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EFFECT OF PHOSPHORUS ON GROWTH, PRODUCTIVITY AND ECONOMICS OF CHICKPEA VARIETIES

V.K. GULPADIYA AND D.S CHHONKAR

Department of Agronomy, Raja Balwant Singh College (Dr B.R.A. University) Bichpuri, Agra (U.P)-283105

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ABSTRACT

The effect of phosphorus on growth and productivity of chickpea varieties was studied during rabi Season of 2011-12 at Research farm, Raja Balwant Singh College, Bichpuri, Agra (U.P.). The experiment comprised of four levels of phosphorus (0, 30, 60 and 90 kg P_2O_5 ha^{-1}) and three chickpea varieties viz. Haryana-1, BG-7 and PBG-7. Results showed that the taller plants root growth and yield and yield attributes were obtained with higher Haryana-1 variety. Most of the growth parameters and yield attributes were increased significantly with every increase in levels of phosphorus up to 60 kg P_2O_5 ha^{-1} which were statistically at par with 90 kg P_2O_5 ha^{-1} but significantly higher than other levels of phosphorus. The increase in grain yield with 30, 60 and 90 kg P_2O_5 ha^{-1} were 42.6, 55.3 and 68.5 %, respectively over control. Haryana-1 recorded the highest grain yield (10.18 q ha^{-1}) excelling BG-7, by 15.2 % and PBG-7 by 21.2%. Maximum net returns (` 32875 $ha^{-1}$) along with a B:C ratio of 2.41 was obtained in Haryana-1. Phosphorus use efficiency decreased with the increase in P level. Net returns (` 30334.8 ha^{-1}) and benefit cost (2.40) ratio were the highest with 60 kg P_2O_5 ha^{-1}.

Keywords: Chickpea, varieties, phosphorus, growth yield, economics

INTRODUCTION

Chickpea (*Cicer aritinum* L.) is the major pulse crop of India. At global level, it ranks fifth in terms of area and production under legumes. It is grown with less care and low manurial requirement. The productivity of chickpea is low because of its cultivation generally in poor soils. Pulses have inherent capacity to fix atmospheric nitrogen in symbiotic association with Rhizobium. This characteristic of pulses has helped in maintaining the sustainable fertility levels of soils. Under the pulses the soil does not allow water to run very fast which enhance the soil productivity, especially in case of the dry farming zones. Because of their better ground coverage, the pulses reduce water losses through evaporation from the soil surface. Application of phosphorus increased the production of pulse crops (Sharma et.al 2014). The response of phosphorus depends upon many factors like climate, variety and soil type and availability of nutrients during the period of growth. The requirement of phosphorus in legumes like chickpea is higher than other crops for their root development and metabolic activities. Phosphorus is the vital component of DNA, RNA, ATP and photosynthetic system and catalyses a number of bio chemical reactions from the beginning of seedling growth through to the formation of grain at maturity. Selection of suitable variety plays a vital role in crop production. The choice of right variety of chickpea helps in augmenting crop productivity. Thus, the value of stable and high yield varieties has been universally recognized as an important non case input for boosting the production any crop. There is a possibility of ranging the productivity per unit area by essential use of phosphorus. Limited information is available on the aspect under agro climatic conditions of Agra reason of Uttar Pradesh. The present investigation was therefore carried out to the study the effect of phosphorus levels on yield and economics of chickpea varieties.

METHODS AND MATERIAL

A field experiment was carried out during *Rabi* season of 2011-12 at the Research farm of Raja Balwant Singh College, Bichpuri Agra (Uttar Pradesh), situated at latitude of $27^0$2' N and longitude of $77^0$9' E with an elevation of 163.4 m above the mean sea level having semi arid, sub tropical climate with extremes of temperature both in summers and winters. The soil was sandy loam with alkaline p^H (7.9) low in organic carbon (3 g kg^{-1}), available nitrogen (170 kg ha^{-1}) phosphorus (18 kg ha^{-1}) and K (110 kg ha^{-1}) Treatments comprised of three chickpea varieties i.e. Haryana-1, BG-7 and PBG-7 and four phosphorus levels, viz. 0, 30, 60 and 90 kg. P_2O_5 ha^{-1} was tested in factorial randomized design with three replications. Entire quantities of K_2O (40 kg ha^{-1}), Nitrogen and quantity of P_2O_5 as per treatment were applied at the time of as basal dressing through and diammonium phosphate and muriate of potash respectively. The rest amount of N was applied as urea. The crop was sown on in second weak of November 2011. All agronomic practices like weeding intercultural practices and irrigation were done according to need of the crop. Growth and yield

attributeds were recorded at maturity. The crop was harvested in the first week of April 2012. Data on grain and straw yields were recorded. Economics of various treatments was calculated on the basis of prevailing market prices of different input and final produce.

