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Yield and Yield Attributes of Chickpea as Influenced by Phosphorus and Bio-fertilizer Application under Rainfed Conditions

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ABSTRACT

Background: Biofertilizers contain an effective tool in rural environments as a beneficial, sustainable and ecofriendly source of plant supplements. These are arranged on premise of the particular supplement accessibility concern. A few microorganisms are normally utilized as biofertilizers including nitrogen-fixing soil microbes (Azotobacter, Rhizobium), nitrogen-fixing cyanobacteria (Anabaena), phosphate-solubilizing microscopic organisms (*Pseudomonas* sp.) and AM fungi. Biofertilizers are minimal expense, effective, eco-friendly and sustainable source of plant supplements to enhance fertilizer.

Methods: A field experiment was conducted on rainfed chickpea at crop research center of career point University, Kota during 2016-17 and 2017-18 with four levels of phosphorus and four bio-fertilizer levels.

Result: The results revealed that crop fertilized with 40 kg P_2O_5/ha and combined application of Rhizobium + PSB proved significantly better than other treatment regarding yield attributes and yield (Grain and straw). The economics in the form of net return and B:C ratio was also computed which was confirmed the results, recorded as yield attributes and yield.

Key words: Bio-fertilizer, Chickpea, Phosphorus, Yield attributes, Yield.

INTRODUCTION

Chickpea (*Cicer arietinum* L.) is one of the *Rabi* season crops what's more, has no doubt been started in the space of present day southeastern Turkey and nearby Syria. The developed chickpea is among the principal grain vegetables that have been cultivated in the Ancient World. It has been one of the main legume yields in the Mediterranean Bowl and Turkey for human sustenance for quite a long time.

Chickpeas show up in early accounts in Turkey around 3500 BCE and in France 6790 BCE. India delivers the most chickpeas worldwide yet they are filled in excess of 50 centuries. It is very good source of carbohydrate, protein, fiber, B nutrients and a few minerals; they are a nutritious staple of many eating regimens.

The development of nodules by Rhizobium for the fixation of nitrogen from atmosphere has been considered as big and natural phenomena to add nitrogen in our soil by pulse crops. Native Rhizobium may be insufficient to formation and development of nodules both native and introduced in legumes often native Rhizobium low in the soil so, adding of Rhizobium culture in the soil is ever beneficial for N fixation.

Chickpea (*Cicer arietinum* L.) is one of the most important major pulse crops of world. Pulse is the cheapest protein source for the poor farmers of the subcontinent of India. Each pulse plant name as mini-fertilizer factory of its own, enriches soil N, fixes atmospheric N in symbiotic contact with the bacteria of Rhizobium. Legume crops are significant source of protein among the all vegetarian in India and having necessary amino acids, nutrients and minerals Pingoliya *et al*. (2013). They contain 22 to 24 percent protein, which is just about to twofold in wheat and threefold in rice Shukla *et al*. (2013).

Besides these aforesaid advantages the productivity of chickpea is still less due to soil hunger of nitrogen and phosphorus. The application of phosphorus plays main role information of energy rich phosphate bonds, Phosphate-lipids and for development of root system. Thus, seed inoculation with bio-fertilizers to increase the availability of nutrient is very essential for this crop. Akansha Singh *et al*. 2021; Das *et al*. 2013 were also observed the effect of biofertilizers inoculation with the seed of chickpea.

MATERIALS AND METHODS

An experiment was carried out at crop Research center of career point university, Kota during *rabi* season of 2016-2017 and 2017-18. The soil was silty clay (Vertisol) with low available nitrogen and phosphorus and high in exchangeable potassium. The experiment consisted 4 levels of phosphorus (0, 30, 40 and 50 Kg P_2O_5/ha and four inoculated with

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Rhizobium, PSB and Rhizobium + PSB). These treatments were tested in Randomized Block Design (RBD) and replicated four times. In early maturing variety GNG-469 was sown at 30 cm row spacing. The Basal dose of 25 kg N/ha was applied through DAP and Urea. The doses of P_2O_5 were applied as per the treatments as basal and bio-fertilizers were given as per treatment by seed dressing. In order to evaluate the effect of different treatments on yield and yield attributes of chickpeas.

RESULTS AND DISCUSSION

Yield attributes

The number of pods/plant, seeds/pod test weight and dry matter production increased significantly with 40 kg P_2O_5/ha (Table 1) over O, 30 kg P_2O_5/ha whereas it was found at par with 5 kg P_2O_5/ha whereas, some reduction was also shown in higher dose of phosphate application. These results are in close conformity with the finding of Meena *et al*. (2001). Fig 1 and 2 shows the effect of phosphorus and biofertilizers on yield attributes of chickpea (Pooled data of 2016-18).

