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Research Article

Studies of Phosphorus and Bio-fertilizers on Growth, Yield and Quality of Chick Pea (*Cicer arietinum* L.) in Eastern Uttar Pradesh

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Abstract: A field experiment was conducted during the winter season (*Rabi*) at Research Farm of S D J Post Graduate College Chandeshwar, U.P. The objectives of the research to findout the suitable levels of phosphorus and bio-fertilizers on growth, yield and quality of chick-pea in eastern U.P. The treatments, comprising the four levels of phosphorus (0,25,50 and 75 kgh^{-1}) and four levels of bio fertilizers (untreated, Rhizobium, P.S.B. and V.A.M.) were evaluated against chick-pea variety (Awrodhi). The results showed that the chick-pea variety "Awrodhi" produced significantly higher growth, yield and quality. The application of 75 kg P_2O_5 ha^{-1} statistically at par with 50 kg P_2O_5 ha^{-1} along with P.S.B. and significantly higher than other treatments combinations in context to growth and yield attributing characters and yields. Quality parameters viz., protein content and protein yield kg/ha were higher in application of 75 kg P_2O_5 and P.S.B. than other treatments, respectively.

Key words: Rhizobium,Phosphate solubilizing bacteria(P.S.B.) Vesicular arbusucular mycorihizea.

Introduction

Chick-pea has one of the highest nutritional composition of any dry edible legume and does not contain any specific major anti-nutritional factors, and contains proteins, carbohydrates, fat, crude fibre, soluble sugar and ash, chick-pea protein digestibility in highest among the dry edible legumes. Legumes are heavy feeders of phosphorus and less responsive to nitrogen and potash because of there capacity to meet their own nitrogen requirement through symbiotic fixation(114 kg N/year), and reduce fertilizer cost to the farmer and improves the texture and structure of soil. The help in mobilizing insoluble soil nutrients and bringing qualitative changes in physical properties of the soil. Phosphate fertilization of chick-pea promotes growth, nodulation and enhance yield and improves grain quality,regulate the photosynthesis, govern physio-bio-chemical process, inlargement root and nodules production and there by increase nitrogen fixation(Singh and Ram 1990). Bio-fertilizer has been proved as the cheapest source of nitrogen and phosphorus for major crop yield, particularly in legumes. Indian soil in general are lacking in effective and specific strains of Rhizobium which are responsible for symbiotic nitrogen fixation. Information regarding its effect on some other aspects, perticularily quality characteristics under varied soil types and sporadic soil fertility. Considering these above facts, adoption of nutrients management fertilizers levels in conjuction with bio-fertilizers to improve production, productivity and efficient utilization of nutrients are the need of the hour. Hanse and attempt was made to assess the response of phosphorus and bio-fertilizers on growth, yield and quality of check-pea in eastern U.P.

Materials And Methods

The study was undertaken during winter season(*Rabi*) of 2015-16 and 2016-17 at Agricultural Research Farm in the department of Agronomy S D Post Graduate College Chandeshwar, Azamgarh (26°47'N and 82°12'E and 84 meter above the mean sea level) U.P. Sixteen treatment combination comprising four phosphorus levels(0,25,50,

and 75 kg ha^{-1}) and four bio-fertilizers(control, Rhizobium,P.S.B. and V.A.M.) were evaluated. The experiment was laid out in randomized block design with four replications. The soil was sandy loam in texture, normal in reaction(pH 7.9), low in nutrients availability nitrogen 165 kg ha^{-1}, P_2O_5 15.65 kg ha^{-1} , and K_2O 237.50 kg ha^{-1}. The crop variety Awrodhi was sown with the seed rate of 80 kg ha^{-1} during the third week of October in respective year. The bio-fertilizer as per treatment treated seed was sown in furrow opened by Kudal at the depth of 5-6 cm. and furrow spacing was maintained 45 cm apart. The required amount of N and K nutrients as basal and P was applied as per treatment. Other management practices were adopted as per recommendation of the crop grown under irrigated conditions.

