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Research Article

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Production and Productivity on Row Spacing and Fertility Levels of White gram (*Cicer kabulium* L.) in Indo-gangetic Plain Zone of Uttar Pradesh

Raghvendra Singh[1], Vijay Kumar Rajpoot[2], Amar Kant Verma[3]*, Sumit Raj[4], Yogesh Pratap Singh[5], Ranjeet Kumar[6] & Amit Prakash Raghuwanshi[7]

[1,2,3,4, 5 & 6]Department of Soil Conservation and Water Management,
C S Azad University of Agriculture and Technology, Kanpur - 208002, Uttar Pradesh
[7]Department of Botany, D. A-V College, Kanpur, Uttar Pradesh
*Corresponding author: *amarkant9004@gmail.com*

Abstract

The field experiment was conducted during *rabi* season of 2014-15 at Soil Conservation and Water Management Farm of C S Azad University of Agriculture and Technology, Kanpur. The experiment consisted nine treatments *viz.* S_1F_1 (*i.e.* 30 cm and 10 kg N, 40 P, 20 kg K, 20 kg Sulfur), S_1F_2 (*i.e.* 30 cm and 20 kg N, 60 kg P, 20 kg K, 20 kg Sulfur), S_1F_3 (*i.e.* 30 cm and 30 kg N, 80 kg P, 20 kg K, 20 kg Sulfur), S_2F_1 (*i.e.* 40 cm and 10 kg N, 40 kg P, 20 kg K, 20 kg Sulfur), S_2F_2 (*i.e.* 40 cm and 20 kg N, 60 kg P, 20 kg K, 20 kg Sulfur), S_2F_3 (*i.e.* 40 cm and 30 kg N, 80 kg P, 20 kg K, 20 kg Sulfur), S_3F_1 (*i.e.* 50 cm and 10 kg N, 40 kg P, 20 kg K, 20 kg Sulfur), S_3F_2 (*i.e.* 50 cm and 20 kg N, 60 kg P, 20 kg K, 20 kg Sulfur), S_3F_3 (*i.e.* 50 cm and 30 kg N, 80 kg P, 20 kg K, 20 kg Sulfur) nine treatments were tested in factorial randomized block design with three replications. From results of present investigation an overall conclusion may be drawn that Kabuli gram variety "Pragti" proved better with 40 cm row spacing in comparison to other treatments with fertility levels at 30 kg N, 80 kg P, 20 kg K, 20 kg S ha^{-1} along with net profit of Rs. 14786 ha^{-1} and benefit : cost ratio of 1:1.59.

Keywords: Seed yield, Stover yield, Harvest index, Net return, B:C Ratio.

Introduction

Chickpea (*Cicer arietinum* L.), the most important pulse crop of *rabi* season, is cultivated mainly in semi-arid and warm temperate regions of the world. It is grown in several countries worldwide as a food source. It is, probably, the highest protein containing gram legume expect groundnut and soybean. Chickpea is the third most important food legume crop and India is the largest producer contributing to 68% of world's chickpea production Basavegowda *et al.* (2019). Even though India is the largest producer of chickpea; it still imports chickpea from other countries. Chickpea is largely cultivated in the temperate region.

Chickpea is a premier pulse crop of India grown in *rabi* season under various cropping systems. In India, it is grown on an area about 9.91 million hectares with an annual production of 8.22 million tones and average productivity is 895 kg ha^{-1}. It contributes about 47% of the total pulse production and about 40% of total pulse growing area in the country.

In India, it is mainly grown in the states of Andhra Pradesh, Bihar, Gujarat, Haryana, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan, Uttar Pradesh, etc. Among these states, Madhya Pradesh is the largest producer of chickpea, which covers 2.79 million hectares area with an annual production of 2.58 million tonnes. Chickpea is an important source of protein in the diets of the poor and is particularly important in vegetarian diets. Also, it is being used increasingly as a substitute for animal protein. Optimum sowing time of chickpea may vary from one variety to another and also from one region to another due to variation of agro-ecological conditions Singh *et al.* (2019).