RESULTS AND DISCUSSION

The results indicated that Variety Haryana-1 produced significantly taller plants, higher length and dry weight of root plant^{-1}, number and dry weight of nodules plant^{-1} than those of BG-7 and PBG-7. Sound root system with the variety Haryana-1 might be due its genetic characters.Variety Haryana-1 also produced significantly more number and weight of pods plant^{-1} than those of BG-7 and PBG-7(Table 2). The number and weight of grains plant^{-1} were appreciably higher by 14.7% and 15 % and 14.5% and 16.7% with the variety Haryana-1 over the BG-7 and PBG-7 varieties, respectively while number and weight of grains pod^{-1} and test weight did not modify due to varieties. Appreciably higher biological, grain and straw yield were recorded with the variety Haryana-1 as compared to BG-7 and PBG-7. The increase in grain yield with Variety Haryana-1 was to the tune of 15.2% and 21.2% over BG-7 and PBG-7. Markedly highest net return of ` 29397.5 ha$^{-1}$ along with B: C ratio of 2.41 was obtained in variety Haryana-1. The lowest net return of ` 25071.5 ha^{-1} was observed in variety PBG-7. The plant growth attributes such as plant height and number of secondary branches plant^{-1} appreciably improved with the application of phosphorus upto 60 kg P_2O_5 ha^{-1} Bahadur *et al.* 2002, Sahu *et al.* 2003, Length and weight of root plant^{-1} and number and weight of nodules plant^{-1} was increased appreciably with every increase in the rate of phosphorus application upto 60 kg P_2O_5 ha^{-1}, beyond that no significant advantage was noticed. It appears that with the increased supply of phosphorus, soil physical condition gets improved which, in turn, might have helped improving the root size and uptake of nutrients. With such improvements in root size, the noted enhanced rate of nodulation was possible. It may also be argued that in presence of adequate phosphorus, bacterial cells become motive and flagellate which, in turn, results in more N_2 fixation and finally better plant growth. It is also a well established fact that the application of phosphorus encourages the formation of new cells and thus promotes the root and shoot growth, whereas in the absences of phosphorus or with inadequate supply the infection remains latent leading to the poor development of roots and nodules, leaves and stem and finally reduce the amount of nitrogen fixed by restricting host plant growth. Some recent evidences (Vishwakarma *et al.* (2012) suggest that phosphorus requirements for nodulation and maximum nodules activities are much greater than poor host plant growth. Infection of Rhizobium bacteria depends on their interception with root hair, under adequate phosphorus application. Nodulation increased due to high bacterial interception on account of properly developed roots and increased density of nodule bacteria.

Table 1: Growth and root characters of chickpea Varieties as affected by phosphorus at harvest

Treatment	Plant height (cm)	Branches plant^{-1}	Secondary Branches plant^{-1}	Dry matter accumulation plant^{-1} (g)	Root length (cm)	Root weight (cm)	Nodules plant^{-1}	Dry Weight of nodules plant^{-1} (g)
Varieties								
Haryana-1	44.12	4.3	9.1	14.22	12.3	173.2	8.5	12.26
BG-7	41.15	3.7	8.1	12.88	11	165.6	7.7	10.96
PBG-7	40.13	3.6	8.1	12.44	10.9	163.5	7.6	10.92
SEm±	0.94	0.08	0.21	0.34	0.32	1.95	0.19	0.32
CD (p=0.05)	2.70	0.22	0.25	0.99	0.92	5.61	0.54	1.06
Phosphorus (kg ha^{-1})								
0	36.27	2.9	7.1	9.56	10	156.1	6.3	9.84
30	40.78	3.7	8.2	12.68	11.2	168.9	7.8	11.14
60	44.30	4.4	9.2	15.20	12.3	173.5	8.8	12.26
90	45.85	4.4	9.2	15.28	12.3	174.1	8.8	12.28
SEm±	1.08	0.09	0.61	0.40	0.37	2.26	0.21	0.37
CD (p=0.05)	3.10	0.25	0.71	1.14	1.07	6.48	0.62	1.06

Application of phosphorus significantly increased the dry matter accumulation in the plant and the differences were well marked upto 60 kg P_2O_5 ha^{-1} (Table 1). When the rate of phosphorus increased from 60 to 90 kg P_2O_5 ha^{-1}, the dry matter accumulation in plant increased marginally. At

harvest, the increases in dry matter accumulation with 30, 60 and 90 kg P_2O_5 ha^{-1} were 32.6, 59 and 59.8, respectively over the control. The favourable effect of phosphorus on plant growth might be due to the fact that phosphorus is the chief constituent of the lipids and nucleo-proteins, an abundance of phosphorus in the meristematic region might have helped in cell division and multiplication, it is also concerned with carbohydrate transformation, respiration and nitrogen fixation and hence it boosted plant growth. The response of phosphorus in terms of dry matter accumulation upto 60 kg P_2O_5 ha^{-1} have also been reported Singh *et al.* (2005) in chickpea.

