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Effect of *Rhizobium* seed inoculation, nitrogen and phosphorus on growth, nodulation, flowering and seed yield of cowpea cv. PUSA PHALGUNI (*Vigna unguiculata* Walp)

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ABSTRACT

An experiment was condcted in randomized block design at Agricultural Experiment Station, N.A.U, Paria, Dist-Valsad (Gujarat) during summer season of 2005 to find out suitable dose of nitrogen, phosphorus with and without *Rhizobium* inoculation in cowpea cv. PUSA PHALGUNI. On the basis of results it can be concluded that 20 kg N + 40kg P_2O_5 / ha along with *Rhizobium* seed inoculation gave significantly higher growth, maximum nodulation and seed yield of cowpea cv. PUSA PHALGUNI. Earliness in flowering was observed with *Rhizobium* inoculation with 10 kg/ha N and higher level of phosphorus (40 kg/ha).

Key words : Cowpea, *Rhizobium* inoculation, Nodulation, Seed yield.

INTRODUCTION

Cowpea (*Vigna unguiculata* Walp) is one of the most important legume vegetable crop grown extensively for its long tender pods as well as seeds as a pulse throughout India. The productivity and production of seed crop is low, due to lack of proper management practices. Among which proper nutrient management (INM) is one of the major factor. Nitrogen fixing bacteria in legumes belonging genus *Rhizobium* not only aids in nitrogen fixation but also produces growth substances like auxins and as such reduces the requirement of nitrogenous and phosphoric fertilizers (Mehta *et al.,*1973). Owing to the energy and as cost intensive manufacture of chemical fertilizers, use of microbial inoculants to supplement a part of nitrogen requirement has attained immerse importance. Keeping in view the above, a field experiment was conducted to find out the effect of *Rhizobium* seed inoculation, nitrogen and phosphorus on growth, nodulation and seed yield of cowpea.

MATERIALS AND METHODS

A field experiment was carried out in summer 2005 at Agricultural Experiment Station, N.A.U, Paria, Dist-Valsad (Gujarat) to find out effect of *Rhizobium* seed inoculation, nitrogen and phosphorus on growth, flowering, nodulation and seed yield of cowpea cv. PUSA PHALGUNI. The soil of experimental site was medium black and clayey in nature having pH 8.15,E.C. 0.17 dSm^{-1}, available nitrogen 235.2kg/ha and available P_2O_5 41.65 kg/ha. The treatments consisted of three levels of nitrogen *i.e.*0,10 and 20 kg/ha, three levels of phosphorus *i.e.* 0,20 and 40 kg/ha and with and without *Rhizobium* seed inoculation. Thus eighteen treatment combinations were replicated thrice in randomized block design with factorial concept in 4.0 x 3.6 m^2 plots with spacing of 45cm x 15cm. Whole quantity of phosphorus and half dose of nitrogen were applied according to treatment before sowing. While, remaining half quantity of nitrogen was applied 30 days after sowing. *Rhizobium* culture was applied to seed by slurry method before sowing and seeds were dried in shade. At maturity, the crop was harvested, threshed in backyard and seeds were collected The data on growth, nodulation at 45 DAS, flowering and seed yield were recorded for statistical interpretation.

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarised under following heads:

Growth parameters :

Plant height and number of branches were not affected significantly due to *Rhizobium* seed inoculation treatment (Table 1). However, maximum plant height was recorded in treated seed. On the contrary number of nodules per plant significantly differed by *Rhizobium* treatment and higher number was noted in treated seed plot. It may be due to the fact that *Rhizobium* inoculation increased nitrogenese activity and synthesis of growth promoting substance like IAA which takes active part in nodulation process. These findings are in conformity with Mishra (1999) and Swaroop *et al.* (2001).

