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Growth, Seed Yield and Protein Contents of Ricebean (*Vigna umbellata*) in Relation to Nitrogen and Phosphorus Nutrition

QAMAR-UZ-ZAMAN AND M. ASGHAR MALIK
Departments of Agronomy, University of Agriculture, Faisalabad–38040, Pakistan

ABSTRACT

The interactive effect of varying levels of nitrogen *viz.* 0, 40 and 60 kg ha^{-1} with that of phosphorus *viz.* 0, 30, 60 and 90 kg P_2O_5 ha^{-1} on the growth, seed yield and protein contents of ricebean was studied in sandy clay loam soil at the Agronomic Research Area, University of Agriculture, Faisalabad during 1995 and 1996. Application of N and P_2O_5 @ 40 and 60 kg ha^{-1}, respectively, resulted in highest leaf area index, crop growth rate, number of pods/plant, number of seeds/pod, 1000-seed weight and grain yield. A combination of 60–90 kg N-P_2O_5 ha^{-1} showed maximum seed protein contents.

Key Words: Ricebean; Nutrition; Growth; Yield quality.

INTRODUCTION

Pulses are an excellent and inexpensive source of vegetable protein. Ricebean (*Vigna umbellata*) has been an under utilized pulse crop. It has recently been introduced by the Plant Genetic Resources Institute (PGRI) of Pakistan Agricultural Research Council, Islamabad. Its complete production technology has yet to be determined (Ahmad & Ashiq, 1992). Mukherjee *et al.* (1980) reported that ricebean had the potential to produce 30 q ha^{-1} seeds and could produce up to 80 q ha^{-1} dry herbage to meet scarcity of green forage during the two lean periods i.e. April-June and November-December. Proper use of fertilizers is an important component of improved production technology. Nitrogen plays a vital role when used as basal dose with phosphorus in legume crops. Biological nitrogen fixation may hold promise in this direction. It influences crop production by either providing nitrogen for crop itself or via a residual effect on subsequent crops (Dart, 1983). The direct transfer of N from forage legumes to companion grasses occurred in mixed pastures (Kang, 1988). Application of phosphorus to legumes improves seed yield considerably (Majid, 1962). Adequate amount of phosphorus in soils favors rapid plant growth, early fruiting and often the quality of vegetation.

Fertilizers increase yield and improve quality of the produce. According to Chandel *et al.* (1978) 20 kg nitrogen and 40 kg phosphorus per ha produced good seed yields of ricebean. Chatterjee and Mukherjee (1979) reported that seed yield potential of ricebean was 1.8–2.8 t ha^{-1} as compared to potential yields of 0.6–1.0 t ha^{-1} of other legumes. Increased seed yield in mungbean with the application of 20–50 kg N-P_2O_5 ha^{-1} was reported by Tomer *et al.* (1985). Nitrogen and phosphorus nutrition of ricebean under varying soil environments is yet to be optimized.

The present study was, therefore, designed to find out a suitable combination of N and P for harvesting increased seed yield with better quality of ricebean.

MATERIALS AND METHODS

The crop was sown in the first week of August during 1995 and 1996. Experiment was laid out in randomized complete block design with four replications using a net plot size of 3.6 m x 5 m. The soil was a sandy clay loam with pH of 7.8, containing 0.68% organic matter, 0.061% nitrogen, 6.25 ppm phosphorus and 189 ppm K_2O. The experiment treatments comprised of varying combinations of N-P_2O_5 *viz.* 40–0 (F_1), 0–30 (F_2), 40–30 (F_3), 40–60 (F_4), 40–90 (F_5), 60–30 (F_6), 60–60 (F_7) and 60–90 (F_8) kg ha^{-1} in addition to control (no fertilized). Seeding was done with a single row hand drill in 60 cm spaced rows using a seed rate of 30 kg ha^{-1}. N and P fertilizers were side drilled at the time of seeding. Four irrigations and two hoeings were done. Crop was sprayed by methyl parathion @ 500 ml $acre^{-1}$ against the attack of whitefly at vegetative stage of crop growth. The crop was harvested in the last week of November. It was sun dried and threshed manually to record observations. The observations on different physico-agronomic traits of ricebean were recorded as follows. Leaf area index (LAI),