Seed inoculation with Rhizobium + PSB recorded significant increase in pods/plant, seeds/pod, test weight and dry matter production (Table 1). Combined effect of Rhizobium and PSB might be due to increase availability of nutrient and nitrogen fixation by root nodules. On non-inoculation of biofertilizer had lower yield of yield contributing factors might be due to less production of nodules which could not contributed much in atmospheric nitrogen fixation. This is also justified by the results of Anjali Eduru *et al*. (2020). Fig 3 and 4 shows the effect of Phosphorus and bio fertilizer on economics of chickpea (pooled data of two year).

Successive increase in phosphorus levels upto 40 kg P_2O_5/ha resulted in yield attributes (pods/plants, seed/pod, test weight and dry matter production). The higher response of chickpea to added phosphorus was mainly due to low P status in the experimental soil. The similar results were observed by Akansha Singh *et al.* 2021; Kumawat *et al*. 2013; Gupta and Sharma 2006; Singh *et al*. 2013.

Grain and straw yields

The grain and straw yield were increased significantly under 40 kg P_2O_5/ha over 0 and 30 Kg P_2O_5/ha and it was significantly at par with 50 kg P_2O_5/ha.

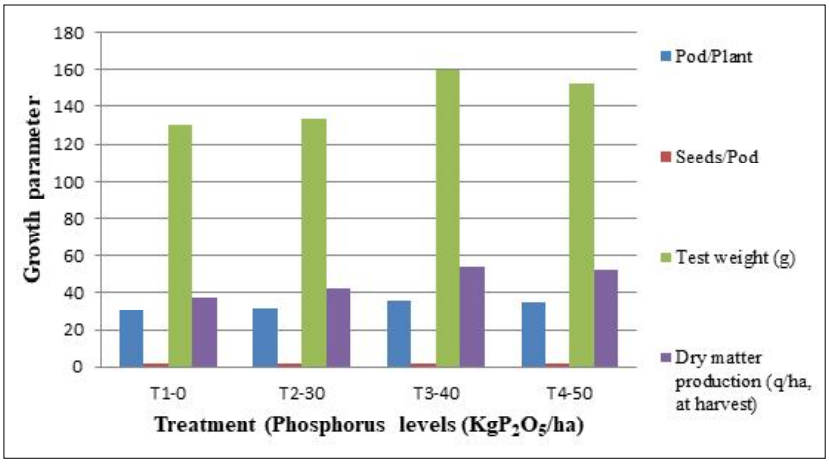

Fig 1: Effect of phosphorus on yield attributes of chickpea (2016-2018) (Pooled data of two year).

Table 1: Effect of phosphorus and biofertilizers on yield attributes of chickpea (2016-18).

Treatment	Pods/plant	Seeds/pod	Test weight (g)	Dry matter production (q/ha, at harvest)
Phosphorus levels (KgP_2O_5/ha)				
0	30.52	1.63	130.33	37.89
30	32.38	1.71	133.26	42.36
40	35.86	1.79	159.63	53.87
50	35.02	1.76	152.54	52.76
C.D. (P=0.05)	0.87	0.03	7.10	1.09
Biofertilizer				
Not inoculated	29.53	1.65	142.21	41.67
Rhizobium inoculation	32.31	1.73	145.18	46.55
PSB inoculation	34.65	1.77	146.32	50.24
Rhizobium + PSB inoculation	36.34	1.82	152.67	52.89
C.D.(P=0.05)	1.51	0.04	6.27	1.88

The application of 40 Kg P_2O_5/ha increased seed yield by 39.13 and 23.58 percent over 0 and 30 kg P_2O_5/ha, respectively (Table 2). The increase in straw yield was 45.03 and 30.25 percent over same treatments. The higher dose of phosphorus is 50 kg P_2O_5/ha. The result is in close conformity of Rajneesh Singh *et al*. (2018) and Meena *et al*. (2001).

Inoculation of bio-fertilizers increased seed yield and straw yield significantly over non inoculation of bio-fertilizers. The maximum and significant seed yield of chickpea was recorded under Rhizobium + PSB treatment (Table 2). The increase in seed yield was 23.09, 13.30 and 3.73 percent due to Rhizobium + PSB over control, Rhizobium and PSB, respectively. The straw yield of chickpea was also affected significantly and maximum straw was produced by Rhizobium + PSB inoculation which was 30.79, 13.88 and 10.93 percent higher over control, Rhizobium and PSB culture, respectively. This might be due to the fact that Rhizobium inoculation increased that root nodulation through better root development and more nutrient availability. It caused vigorous plant growth and dry matter production which resulted in better fruiting or pod formation and consequently it was beneficial to seed yield as well as straw yield. The results obtained in this experimentation on Rhizobium + PSB are in the line with the finding of Das *et al*. (2013).

