

Effect of nitrogen and phosphorus fertilization on growth, yield and nutrient uptake of winter rice bean (*Vigna umbellata*)

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ABSTRACT

A field experiment was conducted during the winter (*rabi*) season of 1994–95 and 1995–96 at Bhubaneswar, in acidic sandy-loam soil, to study the effect of nitrogen and phosphorus fertilization on growth, yield and nutrient uptake of rice bean [*Vigna umbellata* (Thumb.) Ohwi & Ohashi]. Application of nitrogen at 40 kg/ha and phosphorus at 60 kg/ha markedly influenced the branches and pods/plant, seeds/pod and 1,000-seed weight and significantly increased the seed yield by 57.3 and 27.7% over the respective control. The N and P content as well as their uptake in seed and haulm also increased significantly up to 40 kg N and 60 kg P_2O_5 /ha.

Key words : Rice bean, N, P, Nutrient uptake, Yield

Rice bean, a shy-nodulating grain legume crop, is becoming popular in rice fallows and irrigated uplands of Orissa during winter (*rabi*) season also because of availability of short-duration and photo-insensitive genotypes. Unlike other pulses, nitrogen requirement of this crop is high (NBPGR, 1991–92). It also responds well to higher levels of phosphorus fertilization, especially in acidic soil condition with high P-fixing capacity (Mahapatra *et al.*, 1996). Since an information on nitrogen and phosphorus requirement for winter rice bean grown under irrigated condition is meagre,

the present investigation was undertaken on these aspects of this crop.

MATERIALS AND METHODS

A field experiment was conducted during the winter (*rabi*) season of 1994–95 and 1995–96 at Bhubaneswar. Treatments comprising 3 levels of nitrogen (0, 20 and 40 kg N/ha) and 4 of phosphorus (0, 20, 40 and 60 kg P_2O_5 /ha) were tried in randomized block design with 3 replications. A uniform dose of 20 kg K_2O /ha was applied. The soil was sandy loam with pH 5.4, having total N 100 kg, and

available P and K 15.9 kg/ha 153 kg/ha respectively. The test variety 'SRBS 43' was sown on last week of October during both the years, in rows 30 cm apart keeping a distance of 10 cm between the plants. Half of the N and whole P_2O_5 and K_2O were applied at sowing and the remaining N top-dressed 21 days after sowing (DAS) coinciding with hoeing and weeding. The crop received a 186.9 mm rainfall in 18 days and 518.5 mm in 26 days during 1994-95 and 1995-96 respectively. The crop was irrigated at vegetative, flowering and reproductive stages during both the years.

Nitrogen content in plant was determined by the modified kjeldhal's method and phosphorus by calorimetric method, and uptake was computed. The yield attributes, viz. plant height, branches/plant, pods/plant, seeds/pod, were recorded at harvest.

RESULTS AND DISCUSSION

Nitrogen

Application of 40 kg N/ha significantly increased the plant height, branches/plant, leaves/plant, pods/plant, seeds/pod and 1,000-seed weight, hence the seed and haulm yield (Tables 1 and 2). The increase in seed yield 40 kg N/ha was 14.9 and 57.3% higher over 20 kg and no N application respectively. Haulm yield, biological yield and harvest index were also favourably higher at 40 kg N/ha. Behera and Mishra (1997) also reported similar yield increase in winter-sown rice bean crop.

Nitrogen content in seed and its uptake showed an increasing trend with increasing level of N (Table 2). Application of 40 kg N/ha recorded the maximum N content in seed (1.83%) and haulm (1.34%), hence higher N uptake (42.24 kg/ha). Increase in

Table 1. Growth and yield attributes of rice bean as affected by levels of nitrogen and phosphorus (mean data of 2 years)

Treatment	Plant height (cm)	Branches/ plant	Leaves/ plant	Pods/ plant	Seeds/ pod	1,000-seed weight (g)
<i>N (kg/ha)</i>						
0	51.22	2.47	25.54	13.94	5.27	58.19
20	56.47	3.24	31.27	18.19	5.84	59.38
40	69.83	4.33	40.78	22.83	6.67	61.13
CD (P = 0.05)	2.34	0.11	3.26	1.27	0.37	0.33
<i>P₂O₅ (kg/ha)</i>						
0	52.42	2.71	24.76	15.85	5.16	47.39
20	54.37	3.37	29.96	17.63	5.80	59.42
40	62.12	3.56	35.81	19.22	6.19	60.96
60	63.95	3.70	39.62	20.55	6.68	60.96
CD (P = 0.05)	2.71	0.12	3.34	1.29	0.42	0.44

Table 2. Yield, nutrient content and uptake of rice bean as influenced by levels of nitrogen and phosphorus (mean data of 2 years)

Treatment	Seed yield (q/ha)	Haulm yield (q/ha)	Bio- logical yield (q/ha)	Harvest index (%)	Nitrogen content (%)		Phosphorus content (%)		N uptake (kg/ha)	P uptake (kg/ha)
					Seed	Haulm	Seed	Haulm		
<i>N (kg/ha)</i>										
0	5.11	14.58	19.69	25.95	1.32	0.88	0.56	0.28	19.57	6.97
20	7.00	18.54	25.54	27.41	1.07	1.04	0.61	0.31	31.42	10.02
40	8.04	20.61	28.65	28.06	1.83	1.34	0.65	0.36	42.24	12.65
(CD (P = 0.05)	0.36	0.78	1.28		0.04	0.07	0.03	0.02	3.42	1.27
<i>P₂O₅ (kg/ha)</i>										
0	5.88	16.18	22.06	26.55	1.17	0.67	0.51	0.24	17.72	6.88
20	6.47	17.38	23.85	27.13	1.72	1.08	0.58	0.30	29.90	8.96
40	7.02	18.34	25.36	27.68	1.80	1.25	0.64	0.34	35.57	10.73
60	7.51	19.77	27.28	27.53	1.86	1.35	0.69	0.38	40.78	12.69
CD (P=0.05)	0.44	0.87	1.36		0.05	0.09	0.04	0.03	4.51	1.48

N uptake owing to the application of 40 kg N was higher by 34.4 and 115.8% over 20 kg and no N application respectively. Higher N-uptake was owing to increase in both N content in seed and haulm and biological yield of the rice bean crop. Our results confirm the findings of Prasad *et al.* (1994). Phosphorus content in both seed and haulm and also its uptake increased significantly with increasing levels of N application.

Phosphorus

Phosphorus application significantly improved the plant height, leaves/plant, branches/plant, pods/plant, seeds/pod and 1,000-seed weight. Seed and haulm yields increased significantly with increasing P₂O₅ levels up to 60 kg/ha in both the years. The increase in seed yield was 6.9 and 16.1 and 27.7% higher at 60 kg P₂O₅/ha level

compared to that at 40 kg, 20 kg and no P application respectively. Biological yield and harvest index also followed the similar trend. Significant and progressive increase in N and P contents as well as their uptake both by seed and haulm was recorded with increasing level of P₂O₅, the maximum being observed with application of 60 kg P₂O₅/ha. Higher yield at 60 kg P₂O₅/ha could be attributed to favourable effect of all the yield attributes and better N and P uptake (Bhati *et al.*, 1988). Response of rice bean to this higher level of P over the conventional dose of 40 kg/ha might be due to poor phosphate build up of the light-textured sandy loam soil (Mahapatra *et al.*, 1996).

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