Water is one of the most valuable resources for the survival of civilization. However, the agriculture sector is the largest consumer of water resources in India. Assured supply of water is necessary for sustainable agriculture. However, farmers are using water irrationally. Lack of awareness among the farmers about the consequences of irrational use of water and lack of appropriate tools and instruments for regulated and uniform application of the desired quantity of water at the appropriate time are among the major causes of low water-use efficiency at the field-level. This has ultimately led to a decline of the water resources. Farmers' practices need to be critically observed and modified taking into view the perceptions, concerns and constraints of the farmers in adopting better irrigation methods Kumar *et al.* (2017).

Materials and Methods

The experiment was conducted during *rabi* season of 2014-15 in Soil Conservation and Water Management Farm of C S Azad University of Agriculture and Technology, Kanpur in alluvial soil. Soil of the experimental plot was sandy loam in texture and slightly calcareous having organic carbon 0.48%, total nitrogen 0.03%, available P_2O_5 12.6 Kg ha^{-1}, pH 7.3, electrical conductivity 0.34 dS m^{-1}, permanent wilting point 6.3%, field capacity 18.4%, maximum water holding capacity 29.6%, Bulk density 1.46 Mg m^{-3}, particle density 2.56 Mg m^{-3} and porosity 42.9%. The experiment was conducted in a factorial randomized block design with three replications and nine treatments *viz.* S_1F_1 (*i.e.* 30 cm and 10 kg N, 40 P, 20 kg K, 20 kg Sulfur), S_1F_2 (*i.e.* 30 cm and 20 kg N, 60 kg P, 20 kg K, 20 kg Sulfur), S_1F_3 (*i.e.* 30 cm and 30 kg N, 80 kg P, 20 kg K, 20 kg Sulfur), S_2F_1 (*i.e.* 40 cm and 10 kg N, 40 kg P, 20 kg K, 20 kg Sulfur), S_2F_2 (*i.e.* 40 cm and 20 kg N, 60 kg P, 20 kg K, 20 kg Sulfur), S_2F_3 (*i.e.* 40 cm and 30 kg N, 80 kg P, 20 kg K, 20 kg Sulfur), S_3F_1 (*i.e.* 50 cm and 10 kg N, 40 kg P, 20 kg K, 20 kg Sulfur), S_3F_2 (*i.e.* 50 cm and 20 kg N, 60 kg P, 20 kg K, 20 kg Sulfur), S_3F_3 (*i.e.* 50 cm and 30 kg N, 80 kg P, 20 kg K, 20 kg Sulfur). "Pragati" was the variety of Kabuli gram was sown in different rows spacing in cm apart using 5 kg seed ha^1. Full dose of P and K while half dose of N was applied as basal dose at the time of sowing where rest of N was given in two split doses during experimentation. Available moisture at sowing time upto 100 cm soil profile was 269.8 mm. Whereas amount of rainfall received during the crop period was nil against the average annual rainfall of about 800 mm. Recommended package of practices were applied in different treatments. Soil moisture was monitored gravimetrically using the sample collected from 0-25, 25-50, 50-75 and 75-100 cm soil depths at regular monthly intervals to quantify the soil moisture content and growth parameters by randomly selecting three plants for each plots till the harvest.

The data collected on growth, yield attributes and yields were statistically analyzed (Fisher and Yates, 1958). Recommended package of practices and fertilizers doses were applied in different treatments. The harvest index was worked out with the help of following formula:

$$\text{Harvest Index (\%)} = \frac{\text{Seed yield (q ha}^{-1})}{\text{Biological yield (q ha}^{-1})} \text{ X } 100$$

For economic evaluation the cost of cultivation, gross returns, net returns, and B: C ratio were computed using standard procedure based on minimum support price of white gram.

Results and Discussion

The seed yield differences due to fertilizer were found to be statistically significant over control. Seed yield was maximum (10.23 q ha^{-1}) in 40 cm row spacing and (10.18 q ha^{-1}) fertility level 30 kg N, 80 kg P, 20 kg K, 20 kg S ha^{-1}. Similar results were reported by Patel *et al.* (2009) and Chourasiya *et al.* (2018). Stover yield was obtained maximum (17.84 q ha^{-1}) in 40 cm and (17.83 q ha^{-1}) at 30 kg N, 80 kg P, 20 kg K, 20 kg S ha^{-1} of white gram. Similar results were reported by Verma and Yadav, (2018). Biological yield was maximum (28.07 q ha^{-1}) in 40 cm row spacing and (28.01 q ha^{-1}) fertility level 30 kg N, 80 kg P, 20 kg K, 20 kg S $ha^{-}1$. Similar results were reported by Kumari *et al.* 2019. Harvest index was found maximum (36.45 per cent) in 40 cm row spacing and (36.35 per cent) at 30 kg N, 80 kg P, 20 kg K, 20 kg S ha^{-1}. Similar results were reported by Kumar *et al.* (2016).

