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Response of Chickpea (Cicer arietinum L.) to Applied Phosphorus in Black Cotton Soils

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ABSTRACT

A field experiment was conducted at RARS, Lam, Guntur to study the response of chick pea to applied P levels in black cotton soils during r*abi* 2008-09 and 2009-10 with variety JG 11 in randomized block design with five treatments replicated four times. The experimental soil was non saline, slightly alkaline, medium in organic C and avail.P_2O_5, low in available N and high in available K_2O status.

The results of two years experimentation indicated that application of recommended dose of P (50 kg ha^{-1}) in the black cotton soils containing medium level of available P_2O_5 gave significantly higher mean yield (25.13 q ha^{-1}) yields than the absolute control (zero N and P) and zero P(N alone was given) treatments which recorded 20.26 and 21.32 q ha^{-1}, respectively. The mean yield (24.96 q ha^{-1}) obtained in the Soil Test Crop Response based P (76 kg ha^{-1}) application was on par with application of recommended dose of P treatment. Application of 70% recommended dose of P resulted in lower mean yield (22.33q ha^{-1}) than other two P application treatments. P and K contents in shoot at flowering stage were significantly different in different treatments. Variations in soil nutrient status at flowering stage were non significant. At harvesting stage, P content and uptake in grain and available P_2O_5 in soil were significantly high in P applied plots when compared to control plots.

Key words : Chickpea, Cotton Soils, Phosphorus.

Bengalgram (*Cicer arietinum* L.) is a multipurpose pulse crop and phosphorus is the key nutrient for increasing the productivity of pulses. Among the major nutrients phosphorus is highly expensive and its utilization by the crops is often low (Usha rani and Sankar Rao,2009) The medium to heavy black soils of Krishna Zone in Andhra Pradesh were highly fertile with high crop production efficiency. Water holding capacity of these soils is very high resulting in assured crop yields even under rain fed conditions. P fertility status of soils of Andhra Pradesh was medium with fertility index of 1.57 (Pattanayak *et.al,* 2009). Many soil surveys conducted in this zone during the recent years indicated that there was buildup in available P_2O_5 in these soils and most of the soils were now medium to high in soil available P_2O_5 (Lalita Kumari and Swarajyalakshmi,2009). Hence application of fertilizer P_2O_5 is not necessary for these soils which are high or medium in P status. Keeping these facts in view, a field experiment was conducted at RARS, Lam to know the response of Bengal gram to applied phosphorus.

MATERIAL AND METHODS

A field experiment was conducted in the black cotton soils of RARS, Lam during *rabi,* 2008-09 and 2009-10 seasons to know the response of chickpea to applied phosphorus on these soils. The experiment was laid out in a randomized block design with 5 treatments and 4 replications. The treatmental details included i) absolute control (zero N and P) ii) zero P (N alone was given) iii) Recommended dose of P, (50 kg ha^{-1}), iv) STCR based P application (76 kg ha^{-1}) and v) 70 % recommended dose of P. The experimental soil was non saline (0.32 d Sm^{-1}), slightly alkaline (8.12), low in organic C (0.45%) and medium in available P_2O5 (42.5 kg ha^{-1}), low in available N (232 kg ha^{-1}) and high in available K_2O (985 kg ha^{-1}). Soil analysis was done at peak flowering stage and harvesting stage of the crop to know the nutrient status in soil. Data on yield components and grain yield was recorded at harvesting.

Nutrient composition and nutrient uptake in the whole plant at peak flowering stage and in grain at harvesting stage of the crop was studied to know the treatmental effects on these parameters.

Table 1. Effect of different levels of phosphorus application on yield components and grain yield of chickpea (pooled data of 2008-09 and 2009-10)

Treatments	Grain yield (q ha^{-1})			Seed weight plant^{-1} (g)			100 Seed wt.(g)		
	2008-09	2009-10	Mean	2008-09	2009-10	Mean	2008-09	2009-10	Mean
T1-Zero N and P	18.20	22.26	20.20	16.6	22.4	19.5	23.93	22.08	23.01
T2-Zero P(N was applied)	20.50	22.13	21.31	18.8	26.7	22.7	23.76	20.33	22.40
T3-Recommended dose of P Application	22.77	27.48	25.13	20.7	34.3	27.5	24.04	22.18	23.11
T4-STCR based P application	23.32	26.59	24.96	21.2	31.2	26.2	24.46	20.19	22.33
T5- 70% of Recommended dose of P application	20.90	23.78	22.33	19.3	28.7	24.0	24.08	20.85	22.45
SEM+_	1.08	1.14	0.87	0.7	1.6	2.6	0.96	0.59	0.79
CD	3.31	3.50	2.68	2.2	4.9	8.2	NS	NS	NS
CV(%)	10.10	9.50	7.60	7.7	12.9	10.6	7.9	5.40	7.10

Table2. Effect of different levels of phosphorus application on available nutrients in soil at peak flowering stage of chickpea crop (pooled data of 2008-09 and 2009-10).

