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Response of gram (*Cicer arietinum* L.) to STCR based fertilizer application

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Abstract
A field experiment was conducted during *rabi* season of 2020-2021 at Experimental Farm Agronomy section, Oilseeds Research Station, Latur, to assess the effect of STCR based N, P and K application on productivity of gram in vertisol. The topography of experimental field was uniform and leveled. The soil of experimental plot was clayey in texture, moderately alkaline in reaction having p^H 7.02 with chemical composition such as low in available nitrogen (231 kg ha^{-1}), very low in available phosphorous (8.55 kg ha^{-1}) and very high in available potassium (580.89 kg ha^{-1}). The experiment was laid out in Randomized Block Design. The seven treatments were replicated thrice. The application of N, P and K as per STCR + Vermicompost @ 2.5 t ha^{-1} + $ZnSO_4$ @ 20 kg ha^{-1} (T_6) recorded higher growth, yield attributes and seed yield which was at par with the application of N, P and K as per STCR + Vermicompost @ 2.5 t ha^{-1} (T_4) and 100% RDF + Vermicompost @ 2.5 t ha^{-1} + $ZnSO_4$ @ 20 kg ha^{-1} (T_5) and found significantly superior over rest of the treatments.

Keywords: gram, STCR, RDF, vermicompost, ZnSO4, control

Introduction

Chickpea (*Cicer arietinum* L.) is an annual pulse crop belongs to family Leguminaceae (Fabaceae) with sub family Papilionaceae. It is popularly known as bengal gram or gram or channa in India. Chickpeas are naturally low in fat and high in protein, dietary fiber, and carbohydrates. It contains 18-22% protein, 52-70% carbohydrate and 4-6% fat. It also rich in minerals, including phosphorus, magnesium, iron and zinc. India is an important pulse growing country therefore these crops are relevant for crop rotation and crop mixture followed by them. Chickpea conserve nitrogen for succeeding cereal crop up to 56-68 kg nitrogen per ha which is highest among all pluses (Ahlawat *et al.*, 1981) [1]. It is necessary to supply essential nutrient elements in appropriate proportion to maintain soil health and soil fertility and also to increase the crop production. Several approaches have been used for fertilizer recommendation based on chemical soil test so as to attain maximum yield per unit of fertilizer use. Among the various approaches, the target yield approach has found popularity in India (Subba Rao and Srivastava, 2000) [7]. This method not only estimates soil test based fertilizer dose but also the level of yield the farmer can achieve with that particular dose. It gives a real balance between applied nutrients and the available nutrients already present in the soil (Singh *et al.*, 2018) [5]. Fertilizer is one of the costly inputs in agriculture and the use of right amount of fertilizer is fundamental for farm profitability and environmental protection. Imbalanced uses of fertilizer by farmers not only reduce the yield of the crop but also deteriorate the quality of soil and water resource. In India generally the application of fertilizer is based on state level fertilizer recommendations, however the nutrient requirement of crops vary from place to place even from for the same crop. Crop fertilization based on generalized recommendation leads to under fertilization or over fertilization, which leads lower production, profitability along with environmental pollution. Enhancement of farm profitability under different soil climate condition it is necessary to have information on optimum fertilizer recommendation for different crop which are based on the soil test and crop response studies. Keeping in view, the present investigation entitled 'Response of gram (*Cicer arietinum* L.) to STCR based fertilizer application' was undertaken to assess the effect of STCR based N, P and K application on productivity of gram.

Material and Methods

A experiment was conducted during *rabi* season of 2020-2021 at Experimental Farm, Agronomy section, Oilseeds Research Station, Latur, to study the performance of gram (*Cicer arietinum* L.) to STCR based fertilizer application. The soil of experimental plot was clayey in texture, black in colour with good drainage. Soil was low in available nitrogen $^{-1}$ (231.00 kg ha^{-1}), very low in available phosphorous (8.55 kg ha^{-1}) and very high in available potassium (580.89 kg ha^{-1}). The soil was moderately alkaline in reaction having p^{H} 7.04. The experiment was laid out in Randomized Block Design. The seven treatments were replicated thrice. The treatments were T_1 : 100% RDF, T_2 : 100% RDF + Vermicompost @ 2.5 t ha^{-1}, T_3 : NPK as per STCR, T_4 : NPK as per STCR + Vermicompost @ 2.5 t ha^{-1}, T_5 : 100% RDF + Vermicompost @ 2.5 t ha^{-1} + $ZnSO_4$ @ 20 kg ha^{-1}, T_6 : NPK as per STCR + Vermicompost @ 2.5 t ha^{-1} + $ZnSO_4$ @ 20 kg ha^{-1}, T_7 : Control. The gross and net plot size of each experimental unit was 5.40 m x 4.50 m and 4.5 m x 3.9 m, respectively. Sowing was done by dibbling method by using seed rate 50 kg ha^{-1}. The recommended dose of fertilizer was 25: 50:30 kg NPK ha^{-1}. Fertilizers was given as per treatments. The required quantities of nitrogen, phosphorous and potassium were calculated with the help of STCR equation as follows:

