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Nutrient uptake and yield of clusterbean (*Cyamopsis tetragonoloba*) as influenced by nitrogen, phosphorus and seed rate

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ABSTRACT

A field experiment was conducted at Lakhaoti to study the effect of nitrogen, phosphorus and seed rate on yield and uptake of nutrients in clusterbean [*Cyamopsis tetragonoloba* (L.) Taubert] on a sandy-loam soil. The soil was low in organic carbon and available N and high in available P and K with pH 7.8. The crop seeded @ 30 kg/ha gave the highest yield. Application of 20 kg N/ha + *Rhizobium* inoculation resulted in higher yield over their individual application and control, except *Rhizobium* alone in 1988. A dose of 60 kg P_2O_5/ha gave markedly higher seed yield over lower rates of P in both the seasons. Crop seeded using 10 kg seed/ha recorded noticeably higher gum and protein contents in seed than 30 kg/ha, but remained at par with 20 kg seed/ha in both the seasons. The highest values of these were noted with 60 kg P_2O_5/ha and 20 kg N/ha + *Rhizobium* inoculation. The N and P uptake were highest when crop was seeded with 30 kg seed/ha, 60 kg P_2O_5/ha and 20 kg N/ha + *Rhizobium* inoculation.

Like other legume crops clusterbean [*Cyamopsis tetragonoloba* (L.) Taubert] has potential to fix atmospheric nitrogen through its root nodules, which require phosphorus for their proper growth and development. Besides phosphorus, pulses also require nitrogen as a starter dose along with seed inoculation with the effective strain of *Rhizobium* for successful cultivation. Therefore the present study was made to work out the optimum seed rate, phosphorus and nitrogen dose with *Rhizobium* inoculation.

MATERIALS AND METHODS

The field experiment was conducted in summer season of 1988 and 1989 at Amar Singh College, Lakhaoti (Bulandshahr), on a sandy-loam soil. The soil was low in organic carbon (0.02%) and available N (158 kg/ha), medium in available P (17.2 kg/ha) and K (246 kg/h), with pH 7.8. The experiment was laid out in split-plot design, keeping combinations of seed rates (10, 20 and 30 kg/ha) and P_2O_5 levels (0, 30 and 60 kg/ha) in main plot and 4 levels of N (0, 20 kg N/ha, inoculation alone and 20 kg N + *Rhizobium* inoculation) in subplot with 3 replications. Clusterbean cv. 'Pusa Naubahar' was sown on 25 February during both the seasons. The N and P were applied as basal dose through urea and single superphosphate respectively. *Rhizobium* culture was used to inoculate the seed as per the need of the treatment. Extraction and estimation of gum content was done as per the method of Das *et al.* (1977). The N content

in seed was determined using modified kjeldahl's method and then multiplied by 6.25 to obtain protein content.

RESULTS AND DISCUSSION

Seed rate

Crop sown using 30 kg seed/ha gave significantly higher seed yield than 10 and 20 kg seed/ha (Table 1). The increase was 13.7 and 8.9% over 10 and 4.4 and 5.1% over 20 kg/ha in the respective seasons. This increase might be accrued owing to high plant population, as yield is the function of plant population and yield per plant. However, the protein and gum contents (Table 1) were found lowest under this treatment in both the seasons. It might be due to the higher order of competition between crop plants for nutrients, particularly for nitrogen and phosphorus due to higher plant population. Singh and Singh (1989) also reported similar findings. The highest removal of N and P by the crop (Table 2) was noted when it was sown using 30 kg seed/ha. The highest seed and stover yields recorded under this rate might have accounted for.

Phosphorus

Each successive increment in P increased the seed yield remarkably in both the seasons, being highest under 60 kg P_2O_5/ha (Table 1). The mean increase over the control and 30 kg P_2O_5/ha was 11.1 and 4.5% respectively. Almost similar trend was noted for protein and gum contents, being highest with 60 kg P_2O_5/ha (Table 1). Both N and P uptake increased significantly with increasing levels of P_2O_5 up to 60 kg/ha in both the

Table 1. Effect of nitrogen, phosphorus and seed rate on yield and quality of clusterbean

