Growth yield, protein content and nutrient of chick-pea (Cicer arietinum L) as influenced by Phosphorus and bio fertilizers.

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Abstract

A field experiment was conducted at Agronomy Research Farm, Shri Durga Ji Post Graduate College Chandeshwar, Azamgarh, UP. during Rabi 2018-19 and 2019-20. The experiment was laid out in randomized block design with four replications, assigning sixteen treatments consisting of four level of phosphorus (control, 25, 50 and 75 kg ha^{1}) and four bio fertilizers (untreated rhizobium, PSB and VAM). The results indicated that P_20_5 and bio fertilizers on growth, yield and protein content in chick pea seed and nutrients uptake by crop. Significantly higher seed and stover yield were recorded with application of P_2O_5 at the rate of 75kg/ha. Remarkable improvements in protein content and nutrient content as well as their uptake by crop. The crop sown with PSB inoculated showed significant improvement in seed and stover yield (21.84, 22.25, 33.93 and 39.25 in both year respectively) but rhizobium treatment also produced significantly seed yield stover and mentioned treatments and statistically at par to VAM inoculated seed of chick pea.

Key words – Bio fertilizers, Chick pea, Rhizobium, Protein, VAM.

Introduction

Chic kpea (Cicer arietinum L) is the one of the major Rabi legume crop which has high digestible value due to its nutritious value (17-23% protein) in large vegetarian population of country. It's leaves contain malic acid which is very useful stomach ailments and blood purification. The cultivation of pulses without phosphorus fertilizer is major one of the important factors influenced for their low production and productivity, as it encourages vigrour root growth and promotes rhizobial activity in increasing nodulation that exemplify, nitrogen fixation. Phosphorus plays an important vital functional role in energy transfer and metabolic regulation and structural component of many molecules. Efficiency of soil phosphatic fertilizer applied around 10-30% as converted readily to less available forms by the process of P_2O_5 fixation.

The low production of this crop is due to improper use of fertilizers and least importance given to bio-fertilizers such as rhizobium, PSB and VAM fungi . The increasing demand for production of crops and food for such a vast population has led to interest and for the application of bio-fertilizers for better of these crops and good health for soil. It can be very good complimentary to fertilizers. An adequate supply of chemical fertilizers is nearly associated with growth and development of plant. Rhizobium inoculation increase the grain yield of pulse crop to the time of 11-15%. Ali and Chandra (1985). PSB have the consistent Capacity to increase the availability of phosphate to plants by mineralizing organic P_20_5 compounds and with VAM strain inoculation, often yields better growth promotion than indigenous VAM fungi population. Salami *et al* (2005). Thus adopting proper nutrient management practices in conjunction with PSB will help to improve the yield and quality of chickpea besides. maintaining the soil fertility (Singh and Singh 2014).

Materials and Methods-

A field experiment using chick pea as test crop was conducted at Research Farm Shri Durga Ji Post Graduate College Chandeswar, Azamgarh, U.P. during Rabi 2018-19 and 2019-20. The experimental farm is located 26.47° N. latitude and 82.12° E longitude with an altitude of 113 meters above sea level. The soil of experimental site was loamy sand in texture containing 175.42-152.30, 15.25-16.30 and 238.0-236.70 available nitrogen , Phosphors and potassium respectively at experimental year. Defth in 0.15 cm with pH 7.6, Ec 0.48 dsm-1 at 25° C and organic Carbon 0.33 percent. The experiment laid out in randomized black design with the four replications, assigning 16 treatments consisting the four levels of phosphorus (Control 25, 50 and 75 $kgha^1$) and four biofertilizers (Untreated, Rhizobium, PSB and VAM). The treatments were allotted to various plots with help of random table as advocated by Fisher (1950). The net plot size 3.90X4.00m was used for growth yield and related studies. The crop variety Awrodhi develop from a cross between T_3XK_{315}. The fertilizer applied as nitrogen at the rate of 30kg/ha through urea as basal, phosphorus as per treatment through S.S.P. and potassium at rate of 40 kg/ha through muriate of potash as a basal. The protein content was estimated by the seed factor of 6.25 (AOAC 1960), and NPK content were determined and described by Jackson (1967). The results obtained and analysed standard procedures have been presented in table –(1).

Results and Discussion

Effect of Phosphorus -

A significant effect of increasing levels of phosphorus up to 50 kg/ha was observed over control on the final plant population, plant height, number of branches, root nodules plant^{-1} (Table-2). This might be attributed to the role of phosphorus in root development and proliferation, nodules formation and N_2 fixation by supplying assimilates to the roots. Since the soil status of P_2O_5 is low in experimental field, amount of P_2O_5 up to 50 kgha^{-1} full filled the P_2O_5 requirement to the crop. It is the main constituent of energy rich phosphate mulecules Viz ATP and ADP which acts as "energy currency" within plants. The greater uptake of nutrients led to increased root and shoot development, nodulation, plant height, branching, dry matter, accumulation except the initial plant population.