STCR Equation (target yield 25 q ha^{-1}):

N (kg/ha) = (5.25 x Target yield t/ha) – (0.46 x available N kg/ha)

P (kg/ha) = (3.87 x Target yield t/ha) – (2.77 x available P kg/ha)

K (kg/ha) = (1.29 x Target yield t/ha) – (0.04 x available K kg/ha)

Results and Discussion

Growth attributes

Growth attributing characters viz., plant height (cm), number of branches and dry matter accumulation (g) plant-1 were influenced significantly due to different treatments (Table 1). Maximum plant height and number of branches per plant of gram were recorded with application of N,P and K as per STCR + Vermicompost @ 2.5 t ha^{-1} + $ZnSO_4$ @ 20 kg ha^{-1} (T_6) which was at par with the application of N, P and K as per STCR + Vermicompost @ 2.5 t ha^{-1} (T_4), 100% RDF + Vermicompost @ 2.5 t ha^{-1} + $ZnSO_4$ @ 20 kg ha^{-1} (T_5) and N, P and K as per STCR (T_3) and found significantly superior over rest of the treatments. These result could be due to the role of N and P in plant which accelerated various metabolic processes which reflect in greater apical growth, cell elongation and shoot development along with vermicompost which provide supplementary nutrient and enhanced nutrient availability with balanced fertilizer. Also these treatment might have facilitated the applied nutrients efficiently according to the need of crop and enriched nutrients reserved in soil which lead to better content of nutrients by the crop. Similar results were reported by Jadhav *et al.* (2009) [3], Tripathi *et al.* (2013) [8], Kumar *et al.* (2015) [4], and Singh *et al.* (2018) [5].

Maximum total dry matter plant^{-1} (g) of gram was recorded with application of N, P and K as per STCR + Vermicompost @ 2.5 t ha^{-1} + $ZnSO_4$ @ 20 kg ha^{-1} (T_6) which was at par with the application of N, P and K as per STCR + Vermicompost @ 2.5 t ha^{-1} (T_4) and 100% RDF + Vermicompost @ 2.5 t ha^{-1} + $ZnSO_4$ @ 20 kg ha^{-1} (T_5) and found significantly superior over rest of the treatments. This might be due to to greater availability of nutrients in soil leading to better absorption of nutrient which improve photosynthesis and translocation assimilates. Similar findings were reported by Singh *et al.* (2015) and Yadav *et al.* (2017) [9].

Yield and yield attributes

The yield attributing characters of gram *viz*., number of pods plant^{-1}, number of seeds plant^{-1}, number of seeds pod^{-}1, weight of pods plant^{-1} (g), seed yield plant^{-1} (g) and seed yield (kg ha^{-1}) were influenced significantly by different treatments (Table 2). Application of N, P and K as per STCR + Vermicompost @ 2.5 t ha^{-1} + $ZnSO_4$ @ 20 kg ha^{-1} (T_6) recorded significantly higher yield attributes and seed yield (kg ha^{-1}) which was at par with the application of N, P and K as per STCR + Vermicompost @ 2.5 t ha^{-1} (T_4) and 100% RDF + Vermicompost @ 2.5 t ha^{-1} + $ZnSO_4$ @ 20 kg ha^{-1} (T_5) and found significantly superior over rest of the treatments. These result could be attributed due to better translocation of assimilates towards sink. Application of N, P and K based on STCR equation with vermicompost and zinc sulphate enhanced the nutrient metabolism, biological activity and growth parameter which encourage vegetative branches and leads to increased in all yield attributes and final seed yield (kg ha^{-1}). Similar results were noticed in earlier findings of Jadhav *et al.* (2009) [3], Yadav *et al.* (2017) [9], Singh *et al.* (2018) [5] and Srivastav *et al.* (2019) [6].

Economics

Application of N, P and K as per STCR + Vermicompost @ 2.5 t ha^{-1} + $ZnSO_4$ @ 20 kg ha^{-1} (T_6) recorded significantly highest GMR (98443 ₹ ha$^{-1)}$ and NMR (57062 ₹ ha^{-1}) as compared to rest of the treatments. The higher benefit cost ratio (2.83) was also recorded by the application of N, P and K as per STCR (T_3) over rest of the treatments.

