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Nitrogen and Phosphorus Needs of Gram (*Cicer arietinum* L.) Along with Bacterial Fertilization

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The study on the response of bacterial fertilization to gram with different N and P levels has shown that : (1) Gram responds favourably to the inoculation and N and P Fertilization. Inoculation increased the grain and straw yields by 12.4 and 9.5 per cent over no inoculation and no fertilizer N and P application, respectively. (2) Inoculation along with 80 or 120 kg P_2O_5/ha alone or with 15 kg N/ha as starter dose was statistically equally effective to nitrogen fertilization @ 15 or 30 kg with 80 or 120 kg P_2O_5 in respect of yield and N and P content of plants and (3) Inoculation along with 80 kg P_2O_5 proved to be the most economic combination which could increase 33 per cent grain yield over control, 18.6 per cent over inoculation alone and 11.8 per cent over inoculation with 40 kg P_2O_5.

Among the several environmental factors affecting nitrogen fixation, the usefulness of phosphorus for legumes is very critical (Tikka, 1972). Starter dose of N application along with inocu -lation may be helpful in raising the nitrogen fixing capacity of legumes. However, the extent of benefits and appropriate dose of phosphorus to be used will depend on agro-climatic conditions and inherent fertility status of the soil. In view of this, an experiment was con ducted to assess the capability of *Rhizo bium* to fix atmospheric nitrogen by gram crop in soil of Agra and find out suitable dose of nitrogen and phosphor -us for the use of farmers.

MATERIALS AND METHODS

An experimant was conducted at R.B.S. College Research Farm, Bichpuri, Agra on sandy loam soil low in available nitrogen, medium in available phos -phorus and high in available potassium (available N 233.2 kg/ha, available P_2O_5 28.7 kg/ha and available K_2O 342.0 kg/ ha). It was a randomized block design with three replications, with the plot sixe of 9x5 m. The total amount of nitrogen and phosphorus was placed 5 cm below the seed at sowing through urea and superphosphate, respectively in the plots corresponding to their treatments (Table I). *Rhizobium* culture was applied by coating the seeds. C-24 variety of gram (*Cicer arietinum* L.) @ 50 Kg/ha was sown at a row distance of 30 cm. At harvest grain and straw yields were recorded and the samples were analysed for nitro gen and phosphorus contents in the wet digest (Snell and Snell, 1955) and vana

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date phosphomolybdate yellow method (Chapman and Pratt, 1961), respectively The uptake of these nutrients was calculated by multiplying the yield with their corresponding contents data. The statistical analyses were done as per the method described by Snedecor and Cochran (1967). Profit index of different treatments was calculated over the net return under control. The net return value under control was considered equivalent to 100. Net return as given in Table 2 refers to the gross return minus total cost of cultivation.

RESULTS AND DISCUSSION

From the perusal of the data in Table 1, it is evident that application of N and P fertilizers and inoculation of *Rhizobium* culture had a significant

TABLE I. Effect of inoculation and N and P fertilizer application on yield and N and P content of gram.

