plant^{-1} at 0 mg P kg^{-1} level. At high P level, straw yield varied from 1.94 g plant^{-1}produced by genotype Correnteto 5.61 g plant^{-1}produced by genotype BRS Valente, with an average value of 3.68 g plant^{-1}. The difference in straw yield between lowest and highest straw yield producing genotypes was 2 fold at low P level and 2.6 fold at high P level. Overall, increase in straw yield was 133% at high P level compared with low P level. Significant difference among dry bean genotypes in straw yield production is reported by Fageria (2002). Similarly, Fageria (2009) and Fageria et al. (2011) also reported straw yield differences among dry bean genotypes at low and high P level grown on a Brazilian Inceptisol.

Grain yield varied from 0.66 g plant^{-1} produced by genotype BRS Embaixador to 2.11 g plant^{-1} produced by genotype BRS Pontal, with an average value of 1.47 g plant^{-1} at low P level. Similarly, grain yield at high P level varied from 5.33 g plant^{-1} produced by genotype BRS Embaixador to 10.78 g plant^{-1} produced by genotype BRS Pontal, with an average value of 8.61 g plant^{-1}. Overall, increase in grain yield was about 6 fold at high P level compared to low P level. Fageria (2002) and Fageria et al. (2011)) reported grain yield differences among dry bean genotypes at different P levels.

Table 1 : Dry matter yield of straw (DMYS) and grain yield (GY) of thirty dry bean genotypes at two phosphorus levels.

Genotype	DMYS (g plant^{-1})		GY (g plant^{-1})	
	0 mg P kg^{-1}	200 mg P kg^{-1}	0 mg P kg^{-1}	200 mg P kg^{-1}
1. Aporé	1.09hi	2.39m	1.07h-j	8.64d-h
2. Pérola	1.71a-g	4.25b-e	1.68a-f	9.36b-f
3. BRSMG Talisma	1.64a-h	3.19f-l	1.49b-i	8.83d-h
4. BRS Requinte	1.72a-g	3.03h-l	1.65a-f	8.48d-j
5. BRS Pontal	2.13a	3.58d-i	2.11a	10.78a
6. BRS 9435 Cometa	1.87a-c	3.32d-j	1.57b-h	9.72a-d
7. BRS Estilo	1.76a-f	3.38d-j	1.71a-e	9.42b-e
8. BRSMG Majestoso	1.81a-e	3.42d-j	1.46b-i	7.98g-j
9. CNFC 10429	1.64a-h	2.45m	1.45b-i	9.59a-e
10 .CNFC 10408	1.70a-g	2.17m	1.97ab	9.02c-g
11. CNFC 10467	1.92a-c	4.87a-c	1.62a-g	8.15f-j
12. CNFC 10470	2.07ab	4.34b-d	1.89a-c	10.33ab
13. Diamante Negro	1.77a-f	4.16b-f	1.55b-h	9.05c-g
14. Corrente	1.45c-i	1.94m	1.72a-d	10.17a-c
15. BRS Valente	1.03i	5.61a	1.17e-j	9.47b-e
16. BRS Grafite	1.19f-i	4.12b-g	1.01ij	8.35e-j
17. BRS Campeiro	1.63a-h	2.61im	1.10g-j	8.72d-h
18. BRS 7762 Supermo	1.52b-i	3.33d-j	1.54b-i	8.86d-h
19. BRS Esplendor	1.61a-h	4.01c-h	1.59a-h	8.49d-j
20. CNFP 10104	1.65a-h	4.20b-f	1.22d-i	8.63d-i
21. Bambuí	1.53b-i	2.94im	1.53b-i	7.66h-l
22. BRS Marfim	1.45c-i	3.10g-l	1.41c-i	9.07b-g
23. BRS Agreste	1.89a-c	5.05a-c	1.56b-h	8.90c-h
24. BRS Pitamda	1.15g-i	4.11b-g	1.14f-j	7.68h-l
25. BRS Verede	1.24e-i	4.36b-d	1.07h-j	7.36il
26. EMGOPA Ouro	1.28d-i	2.46m	1.41c-i	7.87g-j
27. BRS Radiante	1.41c-i	3.23e-j	1.48b-i	7.29g-j
28. Jalo Precoce	1.58a-i	5.09ab	1.55b-h	6.53m
29. BRS Executivo	1.84a-d	4.26b-e	1.75a-d	8.39e-j
30. BRS Embaixador	1.11hi	3.69a	0.66j	5.33m
Average	1.58b	3.68a	1.47b	8.61a
F-Test				
P Levels (P)	**		**	
Genotype (G)	**		**	
P X G	**		**	
CVP (%)	11.03		9.71	
CVG(%)	9.97		5.84	

**Significant at the 1% probability level. Means followed by the same letter in the same column or same line (P levels) are not significantly different at the 5% probability level by Turkeys test.

Conclusions

Results of this study show that dry bean yield can be improved with the addition of P in the tropical acid soils of Brazil. However, yield differences were significant among dry bean genotypes at the low as well as at the high P levels. The P X genotypes interaction for straw and grain yield were significant, suggesting that dry bean genotypes should be screened at more than one P levels.

References

Fageria, N. K. 2002. Nutrient management for sustainable dry bean production in the tropics. *Communications in Soil Science and Plant Analysis* 33:1537-1575.

Fageria, N. K. 2009. *The use of nutrients in crop plants.* Boca Raton, Florida: CRC Press.

Fageria N. K., V. C. Baligar and C. A. Jones. 2011. *Growth and mineral nutrition of field crops*, 3rd[d] Edition. Boca Raton, Florida: CRC Press.