Treatment	Seed yield (q/ha)		Stover yield (q/ha)		Gum content (%)		Crude protein content (%)	
	1988	1989	1988	1989	1988	1989	1988	1989
Seed rate (kg/ha)								
10	14.6	16.9	35.7	34.9	26.7	28.4	25.5	25.9
20	15.9	17.5	36.5	36.3	26.1	28.2	24.8	25.5
30	16.6	18.4	37.9	25.3	27.6	24.4	24.2	
CD (P = 0.05)	0.6	0.5	1.4	1.5	1.1	0.8	1.0	1.2
P_2O_5 (kg/ha)								
0	14.7	16.8	35.9	35.4	22.8	22.5	23.8	23.5
30	15.8	17.7	36.8	36.1	26.2	26.6	25.3	25.4
60	16.5	18.5	37.3	36.5	38.8	30.1	26.8	26.7
CD (P = 0.05)	0.6	0.5	1.4	1.5	1.1	0.8	1.0	1.2
N (kg/ha)								
0	14.7	16.9	34.3	35.5	23.0	24.6	23.7	23.1
Inoculation alone	16.3	17.8	37.9	36.2	27.2	27.3	25.3	26.4
20 kg N/ha alone	15.2	17.2	35.8	35.9	24.8	25.4	24.1	23.5
20 kg N/ha + inoculation	16.6	18.3	38.7	37.1	28.1	28.7	26.7	27.4
CD (P = 0.05)	0.4	0.5	1.2	1.4	1.3	1.5	2.1	1.5

Table 2. Effect of nitrogen, phosphorus and seed rate on N and P uptake by clusterbean

Treatment	N uptake (kg/ha)						P uptake (kg/ha)					
	Seed		Stover		Total produce		Seed		Stover		Total produce	
	1988	1989	1988	1989	1988	1989	1988	1989	1988	1989	1988	1989
Seed rate (kg/ha)												
10	51.1	65.4	47.1	43.2	98.1	108.5	5.2	6.5	2.7	2.6	7.9	9.1
20	65.3	71.4	47.2	46.4	112.4	117.8	6.7	6.9	2.9	2.9	9.9	9.8
30	72.8	77.6	49.0	47.9	121.8	125.5	7.3	7.9	3.2	3.1	10.5	10.9
CD (P = 0.05)	6.6	5.5	8.4	6.0	12.5	7.3	0.8	0.7	0.3	0.4	0.7	0.6
P_2O_5 (kg/ha)												
0	49.6	55.4	40.3	38.9	89.8	94.3	5.1	5.7	2.6	2.6	7.7	8.3
30	64.3	72.5	48.2	46.5	112.5	118.9	6.4	7.0	2.9	2.9	9.3	9.9
60	74.2	86.5	54.7	52.1	129.9	138.6	7.7	8.5	3.3	3.1	11.0	11.6
CD (P = 0.05)	6.6	5.5	8.4	6.0	12.5	7.3	0.8	0.7	0.3	0.4	0.7	0.6
N (kg/ha)												
0	48.5	57.3	32.3	36.5	80.7	93.8	4.9	5.7	2.2	2.5	7.2	8.2
Inoculation alone	71.3	77.5	54.4	50.6	125.7	128.0	7.1	7.2	3.2	3.0	10.3	10.2
20 kg N/ha alone	54.6	62.1	43.2	41.1	97.8	103.2	5.5	6.2	2.5	2.6	8.0	8.8
20 kg N/ha + inoculation	77.8	89.0	61.2	55.1	138.9	144.1	7.9	8.6	3.8	3.4	11.8	12.0
CD (P = 0.05)	7.2	7.5	7.8	7.3	15.9	11.5	0.7	0.7	0.6	0.4	0.9	0.8

seasons. This increase in N uptake may be attributed to increasing seed and stover yields. However, the increase in P uptake may be the cumulative effect of rise in P concentration in plant tissues and in yield level (Table 1).

N and inoculation

An application of 20 kg N/ha along with seed inoculation with *Rhizobium* culture resulted in significantly higher yield of seed and stover in both the seasons (Table 1). Inoculation alone was found better than 20 kg N/ha. N @ 20 kg/ha as starter dose supplied the crop with sufficient N in early phase of growth followed by nodule bacteria in later part of the crop. Cumulative effect of these 2 might have contributed towards higher yield. Singh *et al.* (1992) reported similar findings with lentil. Treatment 20 kg N/ha + *Rhizobium* inoculation recorded highest protein and gum content (Table 1) in both the years. However, it remained on a par with inoculation alone. Such improvement might be accrued owing to sufficient and prolonged supply of N, which is a constituent of amino-acid precursor of protein synthesis. The crop sown with inoculated seed and receiving 20 kg N/ha as starter dose removed significantly higher amount of N and P (Table 2) than rest of the levels. The higher uptake of N and P under this treatment might be due to increased yield (seed and stover) and increased content of N and P plant parts.

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