Application of 75 kgha^{-1} significantly increased the number of pods/plant^{-1}, number of grains^{-1} plant only but upto 50 kgha^{-1} P_2O_5 also gave the better performance to other yield attributing characters (Table 3). The favourable influence of P_20_5 on yield and yield attributes could be attributed to the overall improvement. These results are in agreement to the findings of Kumar and Singh (2004) and Singh *et_al* (2017).

The quality and NPK content in chick pea seed (Table 4) Application of 75kg P_2O_5 ha^{-1} also improved the protein and NPK content in seed of chick pea and higher value of protein content and NPK in seed (22.15-22.21% , 3.55-3.56 to 0.0483 and 2.47) respectively were recorded significantly at par to application 50Kgha^{-1} P_2O_5. The increase in protein content and NPK content with P_2O_5 application might be due to higher N absorption as a result of N_2 fixation by nodules (Singh *et_al* 2017)

Effect of biofertilizers -

In earlier stage(Final plant population)seed inoculation with VAM significantly better than other biofertilizers but later PSB increase significantly higher plant height and at par to VAM No. of branches, nodules plant were similar to rhizobium inoculated seed of chickpea as different growth attributes such as fresh weight, but dry matter accumulation is significantly superior PSB treated plants (Table 2). Better inoculated by PSB might have also resulted plant height, no. of branches, modules plant fresh and dry weight plant^{-1}. This might be due to fact that PSB inoculated increased root nodulation through better root development, and seed pods no of grains, grain and straw yield and biological yield due to cumulative effect of increased the growth and yield attributes. The results obtained in the investigation are in line with the finding of Pramanik and Singh (2003) and Thenua *et_al* (2010). Seed inoculation with PSB significantly enhanced protein content (21.16- 22.02%) and NPK content in seed over rest inoculation of seed. This mays be due to better nitrogen fixation by the bacteria which in turn helped in better absorption and utilization of all the plant nutrients, thus resulting in more NPK content in seed and protein content (Table-4). The inoculation with PSB helps in realizing P from native as well as protecting fixation of added phosphate and rendered more available P for the plants leading to increased nutrient content of the plant. These results are in close conformity with findings of Meena *et_al*(2004).

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Table-1 Machanical and chemical analysis of the soil of experimental field.

S.No	Particulars	Value		Method of analysis
		2018-2019	**2019-2020**	Hydro meter method (Bouyoucos Method 1962)
1.	Sand(%)	15.50	15.15	
2.	Silt(%)	69.70	69.70	
3.	Clay(%)	14.80	14.95	
4.	Textural class	Sandy loam		Triangular Method (Brady 1983)
5.	Soil reaction	7.60	7.55	Jackson, 1973
6.	Organic carbon(%)	0.33	0.34	Walkly and Black, 1934
7.	Electrical conductivity	0.48	0.46	Rechards 1954
8.	Available N ($Kgha^{-1}$)	175.40	152.30	Subbiah and Asija 1956
9.	Available P_2O_5($Kgha^{-1}$)	15.25	16.30	Olsen's et_al 1954
10.	Available K2O($Kgha^{-1}$)	238.0	236.70	Jackson 1973

Table-2 Effect of Phosphorus and Bio fertilizers on growth attributes.

Treatments	Initial plant population		Final plant population		Plant height cm		No. of branches		No. of Nodules plant^{-1} 90 D.A.S		Fresh shoot weight 90 D.A.S		Dry shoot weight 90 D.A.S	
Phophorus level(Kg ha^{-1})	2018-19	2019-20	2018-19	2019-20	2018-19	2019-20	2018-19	2019-20	2018-19	2019-20	2018-19	2019-20	2018-19	2019-20
0	19.20	19.27	18.11	17.88	45.73	46.46	15.40	15.52	17.50	17.88	68.85	71.01	13.5	13.92
25	19.80	19.87	18.93	18.73	53.60	54.49	18.60	18.75	26.80	27.38	79.56	81.90	15.60	16.06
50	19.88	19.95	19.01	18.80	58.90	59.87	20.70	20.86	33.30	33.20	86.70	86.25	17.00	17.50
75	20.20	0.27	19.31	19.11	59.45	60.38	21.50	21.67	34.00	34.74	93.84	93.60	18.40	18.94
S.Em±	0.33	0.32	0.25	0.26	0.93	0.94	0.32	0.30	0.50	0.49	1.35	1.16	0.22	0.28
C.D. at 5%	N.S.	N.S.	0.72	0.75	2.65	2.68	0.91	0.87	1.44	1.39	3.85	3.29	0.63	0.80
Bio fertilizers														
Untreated	19.30	19.37	18.20	18.01	51.12	51.84	17.20	17.34	23.20	23.70	77.78	80.07	15.25	15.70
Rhizobium	19.82	19.89	18.95	18.71	55.20	56.11	19.90	20.06	29.20	29.83	82.37	84.92	16.15	16.65
P.S.B.	19.86	19.93	18.99	18.79	56.96	57.84	20.25	20.41	30.60	31.26	86.45	88.99	16.95	17.45
V.A.M.	20.10	20.17	19.22	19.01	54.57	55.40	18.45	19.00	27.80	28.40	82.37	84.79	16.15	16.63
S.Em±	0.33	0.32	0.25	0.26	0.93	0.94	0.32	0.30	0.50	0.49	1.35	1.16	0.22	0.28
C.D. at 5%	N.S.	N.S.	0.72	0.75	2.65	2.68	0.91	0.87	1.44	1.39	3.85	3.29	0.63	0.80