Table 1: Effect of different treatments on growth attributing characters of gram

Treatments	Plant height (cm) at harvest	No. of branches at harvest	Dry matter (g) at harvest
T_1 : 100% RDF	52.54	5.93	18.81
T_2 : 100% RDF + VC @ 2.5 t ha^{-1}	53.20	6.20	19.69
T_3 : NPK as per STCR	57.05	6.73	20.11
T_4 : NPK as per STCR + VC @ 2.5 t ha^{-1}	58.79	6.93	21.83
T_5 : 100% RDF + VC @ 2.5 t ha^{-1} + $ZnSO_4$ @ 20 kg ha^{-1}	57.94	6.80	21.76
T_6 : NPK as per STCR + VC @ 2.5 t ha^{-1} + $ZnSO_4$ @ 20 kg ha^{-1}	58.84	7.20	22.22
T_7: Control	48.35	5.73	18.24
SE ±	1.95	0.24	0.72
CD @ 5%	5.40	0.67	2.01
General mean	55.24	6.50	20.38

Table 2: Effect of different treatments on yield attributing characters and yield of gram

Treatments	Number of pods plant^{-1}	No. of seeds plant^{-1}	Number of seeds pod^{-1}	Weight of pods plant^{1}(g)	Seed yield plant^{-1} (g)	Seed Yield (kg ha^{-1})
T_1 : 100% RDF	44.40	57.00	1.47	12.07	8.26	1650
T_2 : 100% RDF + VC @ 2.5 t ha^{-1}	52.07	62.40	1.60	13.47	8.02	1693
T_3 : NPK as per STCR	56.07	64.20	1.67	14.04	9.05	1783
T_4 : NPK as per STCR + VC @ 2.5 t ha^{-1}	60.10	73.80	1.93	15.82	10.25	1868
T_5 : 100% RDF + VC @ 2.5 t ha^{-1} + $ZnSO_4$ @ 20 kg ha^{-1}	59.53	72.52	1.87	15.23	10.12	1849
T_6 : NPK as per STCR + VC @ 2.5 t ha^{-1} + $ZnSO_4$ @ 20 kg ha^{-1}	64.00	75.00	2.00	16.20	10.62	2009
T_7: Control	34.73	34.60	1.07	10.10	6.78	1348
SE ±	2.51	2.94	0.09	0.52	0.44	69
CD @ 5%	6.97	8.14	0.26	1.44	1.22	193
General mean	52.99	62.79	1.66	13.85	9.04	1743

Table 3: Gross monetary returns (₹ ha^{-1}), Cost of cultivation (₹ ha^{-1}), Net monetary returns (₹ ha^{-1}) and B:C ratio of gram as influenced by various treatments.

Treatment	Gross monetary returns (₹ ha^{-1})	Cost of cultivation (₹ ha^{-1})	Net Monetary (₹ ha^{-1})	B:C ratio
T_1 : 100% RDF	80867	34274	46593	2.36
T_2 : 100% RDF + VC @ 2.5 t ha^{-1}	82960	43024	39936	1.93
T_3 : NPK as per STCR	87382	30831	56551	2.83
T_4 : NPK as per STCR + VC 2.5 t ha^{-1}	91538	39581	51957	2.31
T_5 : 100% RDF +VC @ 2.5 ha^{-1} + $ZnSO_4$ @ 20 kg ha^{-1}	90580	44824	45756	2.02
T_6 : NPK as per STCR + VC 2.5 t ha^{-1} $ZnSO_4$ @ 20 kg ha^{-1}	98443	41381	57062	2.38
T_7 : Control	66046	29700	36346	2.22
SE ±	3405	-	3405	
CD @ 5%	9436	-	9436	
General mean	85402	37659	47743	2.3

Conclusion
From the above result it may be inferred that the application of NPK as per STCR + Vermicompost @ 2.5 t ha^{-1} + $ZnSO_4$ @ 20 kg ha^{-1} (T_6) recorded maximum growth, yield attributes and seed yield (kg ha^{-1}), GMR, NMR and B:C ratio in chickpea which was closely followed by application of NPK as per STCR + Vermicompost @ 2.5 t ha^{-1} (1868 kg ha^{-1}) T_4 and 100% RDF + Vermicompost @ 2.5 t ha^{-1} + $ZnSO_4$ @ 20 kg ha^{-1} (1849 kg ha^{-1}) T_5.

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