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Optimization of Sulphur Dose for Chickpea (*Cicer arietinum* L.) Cultivars in Kymore Plateau of Madhya Pradesh, India

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A B S T R A C T

An experiment was designed to assess the response of Sulphur to different Chickpea cultivars at Agriculture farm of Mahatma Gandhi Chitrakoot Gramodaya Vishwavidyalaya, Chitrakoot, Satna (M.P.). Three varieties (DCP 92-03, JG-16, JG-11) and three Sulphur levels (10, 20, 30 and 40 kg S /ha) along with all possible interactions were used. Experimental design fallowing split plot design in three replications was employed data was collected on yield parameters. The result of the study indicated that there were significant variations in the performance of varieties in terms of yield parameters in which DCP 92-03 was found to be more responsive and high yielding. As a result, the highest Seed weight (4.29 g /plant) and yield (2408 kg/ha) were recorded from DCP 92-03 treated with 40 kg S /ha. The result further revealed that there is a promising profit return by investing more on Sulphur application up to 40 kg S /ha. It is, thus, recommended that Sulphur fertilizer should be introduced to optimize productivity in kymore plateau of Madhya Pradesh.

Introduction

Gram or Chickpea (*Cicer arietinum* L.), a member of family Fabaceae, is an ancient self-pollinated leguminous crop, diploid annual (2 N=16 chromosomes) grown since 7000 BC, in different area of the world (Tekeoglu *et al.*, 2000) Archaeological records bestow information that the cultivated chickpea was the first grain legume to be domesticated in the Old World. Chick pea contains 21% protein, 2.2% fat, 62% carbohydrates. It also contains calcium of about 190 mg/100g; Iron 90.5 mg/100g; Phosphorus 280 mg/100g. Among the pulses, chick pea has relatively lower protein content but of higher biological value and protein digestibility. An acid liquid from the granular hairs of leaves and pods contains two acids.They are (i) Malic Acid (90-96%) (ii) Oxalic Acid (4-10%) which are used in the preparation of drugs, and are prescribed for the intestinaldis-orders and blood purification. Moreover, the leaves are used to cure chronic bronchitis and the seeds are considered as antibilious, used as tonic, stimulant and aphrodisiac acid is also supposed to lower the blood cholesterol level. Due to its aphrodisiac properties, it is referred as vajibhakshya in Sanskrit. Chickpea has also the property to act

as hypocholesteremic agent; germinating chickpea is believed to reduce the blood cholesterol level.

Materials and Methods

The Experiment was carried out during *rabi* season of 2015-16 on a well levelled field at Agriculture Farm of Mahatma Gandhi Chitrakoot Gramodaya Vishwavidyalaya, Chitrakoot, Satna (M.P.). The farm is situated in Bundelkhand region of Northern Madhya Pradesh. Geographically Chitrakoot is situated at 25°10' N latitude and 80°85' E longitude and about 190-210 meter above mean sea level. The climate of the area is semi-arid and sub-tropical with hot dry summer and cold winters. The total rainfall of Chitrakoot is 950 mm received in experimental area. Prior to planting of the potato crop, to find out the fertility status, a number of soil samples were taken randomly from the experimental field before the sowing of crop at the depth of 15 cm. These samples were mixed together and a composite soil sample was drawn for chemical analysis. The field was prepared by one ploughing and one cross ploughing by cultivator. Planking was done after each ploughing to make soil friable for proper germination of seed. The recommended dose of nitrogen, phosphorus and potash for Chickpea was 20, 40 and 20 kg per ha, which was provided through DAP, Urea and MOP Fertilizers were placed below the seeds at the time of sowing. Sulphur was applied as per the treatments. Under S_3 it was applied as Basal at the rate of 30 kg/ha and under S_4 it was applied as basal at the rate of 40 kg/ha. Sowing was done as per treatment in rows 30 cm apart opened with the help of Kudal. Seeds were drilled in furrows and covered manually just after sowing. Two manual weeding were done in the experimental crop. First weeding was done with the help of Khurpi as to protect the crop from weed infestation while second intercultural operations were done when crop attains the age of about two months.

Result and Discussion

Yield attributes and yield

All yield and yield components studied in the present investigation were significantly influenced by the applied varieties and S levels. However, number of Seed per plant was found to be significantly affected by the interaction treatments of varieties and S levels.