Table 2: Effect of Phosphorus on yield attributes of chickpea varieties

Treatments	Pods $plant^{-1}$	Weight of pods $plant^{-1}$ (g)	Grains $pods^{-1}$	Weight of grains $pods^{-1}$ (g)	1000 grain weight (g)
Varieties					
Haryana-1	30.1	60.66	1.7	3.30	302.48
BG-7	26	48.42	1.7	3.00	300.24
PBG-7	25	46.32	1.7	2.94	298.30
SEm±	1.13	1.25	0.50	0.87	1.24
CD (p=0.05)	3.25	3.58	NS	NS	NS
Phosphorus (kg ha^{-1})					
0	21	38.78	1.7	2.28	290.90
30	26.1	50.36	1.7	2.96	301.18
60	30.3	58.72	1.7	3.50	304.20
90	30.7	59.34	1.7	3.58	305.08
SEm±	1.31	1.42	0	1.04	1.48
CD (p=0.05)	3.75	3.92	NS	NS	4.24

The grain yield $plant^{-1}$ is the combined effect of number and weight of pods $plant^{-1}$, number and weight of grains $plant^{-1}$ and 1000 grain weight. Almost all yield contributing characters namely number and weight of grains $plant^{-1}$ and 1000 grain weight were also improved appreciably with increasing levels of phosphorus upto 60 kg P_2O_5 ha^{-1}, except 1000 grain weight, where the differences among 30, 60 and 90 kg P_2O_5 ha^{-1}, were not significant.

Biological, grain and straw yields were significantly increased with increasing rates of phosphorus application up to 60 kg P_2O_5 ha^{-1}. The increases in grain yield with 30, 60 and 90 kg P_2O_5 ha^{-1} were to the tune of 42.6, 55.3 and 68.5%, respectively over the control. Response of chickpea to phosphorus upto 60 kg P_2O_5 ha^{-1} was reported by Islam *et al.* (2011). Application of phosphorus also had significant effect on harvest index as compared with control. It may be recall that the application of 90 kg P_2O_5 ha^{-1} failed to bring any additional significant improvement over its lower dose (60 kg P_2O_5 ha^{-1}). It may be pointed out that initial status of the available phosphorus of the soil was in the low range and, therefore, addition of 60 kg P_2O_5 ha^{-1} could have become adequate for normal growth and development of the pulse crop Sahu *et al.* (2002) and Sharma *et al.* (2014).

Table 3: Effect of phosphorus on yield and economics of chickpea varieties

Treatments	Biological yield (q ha^{-1})	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	Harvest index (%)	Net Income (`./ha^{-1})	B/C ratio
Varieties						
Haryana-1	33.42	10.18	23.24	30.5	29397.5	2.41
BG-7	30.23	8.84	21.39	29.2	26104.5	2.25
PBG-7	29.50	8.40	21.10	28.5	25071.5	2.20
SEm±	0.93	0.33	0.60	0.73		
CD (p=0.05)	2.67	0.94	1.72	NS		
Phosphorus (kg ha^{-1})						
0	24.36	6.45	17.91	26.5	22419.8	2.20
30	30.38	9.22	21.16	30.4	27661.9	2.37
60	34.03	10.02	24.01	29.4	30334.8	2.40
90	35.43	10.87	24.56	30.7	27014.7	2.17
SEm±	1.07	0.38	0.69	0.85		

CD (p=0.05)	3.08	1.08	1.99	2.43

It is evident from the Table 2 that the highest net returns of `. 32875 ha^{-1} and B:C ratio (2.52) were obtained with the 60 kg P_2O_5 ha^{-1} followed by application of 30 kg P_2O_5 ha^{-1}. This could be attributed to higher yields of chickpea varieties with 60 kg P_20_5 ha^{-1}. Similar results were reported by Sahu *et al.* (2005).

On the basis results obtained in present study, it can be concluded that out of three varieties Haryana-1 was identified as best variety for cultivation in Agra region with 60 kg P_2O_5 ha^{-1}.

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