Nitrogen levels significantly affected plant height, number of branches and number of nodules per plant (Table 1). Higher level of nitrogen (20 kg/ha) had higher value of all growth parameters than lower level of nitrogen (10 kg/ha). It might be due to that the nitrogen is the

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Table 1 : Effect of *Rhizobium* seed inoculation, nitrogen and phosphorus on growth, nodulation and flowering of cowpea cv. PUSA PHALGUNI

Treatments	Plant height (cm)	Branches/ plant	Nodules/ plant at 45 DAS	Days to 50% flowering
Rhizobium treatment (R)				
R_1: Unterated	45.93	4.33	8.65	50.33
R_2: Treated	46.52	4.51	9.63	48.88
S.E.±	0.73	0.08	0.11	0.48
C.D.(P=0.05)	NS	NS	0.34	1.39
Levels of nitrogen (N_0)				
N_0: Control	44.28	4.15	9.08	49.88
N_1: 10kg/ha	46.21	4.41	9.54	47.83
N_2: 20kg/ha	48.18	4.80	9.60	51.11
S.E.±	0.89	0.10	0.14	0.59
C.D.(P=0.05)	2.37	0.29	0.41	1.71
Levels of phosphorus (P)				
P_0:Control	45.13	4.23	8.88	50.72
P_1:20 kg/ha	46.24	4.46	9.47	49.58
P_2:40 kg/ha	47.30	4.67	9.07	48.55
S.E.±	0.89	0.102	0.14	0.59
C.D. (P=0.05)	NS	0.29	0.41	1.71
Interaction				
RxN	NS	NS	NS	NS
RxP	NS	NS	NS	NS
NxP	NS	NS	NS	NS
RxNxP	NS	NS	NS	NS
C.V.%	8.21	9.80	6.74	5.09

NS = Non significant

major structural constituent of cell, which helps in cell division and cell elongation and accompanied rapid growth and nodulation there by increased branches per plant. Almost similar results were recorded by Mishra and Solanki (1996) and Chowdhary *et al.* (2000).

Considering the effect of phosphorus, plant height was not affected significantly. Where as number of branches and number of nodules per plant were significantly affected by phosphorus levels. Phosphorus at 20 kg/ha and 40 kg/ha were found superior with respect to number of nodules per plant and number of branches per plant, respectively. These treatments were at par in above characters. It might be due to that phosphorus have stimulating effect on plant metabolic processes as phosphorus is a major constituent of cell nucleus and growing root tips which helps in cell division and root elongation. Similar trend was also observed by Chattophdhyay and Dutta (2003) and Majumdar *et al.* (2004).

Flowering :

Days to 50% flowering was significantly affected by *Rhizobium* seed inoculation (Table 1). *Rhizobium* inoculation hastens early flowering than uninoculated. It might be due to increased nitrogenese activity and synthesis of growth promoting substances as IAA and leads to early flowering. (Kanaujia *et al.,* 1997).

Higher level of nitrogen (20kg/ha) delayed flowering. It might be due to higher dose of nitrogen leads to luxurious vegetative growth and thereby delayed flowering. Similar trend was noted by Mishra (1999).

Phosphorus application also had significant influence on days to 50% flowering. The higher level of phosphorus induced early flowering, which was at par with P_1 (20kg/ha). It might be due to that phosphorus play a key role in energetic metabolic and bio-synthesis reaction, which govern cell multiplication resulting in rapid completion of vegetative growth. (Mishra, 1999).

Table 2 : Effect of *Rhizobium* seed inoculation, nitrogen and phosphorus on yield parameters and seed yield of cowpea cv. PUSA PHALGUNI