Seed yield Kg/ha

The variety DCP 92-03 (V_1) recorded significantly higher seed yield (1789.99 kg /ha) which was 157.98% and 132.06% higher over JG-16 (V_2) and JG-11 (V_3) respectively. Highest seed yield (1421 kg /ha) noted with 40 kg S/ha (S_4) level which was 80.32, 40.97 and 26.64% significantly superior seed yield over 10 kg S/ha (S_1), 20 kg S/ha (S_2) and 30 kg S /ha (S_3) level. 30 kg significantly higher seed yield over 10 kg S /ha (S_1) and 20 kg S/ha (S_2). Treatment 40 kg S/ha (S_4) show higher seed yield over 30 kg S/ha (S_3) but did not touch the levels of significance in all the three varieties. Thus, the variety (V_1) (DCP 92-03) with 40 kg S/ha (V_1S_4) resulted in significantly higher seed yield (2408 Kg/ha)

Straw yield Kg/ha

The variety DCP 92-03 (V_1) recorded significantly highest straw yield (3290 kg / ha) which was significantly higher over JG-16 (V_2) (1924 kg/ha) and JG-11 (V_3) (1808 kg/ha). Highest straw yield (2534 kg/ha) noted with 40 kg S/ha (S_4) level which was significantly superior over 10 kg S/ha (S_1) but statistically at par with 20 kg S/ha (S_2) and 30 kg S/ha^{-1}(S_3), respectively.

Harvest index (%)

Harvest index observed to be 26% to 35% percent under different varieties of chickpea. It is clear from the results, that the varieties DCP 92-03 (V_1) recorded significantly higher harvest index over JG-11 (V_3) and JG-16 (V_2)However, Variety JG-11 (V_3) was also noted higher harvest index over JG-16 (V_2) increase the harvest index significantly up to 30 kg S/ha^{-1} (S_3) thereafter it was slightly increased but remains at par. Maximum harvest index (34%) noted with 40 kg S/ha^{-1} (S_4) level which was significantly superior over 10 kg S/ha^{-1} (S_1) and 20 kg S/ha^{-1} (S_2) levels but statistically at par with 30 kg S/ha^{-1} (S_3) Whereas, 30 kg S/ha^{-1} (S_3) also recorded significantly higher harvest index over 10 kg S/ha^{-1} (S_1) and 20 kg S/ha^{-1} (S_2) treatment.

Table.1 Yield and yield components influenced by different treatment levels

Treatment	Seed yield (kg/ha)	Straw yield (kg/ha)	Harvest index (%)	Cost of cultivation	Gross return	Net return	B:C ratio
(A) Cultivars							
V_1:DCP 92-03	1790	3290	35	27465	104989	77424	3.8
V_2: JG-16	693	1924	26	23265	42247	18982	1.8
V_3: JG-11	771	1808	30	23265	46147	22882	1.9
S.E m.±	73	97	2		4019	4021	0.14
C.D.(P=0.05)	217	290	5		11942	11948	0.43
(A) Sulphur levels (kg S/ha^{-1})							
S_1:10	788	2186	26	23616	47871	24255	1.9
S_2 :20	1008	2373	29	24315	60268	35953	2.4
S_3:30	1122	2269	32	25015	66416	41401	2.8
S_4:40	1421	2534	34	25715	83289	57574	3.1
S.E. m.±	45	105	1		2541	2541	0.097
C.D.(P=0.05)	135	312	3		7549	7551	0.29

Economics

The highest gross and net income of Rs.104989/- and Rs 77524/- was recorded under (V_1) (DCP 92-03). The variety JG-16 (V_2) gave the minimum gross and net income. Under different varieties of chickpea, highest B:C ratio (3.805) was obtained from DCP 92-03 (V_1), Whereas minimum B:C ratio (1.80) under JG-16 (V_2) Under different levels of Sulphur 40 kg S/ha^{-1} (S_4) gave highest gross and net income of Rs.83289/ha^{-1} and Rs.57574 / ha^{-1} which is followed by 30 kg S/ha^{-1} (S_3) with Gross returns (Rs.66416/ha^{-1} and Net returns Rs.41401/ha^{-1}) and minimum (Gross returns Rs.47871 and Net returns Rs.24255/ha^{-1}) under 10 kg S/ha^{-1}(S_1). Highest net income of Rs.57574/ha^{-1} and B:C ratio (3.14) were recorded with 40 kg S/ha^{-1} (S_4) respectively (Table 1).

In conclusion, the variety DCP 92-03 gave higher seed yield, net returns an B:C ratio as compared to other varieties in the Kymore Plateau of Madhya Pradesh. Application of 40 kg S/ha^{-1} gave higher nodulation parameters. yield attributes and seed yield of chickpea. Maximum net return and B: C ratio was obtained under DCP 92-03 and Sulphur 40 kg S/ha^{-1}. The variety DCP 92-03 with Sulphur @ 40 kg S /ha^{-1} recorded significant maximum seed and straw yield and net return

of chickpea. Finally chickpea variety DCP 92-03 grown with 40 kg S/ha^{-1}+ 100% of RDF seed treatment by Rhizobium and PSB culture under Kymore Plateau of Madhya Pradesh was found best treatment for obtaining higher seed yield of chickpea with highest net returns and benefit cost ratio.

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