Results and Discussion

(a) Growth Attributes

The data related to plant height(cm), No. of branching $plant^{-1}$, no. of nodules $plant^{-1}$, fresh shoot weight $plant^{-1}$ and dry shoot weight $plant^{-1}$(g) have been presented in Table—1). All the above mention characters continuously with advancement under all treatments, and maximum was observed application of 75 kg P_2O_5 ha^{-1} and significantly superior over rest doses of kg P_2O_5. Application of 75 kg P_2O_5 produced statistically at par to 50 kg P_2O_5 ha^{-1} and significantly higher than rest application of P_2O_5. The data presented in Table-1 regarding the days taken to 50% flowering indicated the various level of phosphorus and bio-fertilizers treated did not cause significant variation during the both years. It was due to the pronounced effect of highest levels of phosphorus enable the plant growth faster, increased root growth as well as no. of nodules $plant^{-1}$, fresh and dry weight. It is a being and energy bond compound, have greater importance in the transformation of energy required for almost all metabolic process. Similar results have been reported by Singh et-al(2005). Singh and Singh 1997, Sarkar *et.al* 1995 and Saraf *et.al* 1997.

The various seed inoculation by bio-fertilizers affected the plant height, no. of branches, no. of nodules, fresh and dry weight and yield contributing characters of check-pea. P.S.B. inoculated seeds statistically at par to Rhizobium treated seed and significantly superior to other rest inoculated seeds (Table-1). This might be due to application of P.S.B. increase the availability of N.P.K. resulted on increase in physiological process which ultimalty inhanced the growth and yield contributing characters Meena *et.al* (2005).

(b) Yield attributes

The data presented in (Table-2) showed that the yields parameters viz., seeds/pods, pods/plant, grains/plant and test weight used of biofertilizer as PSB during both the year except test weight, respectively. This might be due to applied of PSB increase the availability of NPK resulted on increase in yield attributing characters Meena *et al.* (2005).

The results of the present study indicated that the yield contributing characters viz., of seeds $pods^{-1}$, Pods $plant^{-1}$, no. of grains $plant^{-1}$, and 100 grain weight(g), were consistently with increasing levels of phosphorus to 75 kg P_2O_5 during both the years in (Table-2). Application of 75 kg P_2O_5 ha^{-1} which was at par with 50 kg P_2O_5 ha^{-1} but significantly higher in no. of grains $plant^{-1}$. The application of phosphorus accelerated the production of photosynthetic and their trans location from source to sink, which ultimately gave the higher values of yield contributing characters. These results are in agreement with the findings of Khan et-al(2005), Meena *et.al* (2006), Kumar *et.al* (2007), with increasing levels of phosphorus.

(c) Yields and Quality of Chickpea

The yields and quality of chickpea were significantly with increasing doses of phosphorus of 75 Kg P_2O_5 during both the years. Applied of 75 Kg P_2O_5/ha which was at par with 50 kg/ha. The data presented in table-2 showed that the use of 75 kg P_2O_5/ha enhanced grain yield by 89.63 and 89.34% over control, 14.91 and 14.71% over 25 kg P_2O_5/ha and 1.72% and 1.56% over 50 kg P_2O_5/ha during respective years, respectively in (Table-2). These results were supported by Khan et al. 2005 and Kumar et al. 2007.

The different seed inoculation by bio-fertilizer affected the yields and quality of chickpea. PSB inoculated seeds statistically at par to Rhizobium treated seed and significantly superior to other rest inoculation seeds (Table-2). The PSB enhance the grain yield of chickpea 25.95 and 25.78%, straw yield 15.62 & 20.74% and maximum protein content 21.96 and 22.02% and protein yield 43.01 and 42.84% over un-inoculated treatments during both the years, respectively. The similar results were reported by Meena et al. (2005).

Table-1. Growth attributes of chick-pea as influence by phosphorus and bio-fertilizers.