$$LAI = \frac{\text{Total Leaf Area}}{\text{Land Area}}$$

CGR was calculated by using the formula described by Gardner (1985),

$$CGR = \frac{W_2 - W_1}{t_2 - t_1}\left(gm^{-2}d^{-1}\right)$$

Number of pods/plant, number of seeds/pod, 1000-seed weight and grain yield (kg ha^{-1}) were recorded at final stage by taking a sample of 5 plants from each plot and then averaged. For protein content, 500 seeds from each plot were taken and were ground. The digestion was done by Gunning and Hibhards method of H_2SO_4 and distillation was made with Microjeldhal Apparatus (Jackson, 1962) to determine nitrogen contents in seeds. Thereafter protein content in the seed was calculated by multiplying total nitrogen in the seed with constant factor 5.71 (Peter *et al.*, 1980). Data collected were analysed statistically using Fisher's analysis of variance technique and least significant difference (LSD) test at 5% probability level was applied to compare the differences among treatments means (Steel & Torrie, 1984).

RESULTS AND DISCUSSION

Leaf area index (LAI) was increased significantly by N and P fertilizer application as compared with control (Table I). Application of N and P_2O_5 @ 40–60 and 60–60 kg ha^{-1} produced statistically highest and similar LAI. Crop growth rate (CGR) was also increased significantly by the fertilizer application. The maximum CGR (15.18 $gm^{-2}d^{-1}$) was found where fertilizer was applied @ 40–60 kg ha^{-1}. However, crop fertilized @ 40–60 and 60–90 kg ha^{-1} N and P exhibited statistically similar CGR. On the contrary, crop grown without fertilizer application exhibited the minimum CGR (4.55 g $m^{-2}d^{-1}$).

Different nitrogen and phosphorus levels affected number of pods per plant almost invariably. However, application of 40–30 and 40–60 kg ha^{-1} N and P resulted in maximum and statistically similar number of pods per plant (Table I). Application of P alone had no effect on pods per plant. Application of nitrogen and phosphorus alone or in combination increased number of seeds per pod significantly over control (Table I). Nitrogen and phosphorus @ 40–60 and 40–90 kg ha^{-1} produced maximum number of seeds per pod and were similar with each other. A further increase or decrease in either nitrogen or phosphorus decreased the number of seeds per pod. These results support the findings of Gowda and Gowda (1978), Patel (1988) and Hamid *et al.* (1991) who reported increased number of pods/plant and seeds/pod of mungbean to the application of nitrogen and phosphorus.

Table I. Growth, yield and quality characteristics of ricebean as influenced by different nitrogen and phosphorus applications (Average of two years)

Treatment $N–P_2O_5$ (kg ha^{-1})	Leaf area index (LAI)	Crop growth rate (CGR)	No. of pods/plant	No. of seeds/pod	1000–grain weight (g)	Grain yield kg/ha	Grain protein content (%)
0 0 (Control)	3.53 e	5.47 f	62.35 d	6.03 d	47.95 e	1015 c (00.00)	18.20 e
40 0	5.10 d	8.60 e	71.90 cd	6.80 bc	52.58 e	1194 bc (17.03)a	18.99 de
0 30	4.99 d	8.01 e	83.45 bcd	6.80 bc	58.38 d	1375 b (35.46)	19.28 d
40 30	6.06 bc	13.15 abc	116.90 ab	6.75 bc	61.19 bcd	1722 ab (69.65)	22.03 bc
40 60	6.79 a	15.18 a	149.15 a	7.80 a	68.10 a	1940 a (91.13)	22.42 b
40 90	5.55 bcd	12.21 cd	97.00 bcd	7.25 abc	64.32 abc	1750 a (72.41)	22.63 ab
60 30	5.66 bcd	10.51 dc	100.40 bc	6.45 c	59.22 cd	1722 ab (69.65)	21.48 c
60 60	6.12 ab	12.84 bc	84.05 bcd	7.60 abc	65.10 ab	1736 ab (71.03)	22.87 ab
60 90	5.25 cd	15.10 ab	88.10 bcd	7.45 abc	64.57 abc	1829 a (80.19)	23.37 a

Any two means not sharing a letter in common differ significantly from each other at 5% level of probability.

Figures in parenthesis show percent increase over control.

Application of nitrogen alone had no effect on 1000-grain weight as against P alone that increased it over control. A further increase in both N and P application rates increased 1000-grain weight. Application of 40 and 60 kg N along with 60 and 90 kg P gave the highest and statistically similar 1000-grain weight in ricebean. Tomer *et al.* (1985) and Patel *et al* (1988) also reported the increase in 1000-seed weight of mungbean due to NP applications.