Economic performance

Net return was computed after calculation of cost of cultivation. The net return (Rs/ha) was Rs 900080 found with 40 kg P_2O_5/ha which was due to higher grain and straw yield of chickpea. The percent increase over 0, 30 and 50 kg P_2O_5/ha was 61.10, 36.04 and 4.34. The seed dressing with bio-fertilizer was also increased by the inoculation of Rhizobium + PSB which was maximum with this combination (Rs 86995.00) The net return was increased over non inoculated Rhizobium alone and PSB alone 35.94, 18.66 and 7.26 percent due to Rhizobium+ PSB inoculation, respectively (Table 2) According to the findings of Akansha

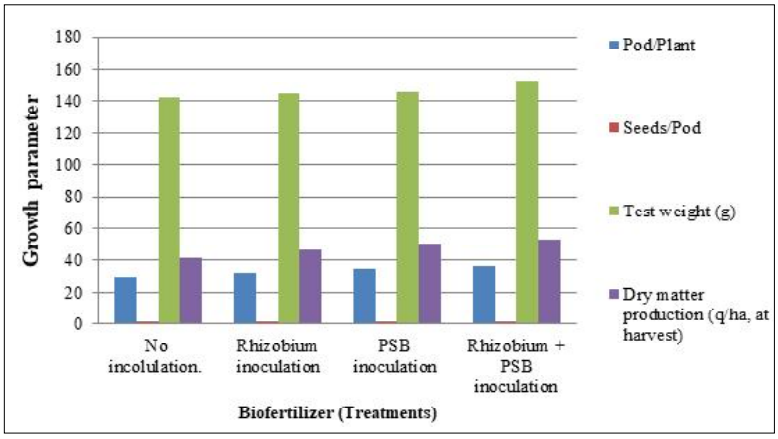

Fig 2: Effect of Biofertilizer on yield attributes of chickpea (2016-2018).

Table 2: Effect of phosphorus and biofertilizers on yield and economics of chickpea. (2016-2018).

Treatment	Seed yield (q/ha)	Straw yield (q/ha)	Net return (Rs/ha)	B:C ratio
Phosphorus levels (KgP_2O_5/ha)				
0	18.63	19.21	55915	1.96
30	20.95	21.39	66215	2.32
40	25.92	27.12	90080	3.16
50	25.06	27.12	86330	3.03
C.D. (P=0.05)	4.39	0.7		
Biofertilizer				
Not inoculated	20.35	21.27	63995	2.25
Rhizobium inoculation	22.11	24.43	73315	2.57
PSB inoculation	24.15	25.08	81105	2.85
Rhizobium + PSB inoculation	25.05	27.82	86995	3.05
C.D.(P=0.05)	0.83	2.45		

❖ Market price

a) Chickpea → Rs. 3500/q

b) Straw → Rs. 1000/q

Cost of cultivation of chickpea= Rs. 28500/ha.