Treatments	Plant height(cm) 75 D.A.S.		No. of branching plant^{-1} 90 D.A.S		No. of nodules plant^{-1} 90 D.A.S		Fresh shoot weight plant^{-1}(g) 90 D.A.S.		Dry shoot weight plant^{-1}(g) 90 D.A.S.		50% Days to flowering	
P_2O_5 level kg/ha	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17
0	68.85	71.01	13.50	13.92	17.50	17.88	28.60	28.99	13.50	13.92	73.00	73.35
25	79.56	81.90	15.60	16.06	26.80	27.38	35.64	36.09	15.60	16.06	73.80	74.16
50	86.70	89.25	17.00	17.50	32.50	33.20	40.47	40.95	17.00	17.50	74.30	74.65
75	93.84	96.60	18.40	18.94	34.00	34.74	42.27	42.77	18.40	18.94	74.65	75.00
SEm$^{\pm}$	1.35	1.16	0.22	0.28	0.50	0.49	0.61	0.59	0.22	0.28	0.99	1.27
C.D. at 5%	2.85	3.29	0.63	0.84	1.44	1.39	1.74	1.67	0.63	0.80	N.S.	N.S.
Bio-fertilizer												
Control (untreated)	77.78	80.07	15.25	15.70	32.20	23.70	35.80	34.26	15.25	15.70	73.45	73.80
Rhizobium	82.37	84.92	16.17	16.65	29.20	28.93	37.57	38.01	16.15	16.65	74.13	74.48
P.S.B.	76.45	88.99	16.95	17.45	30.60	31.26	39.99	40.44	16.95	17.45	74.30	74.65
V.A.M.	82.37	84.39	16.15	16.63	27.80	28.40	35.68	36.09	16.15	16.63	73.88	74.24
SEm$^{\pm}$	1.35	1.16	0.22	0.28	0.50	0.49	0.61	0.59	0.22	0.28	0.99	1.27
C.D. at 5%	2.85	3.29	0.63	0.84	1.44	1.39	1.74	1.67	0.63	0.80	N.S.	N.S.

Table-2: Yield attributes, yield and quality of chick-pea as influence by phosphorus and bio-fertilizers.

Treatments	No. of seed pod^{-1}		No. of pods plant^{-1}		No. of grains plant^{-1}		100 grain weight		Grain yield q/ha		Straw yield q/ha		Protein content in seed %		Protein yields (kg/ha)	
P_2O_5 level kg/ha	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17
0	1.16	1.18	56.80	58.43	66.09	66.12	13.45	13.57	12.15	12.39	23.48	26.84	18.10	18.14	219.90	224.75
25	1.36	1.38	62.25	64.30	85.25	89.17	17.00	17.14	20.05	20.46	30.88	36.42	20.09	20.14	402.80	412.06
50	1.42	1.44	71.50	73.56	106.83	106.51	20.15	20.31	22.65	23.11	34.44	39.59	21.84	21.90	494.67	506.10
75	1.45	1.47	73.60	75.72	107.04	111.96	20.97	21.13	23.04	23.47	34.70	36.38	22.15	22.21	510.34	521.27
SEm$^{\pm}$	0.02	0.02	1.04	1.16	1.54	1.26	0.30	0.30	0.33	0.31	0.40	0.58	0.16	0.19	56.75	32.51
C.D. at 5%	0.06	0.07	2.97	3.30	4.40	3.60	0.85	0.86	0.93	0.90	1.13	1.64	0.46	0.53	162.64	93.01
Bio-fertilizer																
Control(untreated)	1.20	1.22	62.50	64.30	75.50	79.07	17.17	17.32	17.34	17.69	28.48	32.59	19.34	19.39	335.36	343.00
Rhizobium	1.36	1.38	66.80	68.72	91.58	95.78	18.14	18.29	19.90	20.30	31.50	36.90	20.59	20.65	409.74	419.20
P.S.B.	1.50	1.53	69.50	71.50	105.19	109.91	18.31	18.45	21.84	22.25	32.93	36.35	21.96	22.02	479.61	489.95
V.A.M.	1.33	1.35	65.60	67.49	87.95	91.99	17.95	18.09	18.81	19.20	30.59	34.07	20.38	20.33	383.35	390.34
SEm$^{\pm}$	0.02	0.02	1.04	1.16	1.54	1.26	0.30	0.30	0.33	0.31	0.40	0.58	0.16	0.19	27.96	27.25
C.D. at 5%	0.06	0.07	2.97	3.30	4.40	3.60	N.S.	N.S.	0.93	0.90	1.13	1.64	0.46	0.53	69.13	68.86

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