Nitrogen application alone resulted in grain yield similar to unfertilized plots. All other fertilizer levels except phosphorus alone @ 30 kg ha^{-1}, resulted in statistically similar grain yield in ricebean. However, 40-60 kg ha^{-1} N and P_2O_5 application gave the highest grain yield of 1940 kg ha^{-1} and being 91% higher as compared with control.

Application of nitrogen alone produced grains with protein contents similar to unfertilized (control) plots. Similarly grain protein content were also same where nitrogen or phosphorus were applied alone. Application of N and P @ 40 and 90 kg ha^{-1} produced grains with highest protein content (22.63%). A further increase in N application rate reduced grain protein at lower (30 kg ha^{-1}) rate of P application but protein content was again improved when higher N application (60 kg ha^{-1}) was accompanied by moderate (60 kg ha^{-1}) to higher (90 kg ha^{-1}) rate of phosphorus application. Rajput *et al.* (1992) and Abbas (1994) also reported increase in seed yield of mungbean because of NP applications. Significant increase in grain protein contents was also observed because of different fertilizer applications.

CONCLUSION

Keeping in view the overall performance of the crop as influenced by the application of different combinations of N and P, it can be concluded that 40–60 kg NP ha^{-1} was the optimum level for exploiting the maximum potential of ricebean under the given situation.

REFERENCES

Abbas, Z., 1994. Growth, yield and quality response of mungbean to N, P and K fertilizer application. M.Sc. Thesis. Deptt. Agron., Univ. Agri., Faisalabad.

Ahmad, Z. and R. Ashiq, 1992. Genetic variability and correlation studies in ricebean. *Pak. J. Agri. Res.*, 13: 121–5.

Chandel, K.P., B.S. Joshi, R.K. Arora and K.C. Part, 1978. Ricebean: A new pulse with high potential *Indian Farming*, 28: 19–22.

Chatterjee, B.N. and A.K. Mukherjee, 1979. A new ricebean for fodder and grain pulse. *Indian Farming*, 26: 29–31.

Dart, P., 1983. Application of biological nitrogen fixation for increasing crop production. Advances in Nitrogen Fixation Res. *Proc. 5th Int. Symp of N_2-Fixation*, pp: 45–6.

Gardner, F.P., R.P. Pearce and R.KL. Mitchell, 1985. Growth and development in physiology of crop plants, pp: 187–208. Iowa State Univ. Press Ames.

Gowda, S.T. and K.T.R. Gowda, 1978. Influence of fertilizer on the yield and yield components of green gram. *Indian J Agron.*, 23: 374 (*Field Crop Absts.*, 33: 9022; 1980).

Hamid, A., 1991. Foliar fertilization of nitrogen in mungbean. Influence of rate and frequency of application. *Ann. Bangladesh Agric.*, 1: 33–9 (*Field Crop Absts.*, 46: 5848; 1993).

Jackson, M.L., 1962. Soil chemical analysis, p. 129. Constable and Co. Ltd, London.

Kang, B.T., 1988. Advances in Nitrogen Cycling in Agricultural Ecosystem. J.R. Wilson (ed.). pp: 333–48. C.A.B. International Wallingford, Connecticut, USA.

Majid, M.A., 1962. Effect of different doses of phosphate fertilizer on the yield of important varieties of gram. M.Sc. Thesis. Univ. Agri., Faisalabad, Pakistan.

Mukherjee, A.K., M.A. Roquib and B.N. Chatterjee, 1980. Ricebean for the scarcity period. *Indian Farming*, 30: 26–8.

Patel, R.R., J.R. Patel and G.V., Sasani, 1980. Effect of inoculation, N and P fertilization on yield and yield attributes of green gram. *Gujrat Agri. Univ. J.*, 14: 17–22 (*Field Crop Absts.*, 43: 527; 1990).

Peter, L.P. and V.R. Young, 1980. Nutritional evaluation of protein foods, p. 8. The United Nations University Japan.

Rajput, H.A., T. Masood, M. Jamil and M. Afzal, 1992. Response of mungbean to NPK fertilizer under irrigated conditions. *Pak. J. Agric. Res.*, 30: 485–8.

Steel, R.G.D. and J.H. Torrie, 1984. Principles and Procedures of Statistics. McGraw Hill Book Co. Inc., New York, USA.

Tomer, N.K., J. Nath and J. Chandra, 1985. Evaluation of fertilizer needs of mung. *Fertilizer News*, (India) 30: 32–3. (*Field Crop Absts.*, 39: 6097; 1986).

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