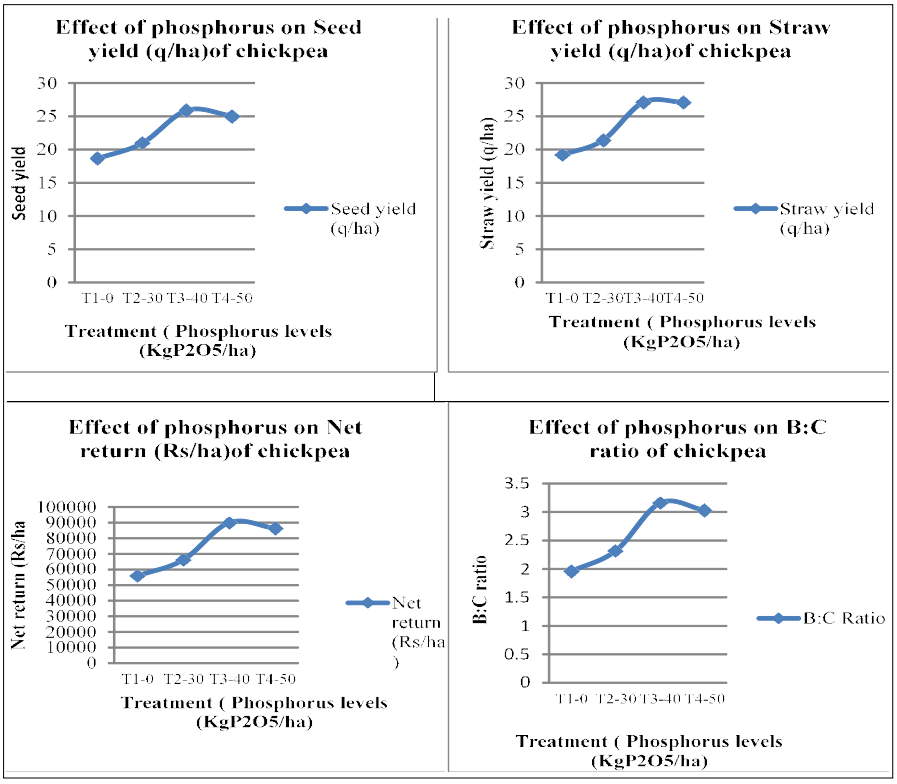

Fig 3: Effect of Phosphorus economics of chickpea (2016-2018).

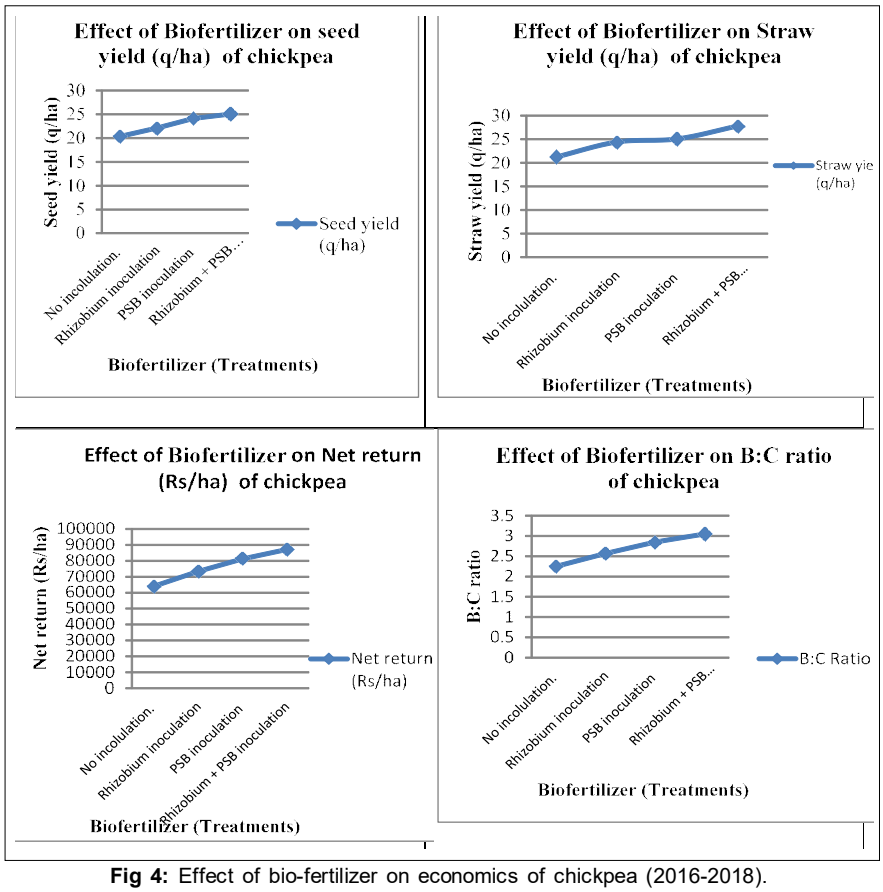

Fig 4: Effect of bio-fertilizer on economics of chickpea (2016-2018).

Singh *et al.* (2021) which concluded that net return is directly depends on yield and market prices.

B: C ratio

Benefit to cost ratio (B:C ratio) was also found in the close conformity that of the net return. B:C ratio was maximum 3.16 with 40 kg P_2O_5/ha and with inoculation of Rhizobium + PSB (3.05) wherein, the inoculation of single application of Rhizobium and PSB was more than control. B:C ratio was varied between 1.96 to 3.16 with the application of phosphorus from 0 to 50 Kg P_2O_5/ha and it was ranged from 2.25 to 3.05 with bio fertilizer application from no inoculation (control) to Rhizobium + PSB (Table 2).

CONCLUSION

The effect of phosphorus levels and biofertilizer on yield attributes and yield of chickpea were evaluated to find out the real values, effective on growth parameters and yield responses. The remunerative dose of phosphorus and inoculation of bio fertilizer were computed. The effective dose of phosphorus was observed as 40 Kg P_2O_5/ha and Rhizobium + PSB inoculation was found statistically significant to produce more yield of chickpea in rainfed conditions of vertisols of Rajasthan.

Certificate

It is to certify that the manuscript is not send anywhere and no any part or data are also not sent elsewhere for publication.

Conflict of interest: None.

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