Treatments	Yield (q/ha)		N content(%)		P content(%)		N uptake (kg/ha)		P uptake (kg/ha)		Total uptake (kg/ha)	
	Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw	N	P
N_0P_0	21.0	22.5	2.52	0.72	0.42	0.06	52.90	16.20	8.81	1.35	69.10	10.16
N_1P_0	23.7	24.7	2.81	0.80	0.45	0.05	69.02	19.77	10.67	1.24	88.79	11.91
N_1P_1	25.3	25.0	2.92	0.79	0.76	0.09	73.92	19.80	19.24	2.25	93.72	21.49
N_1P_2	28.2	27.9	2.91	0.78	0.88	0.12	81.50	21.72	24.25	3.34	103.22	27.59
N_1P_3	28.2	27.8	2.92	0.78	0.86	0.13	82.43	21.72	24.27	3.62	104.15	27.89
N_2P_0	23.6	24.6	2.89	0.79	0.46	0.05	68.35	19.43	10.90	1.23	87.78	12.13
N_2P_1	25.1	25.0	2.91	0.79	0.75	0.10	73.04	19.73	18.83	2.49	92.77	21.32
N_2P_2	28.0	27.0	2.91	0.78	0.85	0.13	81.50	21.04	23.80	3.51	102.54	27.31
N_2P_3	28.1	27.8	2.92	0.79	0.88	0.12	82.11	22.01	24.70	3.39	104.12	28.09
N_3P_0	23.9	25.9	2.90	0.82	0.40	0.06	69.25	21.19	9.55	1.55	90.44	11.10
N_3P_1	25.0	26.1	2.90	0.80	0.70	0.09	67.45	20.90	17.41	2.35	88.35	19.76
N_3P_2	28.1	27.6	2.92	0.79	0.83	0.12	81.90	21.84	23.31	3.32	103.74	28.63
N_3P_3	28.0	28.3	2.90	0.80	0.83	0.14	75.60	28.70	23.94	3.27	98.30	17.21
N_4P_0	23.4	26.5	2.92	0.82	0.45	0.04	68.27	21.70	10.52	1.06	89.97	11.58
N_4P_1	25.0	26.5	2.90	0.82	0.73	0.80	72.65	21.70	18.30	2.12	94.35	20.42
N_4P_2	28.0	27.8	2.90	0.81	0.81	0.11	82.04	22.52	22.66	3.06	104.56	25.72
N_4P_3	28.1	27.8	2.92	0.82	0.85	0.12	82.05	22.84	23.90	3.34	104.89	27.24
C. D. 5%	2.1	1.8	0.22	0.06	0.08	0.03	7.94	1.92	2.03	0.44	12.50	3.12

N_0 = No inoculation and no fertilization
N_1 = Fertilizer N 15 kg/ha
N_2 = Inoculation only
N_3 = Inoculation and fertiliser N kg/ha
N_4 = Fertiliser N 30 kg/ha

P_0 = No application of phosphorus
P_1 = 40 kg P_2O_5/ha
P_2 = 80 kg P_2O_5/ha
P_3 = 120 kg P_2O_5/ha

effect on grain yield. The highest yield i.e. 28.0 to 28.2 q/ha was obtained where phosphorus at the rate of 80 Kg. or 120 Kg P_2O_5 was applied with either of the nitrogen levels along with inoculation. The effect of each nitrogen treatment in respect to yield was almost the same at both these P levels. Irrespective of nitrogen levels, 80Kg. P_2O_5 produced the same grain yield as could be produced by the application of phosphorus @ 120 Kg. P_2O_5/ha. It is of interest to note that the addition of nitrogen with inoculation did not significantly increase the grain yield over inoculation alone and with all the levels of phosphorus. Rhizobium inoculation increased the grain yield by 12.4 per cent over control. Moreover Rhizobium inoculation with 80 Kg P_2O_5/ha increased the grain yield by 33.0, 18.6 and 11.6 per cent over control, inoculation alone and inoculation with 40 kg P_2O_5 respectively, Thus, bacterial inoculation in gram proved to be more advantageous if it is advocated with phosphorus application @ 80 kg P_2O_5. Inoculation replaced the use of 15 kg/ha nitrogen and thus could save 33.3 kg urea per hectare. The superiority of this treatment might be attributed to the optimum and balanced supply of the plant nutrients and from this it can be concluded that inoculation itself can fulfil the nitrogen requirement of gram crop but sufficient amount of phosphorus should be applied for nodulation. Tikka (1972) also reported that application of P_2O_5 is a must in gram. According to Katti (1968) yield characters of gram were influenced by inoculation + P_2O_5 treatment in alluvial clay loam soil.

TABLE II. Economics of different treatments of *Rhizobium* inoculation and N and P fertilizer application.

Treatments	Net return Rs/ha	Profit index
Control (N_0PO)	2253.50	100.0
N_1P_0	2623.35	116.4
N_1P_1	2591.55	115.1
N_1P_2	2776.65	123.2
N_1P_3	2526.15	112.0
N_2P_0	2666.00	118.3
N_2P_1	2612.30	115.9
N_2P_2	2792.30	123.8
N_2P_3	2517.00	111.6
N_3P_0	2651.15	117.6
N_3P_1	2543.65	113.3
N_3P_2	2749.15	121.7
N_3P_3	2469.15	109.5
N_4P_0	2527.80	112.1
N_4P_1	2503.30	111.0
N_4P_2	2681.30	118.9
N_4P_3	2424.80	107.6

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