Table-3 Effect of Phosphorus and Bio fertilizers on yield attributing characters and yield .

Treatments	No . of pods plant^{-1}		No. of seed pod^{-1}		No. of grains plant^{-1}		100 grain weight(g)		Harvest index(%)		Biological yield(qha^{-1})		Grain yield(qha^{-1})		Straw yield(qha^{-1})	
Phophorus level(Kg ha^{-1})	2018-19	2019-20	2018-19	2019-20	2018-19	2019-20	2018-19	2019-20	2018-19	2019-20	2018-19	2019-20	2018-19	2019-20	2018-19	2019-20
0	56.80	58.43	1.16	1.18	66.90	66.12	13.45	1357	34.14	31.60	35.63	39.23	12.15	12.39	23.48	26.84
25	62.50	64.30	1.36	1.38	85.25	89.17	17.00	17.14	39.26	38.01	50.93	56.88	20.05	20.46	30.88	36.42
50	71.50	73.56	1.42	1.44	101.83	106.51	20.15	20.31	39.63	36.97	57.09	62.49	22.65	23.11	34.44	39.39
75	73.60	75.72	1.45	1.47	107.04	111.96	20.97	21.13	39.87	36.81	57.74	63.75	23.04	23.47	34.70	40.80
S.Em±	1.04	1.16	0.02	0.02	1.54	1.26	0.30	0.30	0.47	0.49	0.51	0.65	0.33	0.31	0.40	0.58
C.D. at 5%	2.97	3.30	0.06	0.07	4.40	3.60	0.85	0.86	1.33	1.40	1.45	1.85	0.93	0.90	1.13	1.64
Bio fertilizers																
Untreated	62.50	64.30	1.20	1.22	75.50	79.70	17.17	17.32	37.49	34.91	48.81	50.27	17.34	17.69	28.48	32.56
Rhizobium	66.80	68.72	1.36	1.38	91.58	95.78	18.14	18.29	38.29	35.13	51.40	52.20	19.90	20.30	31.50	36.90
P.S.B.	69.50	71.50	1.50	1.53	105.19	109.91	18.31	18.45	39.41	35.70	54.76	61.61	21.84	22.25	36.93	39.25
V.A.M.	65.60	67.49	1.33	1.35	87.93	91.99	17.95	18.09	37.71	35.66	49.40	50.27	18.81	19.20	30.59	32.07
S.Em±	1.04	1.16	0.02	0.02	1.54	1.26	0.30	0.30	0.47	0.49	0.51	0.65	0.33	0.31	0.40	0.58
C.D. at 5%	2.97	3.30	0.06	0.07	4.40	3.60	NS	NS	NS	NS	1.45	1.85	0.93	0.90	1.13	1.64

Table-4 Effect of Phosphorus and Bio fertilizers on quality of chick-pea .

Treatments	Protein content in seed%		Nitrogen content in seed %		Phosphorus content in seed%		Potassium content in seed %	
Phophorus level(Kg ha^{-1})	2018-19	2019-20	2018-19	2019-20	2018-19	2019-20	2018-19	2019-20
0	18.10	18.14	2.90	2.91	0.340	0.342	1.31	1.31
25	20.09	20.14	3.22	3.23	0.450	0.453	2.11	2.11
50	21.84	21.90	3.50	3.51	0.470	0.473	2.40	2.40
75	22.15	22.21	3.55	3.56	0.480	0.483	2.47	2.47
S.Em±	0.16	0.19	0.03	0.03	0.007	0.007	0.04	0.04
C.D. at 5%	0.46	0.53	0.07	0.07	0.021	0.020	0.11	0.10
Bio fertilizers								
Untreated	19.34	19.39	3.10	3.11	0.390	0.393	1.74	1.75
Rhizobium	20.59	20.65	3.30	3.31	0.450	0.453	2.11	2.11
P.S.B.	21.96	22.02	3.52	3.53	0.460	0.463	2.25	2.26
V.A.M.	20.28	20.33	3.25	3.26	0.440	0.443	2.18	2.18
S.Em±	0.16	0.19	0.03	0.03	0.007	0.007	0.04	0.04
C.D. at 5%	0.46	0.53	0.07	0.07	0.021	0.020	0.11	0.10