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Research Article

Response of chickpea (GG-1) to nitrogen, phosphorus and sulphur with and without bio-fertilizers under supplementary irrigation in *Bhal* region of Gujarat

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ABSTRACT : A field experiment was conducted during *Rabi* Seasons of 2007-08 to 2010-11 on clayey soil to find out response of chickpea to nitrogen, phosphorus, sulphur and bio-fertilizer. Application of 40 kg N ha^{-1} gave 8.23 per cent higher yield over 20 kg N ha^{-1}. Application of 20 kg S ha^{-1} significantly increased the seed yield of chickpea and recorded 5.5 per cent increase in seed yield over no sulphur. Phosphorus and *Rhizobium* application did not show any significant effect on seed yield of chickpea. The most productive and economical level of fertilization was 40 kg N and 20 kg S ha^{-1}.

KEY WORDS : Chickpea, Phosphorus, Sulphur, Bio-fertilizer, *Rhizobium*

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INTRODUCTION

Chickpea (*Cicer arietinum*) is the major food legume of India. Chickpea besides being a rich source of highly digestible dietary protein (17-21%), it is also rich source of Ca, iron, niacin, vitamins B and C. Besides the aforesaid advantages the productivity of chickpea is still very less due to the hungry soils, mainly deficient in nitrogen, phosphorus and sulphur. Among the major nutrients, nitrogen plays a key role for the plant growth. It imparts green colour to leaves, stem and make enable them for efficient photosynthesis. It also plays an important role in plant metabolism by virtue of being an essential constituent of structural cell. Nitrogen also plays a vital role in synthesis of chlorophyll as well as amino acids, which contribute to the building unit of protein and thus growth of plant. Phosphorus application to legume plays a key role in formation of energy rich phosphate bonds, phospholipids and for development of root system. Sulphur is generally called the fourth major nutrient because crops, in general, require sulphur just slightly less than phosphorus. Sulphur being the constituent of some amino acids, promotes the bio synthesis of protein. Sulphur have their role in growth and development of crop in legumes. Seed inoculation with bio-fertilizers increases the availability of nutrients to plants.

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EXPERIMENTAL METHODS

The field experiment was conducted at Agricultural Research Station, Anand Agricultural University, Arnej during *Rabi* Seasons of 2007-08 to 2010-11. The soil of the experimental field was clayey in texture. The soil was low in available N (123 kg^{ha-1}), available P (15 kg^{ha-1}) and high in available K (521 kg^{ha-1}) and the organic carbon content was 0.35 per cent. The field experiment was laid out in Factorial Randomized Block Design (FRBD) replicated four times with net plot size of 10.8 m^2 (2.7 m x 4 m) consisting of combination of 2 levels nitrogen *viz.*, 20

and 40 kg N ha^{-1}, 2 levels of phosphorous *viz.*, 00 and 20 kg P_2O_5 ha^{-1}, 2 levels of sulphur *viz.*, 00 and 20 kg S ha^{-1} and 2 levels of bio-fertilizer *viz.*, uninoculated and inoculated with *Rhizobium*. Nitrogen in the form of urea, phosphorus in the form of SSP and sulphur in the form of gypsum was applied as per the treatments. Two irrigations of 50 mm were given at 21 DAS and 45 DAS. All other crop management practices have been followed as per the crop production guide. Inoculation of *Rhizobium*, wherever, required, was done prior to sowing. Inoculated seeds were dried in shade for an hour before sowing. In order to evaluate the effect of different treatments on yield and qualities of chickpea, the observations were recorded from five plants taken at random from each plot.

EXPERIMENTAL RESULTS AND ANALYSIS

The results obtained from the present study have been discussed in detail under following heads :

Yield:

Application of nitrogen to chickpea enhanced significantly grain yield during 2007-08, 2008-09 as well as in pooled analysis. In pooled analysis, 40 kg N ha^{-1} produced significantly higher grain yield than 20 kg N ha^{-1} (Table 1). N @ 40 kg ha^{-1} gave 8.23 per cent higher yield over N @ 20 kg ha^{-1}. Application of nitrogen promoted the development all yield attributes *viz.*, number of branches, pods per plant, seeds per pod and test weight over its respective lower dose. The better development of these attributes due to application of nitrogen resulted in significant increases in yield. These findings are in conformity with those of Bali *et al.* (1991) and Tank *et al.* (1992). Application of phosphorus did not show any significant effect on grain yield of chickpea during all the years as well as in pooled analysis except 2010-11 (Table 1). Application of 20 kg S ha^{-1} showed significant effect on seed yield of chickpea during only one year (2010-11) and in pooled analysis; and recorded 5.5 per cent increase in seed yield over no sulphur (Table 1).

Table 1: Seed yield of chickpea as influenced by different treatments

Treatments	Seed yield (kg ha^{-1})				Pooled
	2007-08	2008-09	2009-10	2010-11	
Bio-fertilizer					
No inoculation	879	1334	1257	1739	1302
Inoculated	881	1398	1336	1762	1345
S.E.±	32.2	35	40	50	19.49
C.D. (P=0.05)	NS	NS	NS	NS	NS
Nitrogen (kg N ha^{-1})					
20	792	1307	1244	1739	1271
40	968	1425	1349	1762	1376
S.E.±	32.2	35	40	50	19.49
C.D. (P=0.05)	93	102	NS	NS	54.52
Phosphorus (kg P_2O_5 ha^{-1})					
00	863	1327	1243	1611	1261
20	897	1405	1350	1890	1386
S.E.±	32.2	35	40	50	37.83
C.D. (P=0.05)	NS	NS	NS	145	NS
Sulphur (kg S ha^{-1})					
00	870	1348	1259	1674	1288
20	891	1385	1334	1827	1359
S.E.±	32.2	35	40	50	19.49
C.D. (P=0.05)	NS	NS	NS	145	54.52
Sig. Interactions	-	-	-	-	YxP
C.V.%	17.93	12.63	15.08	14.01	14.42

NS=Non-significant

Table 2 : Seed yield of chickpea as influenced by interaction of year and phosphorus treatments

Treatments	Seed yield (kg ha^{-1})				Pooled
	2007-08	2008-09	2009-10	2010-11	
Phosphorus (P_2O_5 kg ha^{-1})					
0	863	1327	1243	1611	1261
20	897	1405	1350	1890	1386
S.E.±	39.0		C.D. (P=0.05)	109.0	

The increase in yield under the influence of sulphur application might be due to the important role of sulphur in energy transformation, activation of enzymes and also in carbohydrate metabolism. These results are in close confirmity with the findings of Karwasara and Raj (1984), Singh and Ram (1991) and Joseph *et al.* (1995). *Rhizobium* inoculation to chickpea had no significant yield advantage compared to the uninoculated crop during all the years as well as in pooled analysis (Table 1). The lack of yield response to *Rhizobium* inoculation could probably be ascribed to the inadequate inoculum of the effective strains in the rhizosphere capable of causing prompt and effective nodulation which in turn depends on the survival and multiplication of the applied inoculum (Kothari and Saraf, 1988).

Interaction effect:

Interaction effect between levels of phosphorus and year for seed yield was found significant in pooled analysis. Seed yield of 1890 kg ha^{-1} obtained under 20 kg P_2O_5 ha^{-1} during the year 2010-11 was significantly superior over rest of combinations (Table 2).

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