Table 1: Effect of row spacing and fertility levels on seed yield, stover yield, biological yield and harvest index under different treatments

Treatments	Seed yield (q ha^{-1})			Stover yield (q ha^{-1})			Biological yield (q ha^{-1})			Harvest index (%)		
Row spacing (cm)												
S_1	9.08			16.23			25.31			35.87		
S_2	10.23			17.84			28.07			36.44		
S_3	9.65			17.10			26.75			36.07		
Fertility levels (N, P, K, S, in kg ha^{-1})												
F_1	9.06			16.51			25.57			35.41		
F_2	9.28			16.88			26.16			35.48		
F_3	10.18			17.83			28.01			36.35		
	S	***F***	***SXF***	***S***	***F***	***SXF***	***S***	***F***	***SXF***	***S***	***F***	***SXF***
SE(D)±	0.22	0.22	0.37	0.25	0.25	0.38	0.31	0.31	0.51	0.38	0.38	0.66
CD (P= 0.05)	0.46	0.46	NS	0.54	0.54	NS	0.67	0.67	NS	0.81	0.81	NS

Table 2: Effect of row spacing and fertility levels on gross return, net return and cost: benefit ratio under different treatments

Treatments	Cost of cultivation (Rs. ha^{-1})	Gross return (Rs. ha^{-1})			Net return (Rs. ha^{-1})	Benefit: cost ratio
		By seed	By stover	Total		
Row spacing (cm)						
S_1	24976	30146	5275	35421	10444	1:1.42
S_2	24976	33964	5798	39762	14786	1:1.59
S_3	24976	32038	5558	37596	12620	1:1.51
Fertility levels (N, P, K, S, in kg ha^{-1})						
F_1	31857	30079	5366	35445	3588	1:1.11
F_2	33007	30810	5486	36296	3289	1:1.10
F_3	34157	33798	5795	39592	5436	1:1.16

Perusal of the data presented in Table-2 make it clear that cost of cultivation (Rs. 31857 ha^{-1}) in F_1 fertility levels *i.e.* 10 kg N, 40 kg P, 20 kg K, 20 kg S ha^{-1}, (Rs. 33007 ha^{-1}) in F_2 *i.e*. 20 kg N, 60 kg P, 20 kg K, 20 kg S ha^{-1} and (Rs. 34157 ha^{-1}) in F_3 30 kg N, 80 kg P, 20 kg K, 20 kg S ha^{-1}. Gross returned was statistically higher (Rs. 39762 ha^{-1}) obtained in 40 cm with 30 kg N, 80 kg P, 20 kg K, 20 kg S ha^{-1} followed by (Rs. 37596 ha^{-1}). In 50 cm row spacing with 20 kg N, 60 kg P, 20 kg K, 20 kg S ha^{-1}. The highest net profit (Rs. 14786 ha^{-1}) worked out in 40 cm row spacing and 30 kg N, 80 kg P, 20 kg K, 20 kg S ha^{-1} Singh *et al.* (2017) reported that row spacing of 45 cm gave higher seed yield and B:C ratio. Similar resulted were also reported by Aggarwal *et al.* (2016) also forward similar trend in yield and economics of chickpea Rachhoya *et al.* (2018).

Conclusion

From results of present investigation an overall conclusion may be drawn that white gram variety "Pragti" proved better with 40 cm row spacing in comparison to other treatments with fertility levels at 30 kg N, 80 kg P, 20 kg K, 20 kg S ha^{-1} along with net profit of Rs. 14786 ha^{-1} and benefit : cost ratio of 1:1.59 would be quite remunerative for higher productivity alongwith seed yield in Indo-gangetic plain zone of Uttar Pradesh.

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