Treatmental details	Available N (kg ha^{-1})			Available P_2O_5 (kg ha^{-1})			Available K_2O (kg ha^{-1})		
	2008-09	2009-10	Mean	2008-09	2009-10	Mean	2008-09	2009-10	Mean
T1-Zero N and P	297	232	265	49.50	32.8	41.15	978	982	980
T2-Zero P(N was applied)	290	202	246	45.16	34.8	39.98	901	965	933
T3-Recommended dose of P aplication	308	222	265	48.27	55.1	57.69	882	1039	961
T4-STCR based Papplication application	297	238	268	50.90	78.8	64.85	889	1068	979
T5- 70% of Recommended dose of P application	274	251	263	49.00	57.2	53.10	903	898	901
SEM+_	24.1	23.2	11.4	4.00	2.78	2.33	885	43.7	35.9
CD	NS	NS	35.1	NS	8.93	7.17	NS	NS	NS
CV(%)	16.4	9.2	9.5	10.60	9.50	10.60	9.9	7.2	7.6

Table 3. Effect of different levels of phosphorus application on available nutrients in soil at harvesting stage of chickpea crop (pooled data of 2008-09 and 2009-10)

Treatmental details	Available N (kg ha^{-1})			Available P_2O_5 (kg ha^{-1})			Available K_2O (kg ha^{-1})		
	2008-09	2009-10	Mean	2008-09	2009-10	Mean	2008-09	2009-10	Mean
T1-Zero N and P	244	209	227	29.6	49.6	39.6	913	1063	988
T2-Zero P(N was applied)	265	213	239	29.9	40.4	35.2	925	1086	1006
T3-Recommended dose of P Application	261	219	240	27.0	52.6	39.8	877	966	922
T4-STCR based P application Application	266	209	238	43.0	55.5	49.3	887	1031	959
T5- 70% of Recommended dose of P application	290	212	251	31.9	52.2	42.1	870	1051	961
SEM+_	7.6	5.7	8.1	1.7	1.9	2.3	68.5	50.5	52.5
CD	NS	NS	NS	5.4	6.4	7.0	NS	NS	NS
CV(%)	12.9	4.6	10.8	10.8	6.9	11.6	12.9	9.7	10.9

RESULTS AND DISCUSSION

Yield components and grain yield

The mean grain yield (q ha^{-1}) of two seasons was significantly affected by application of different levels of phosphorus. The results of two years of experimentation indicated that application of recommended dose of phosphorus (50 kg ha^{-1}) in the black cotton soils containing medium level of available P_2O_5 gave significantly higher mean yield (25.13 q ha^{-1}) than the absolute control (T1- zero N and P) and zero phosphorus (T2-N alone was given) treatments which recorded 20.26 and 21.32 q ha^{-1} respectively. The mean yield (24.96 q ha^{-1}) obtained in the STCR based phosphorus (76 kg ha^{-1}) application treatment was on par with application of recommended dose of phosphorus treatment (Table1). Application of 70% recommended dose of phosphorus resulted in lower mean yield (22.33 q ha^{-1}) than other two phosphorus application treatments. Significant increase in seed wt. $plant^{-1}$ was recorded in T3 (recommended phosphorus application) over T1 (zero N and P). The effect of different levels of P application was non significant on 100 seed weight of Bengal gram grain. Rana *et al,* (1998) reported a linear increase in yield of legumes as the dose of P_2O_5 was increased. Increase in seed yield of mung bean with increased application of phosphorus was reported by Sharma and Rajendra Prasad, (2009)

Available nutrient status in soil

Status of soil available nutrients was studied at peak flowering stage and harvesting stage of the crop in both the seasons. Pooled data of both the seasons indicated that, at peak flowering stage of the crop, the available N and P_2O_5 contents in soil were significantly affected by different treatments where as their effect was non significant on soil available K_2O (Table 2). At harvesting stage of the crop, the treat mental effect was significant only on available P_2O_5 in soil and the effect was non significant on available N and K_2O (Table 3).

Nutrient composition and nutrient uptake

Data on nutrient composition and uptake in whole plant at peak flowering stage and at harvesting stage of the crop was recorded during *rabi,* 2008-09 only. The data indicated that the treat mental effect was non-significant on the N content in whole plant where as P and K contents were significantly affected at peak flowering stage. Uptake of N and P in the whole plant at peak flowering stage was significantly increased due to increased P application while K uptake was unaffected.

Table 4. Effect of different levels of phosphorus application on nutrient composition and uptake in the whole plant at peak flowering stage of chickpea crop (*rabi*, 2008-09)

Treatmental details	Shoot dry Matter(g)	Nutrient composition (%)			Nutrient Uptake (mg/plant)		
		N	P	K	N	P	K
T1-Zero N and P	18.14	1.79	0.328	2.96	321.5	59.73	540
T2-Zero P(N was applied)	18.06	1.70	0.325	3.09	319.3	56.80	573
T3-Recommended dose of P Application	21.27	1.98	0.333	3.04	428.8	60.21	661
T4-STCR based P Application	22.06	1.60	0.428	3.44	360.5	87.80	737
T5- 70% of Recommended dose of P application	21.19	1.70	0.267	2.79	362.0	55.13	595
SEM+_	1.34	0.11	0.023	0.12	15.9	4.58	23.3
CD	NS	NS	0.070	0.37	49.3	NS	71.9
CV(%)	13.10	12.70	10.700	8.00	8.9	16.10	7.5

Table 5. Effect of different levels of phosphorus application on nutrient composition and uptake in the grain at harvesting stage of chickpea crop (rabi, 2008-09)

Treatmental details	Nutrient composition (%)			Nutrient uptake (mg plant^{-1})		
	N	P	K	N	P	K
T1-Zero N and P	5.67	0.589	2.96	996	98	591
T2-Zero P(N was applied)	6.03	0.628	3.24	1144	109	630
T3-Recommended dose of P aplication	6.16	0.670	3.10	1483	140	640
T4-STCR based P application application	5.86	0.690	3.33	1215	135	705
T5- 70% of Recommended dose of P application	5.93	0.595	3.31	1155	107	636
SEM+_	0.16	0.030	0.04	61.1	7.9	37.2
CD	NS	NS	0.14	188.4	24.4	NS
CV(%)	4.80	9.5	3.00	10.8	14.8	11.6

Nutrient composition in the grain was not significantly affected by different treatments .Uptake of N and P in the grain at harvesting stage of the crop was significantly increased due to increase in P application while K uptake in the grain was non significant.

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