Treatments	Pods/cluster	Cluster/ plant	Pods/ plant	Seeds / pod	Seed yield (q/ha)
Rhizobium treatment					
R_1:Untreated	3.18	9.66	31.24	12.26	23.77
R_2: Treated	3.38	10.05	32.89	12.64	26.83
S.E.±	0.07	0.12	0.53	0.12	0.39
C.D. (P=0.05)	0.20	0.36	1.53	0.36	1.12
Levels of nitrogen(N)					
N_0:Control	3.08	8.41	28.32	12.01	21.11
N_1:10kg/ha	3.32	9.98	33.03	12.34	25.91
N_2: 20kg/ha	3.44	11.18	34.84	13.00	28.89
S.E.±	0.09	0.15	0.65	0.15	0.47
C.D. (P=0.05)	0.24	0.44	1.87	0.45	1.37
Levels of phosphorus					
P_0:Control	3.12	9.39	30.96	11.79	22.83
P_1: 20kg/ha	3.25	9.76	31.90	12.32	24.83
P_2:40kg/ha	3.46	10.41	33.33	13.24	28.24
S.E.±	0.09	0.15	0.65	0.15	0.47
C.D. (P=0.05)	0.24	0.44	1.87	0.45	1.37
Intrection					
RxN	NS	NS	NS	NS	NS
RxP	NS	NS	NS	NS	Sig
NxP	NS	NS	NS	Sig	NS
RxNxP	NS	NS	NS	NS	NS
C.V.%	11.09	6.70	8.62	5.34	8.01

NS = Non significant

Yield parameters:

From the Table 2, It is clear that number of clusters per plant, pods per plant and per cluster, numbers of seeds per pod and seed yield were significantly affected by *Rhizobium* seed inoculation. A higher value for each character was noted in *Rhizobium* treated plot. It may be due to an optimum supply of nitrogen by nitrogen fixing bacteria resulting in an increase in photosynthetic area and there by augment food supply to improved yield attributing characters and ultimately increased the seed yield. These results are in close agreement with Mishra and Solanki (1996) and Rajput (1994).

Yield parameters were significantly affected by different levels of nitrogen (Table 2). An application of nitrogen @ 20kg/ha significantly improved yield attributes and there by increased seed yield (28.89q/ha). This might be due to that optimum supply of N plays a vital role in alleviating nutritional deficiency in plants particularly at reproductive phase which resulted in producing more number of pods per plant, seeds per pod and finally higher seed yield. These findings are in close conformity with Mishra (2003) and Lal (2004).

Phosphorus had significant influence on yield parameters of cowpea (Table 2). Application of phosphorus at higher level (40kg/ha) significantly affected seed yield (q/ha) and yield attributes. It might be due to phosphorus seems to produce and retain photosynthetic activity, uptake of other nutrients, reproductive activity and photosynthetic translocation from source to sink. Majumdar *et al.* (2004) and Vikrant *et al*.(2005) also reported similar result.

Interaction effect :

An interaction effect was found non-significant in all parameters in present investigation except N x P on number of seed/pod and R x P on seed yield q/ha. Considering the interaction effect of N x P on number of seeds per pod, (Table 3), maximum number of seeds per pod was noted in N_2P_2 interaction (20 kg/ha N and 40 kg/ha P_2O_5). Whereas, lower value was obtained in without nitrogen and phosphorus application (N_0P_0).

Regarding interaction effect of R x P on seed yield (q/ha) (Table 4), the treatment combination R_2P_2 (*Rhizobium* seed inoculation + 40 P_2O_5 kg/ha) gave significantly more seed yield per ha (30.83 q/ha). Whereas, lowest seed yield was obtained with treatment combination R_1P_0.

Table 3 : Interaction effect of N x P on number of seeds per pod of cowpea cv. PUSA PHALGUNI

Nitrogen levels	Phosphorus levels		
	P_0	P_1	P_2
N_0	11.56	11.96	12.53
N_1	11.74	12.42	12.82
N_2	12.04	12.58	14.39
S.E. ±	0.27		
C.D. (P=0.05)	0.78		
C.V. %	5.34		

Table 4 : Interaction effect of RxP on seed yield (q/ha) of cowpea cv. PUSA PHALGUNI

Phosphorus levels	*Rhizobium* levels	
	R_1	R_2
P_0	21.79	23.88
P_1	23.87	25.79
P_2	25.66	30.83
S.E. ±	0.67	
C.D. (P=0.05)	1.93	
C.V.%	8.01	

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