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Effect of graded levels of potassium on growth, yield and economics of greengram

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Abstract
The field experiment entitled with "Effect of graded levels of potassium on growth, yield and economics of greengram" was carried out during *Kharif* season of 2014 at Agronomy Farm, Department of Agronomy and Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. The objective of experiment is to investigate the effect of various potassium levels with addition of foliar spray of KCL (potassium chloride) on growth, yield and quality of greengram. The experiment findings revealed that growth traits *viz*., plant height (cm), number of branches plant^{-1}, dry matter plant^{-1} (gm) and chlorophyll content index were found significantly superior in the treatment with application of RDF + 40 kg K_2O ha^{-1} than rest of graded potassium level treatments. However, The yield and quality contributing attributes i.e. pod length (cm), Number of pods plant^{-1}, Number of seeds pod^{-1}, Weight of seeds plant^{-1}, 1000 seed wt (g) seed yield kg ha^{-1}, Straw yield kg ha^{-1}, Biological yield kg ha^{-1} and Protein content (%) were registered significantly superior in the treatment with application of RDF + 40 kg K_2O ha^{-1} than other graded potassium level treatments. On the basis of economics of experiment highest GMR (44489 Rs.ha^{-1}), NMR (26358 Rs.ha^{-1}) and B:C ratio(2.45) were noticed significantly highest in the treatment with application of RDF + 40 kg K_2O ha^{-1} over the remaining graded potassium level treatments.

Keywords: Greengram, RDF, Growth, Yield, Quality, Economics

Introduction
Pulses are least preferred by farmers because of high risk and less remunerative than cereals; consequently, the production of the pulses is significantly low to meet the demand of pulses. Majority of Indian population is vegetarian, pulses are cheap and best source of protein for Indian diet. It contains 20-25 per cent protein, which is more than two times of cereals. India is the major pulse growing country of the world accounting for one third of world acreage under pulses and one fourth of the world production. (Beg *et al*. 2013) [4].

It belongs to the family leguminaceae so it has the capacity to fix atmospheric nitrogen. It's one of the important *kharif* pulse crops of India which can be grown as catch crop between *rabi* and *kharif* seasons. India alone accounts for 65% of its world acreage and 54% of the total production. It is grown on about 3.50 M ha in the country mainly in Rajasthan, Maharashtra, Andhra Pradesh, Karnataka, Orissa and Bihar.

Greengram [*Vigna radiata* (L.)] is one of the important food legumes grown in India and third most important pulse crop of India after chickpea and pigeon pea. In India, the name greengram is more commonly used than mung bean. Mungbean is an excellent source of protein (25%) with high quality of lysine (460 mg/g) and tryptophan (60 mg/g). It also has remarkable quantity of ascorbic acid when sprouted and also have riboflavin (021 mg/100 g) and minerals (3.84 W 100 g). The total area under pulses is 23.63 mha with an annual production of 14.76 M tonnes in the country. In India green gram occupies 3.4 million hectare area and contributes to 1.4 million tonnes in pulse production (Anonymous. 2010-11). Mungbean contributes 14% in total pulse area and 7% in total pulse production in India. The low productivity of mungbean may be due to nutritional deficiency in soil and imbalanced external fertilization (Awomi *et al.*, 2012) [13].

Greengram also plays an important role in sustaining soil fertility by improving soil physical properties and fixing atmospheric nitrogen. It is a drought resistant crop and suitable for dry land farming and predominantly used as an intercrop with other crops. It is mostly consumed in Southern India. Considering its nutritional value and price, it is necessary to raise its production level and nutritional quality.

Methodology
A field experiment entitled "Effect of graded levels of potassium on growth, yield and economics of greengram" was conducted at the farm of Agronomy, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during *kharif* season of 2014. The experimental site was fairly

leveled and uniform in depth and topography. The soil was clayey in texture, slightly alkaline in nature, moderate in organic carbon, medium in available nitrogen, moderate in phosphorus and moderately high in available potassium. The experiment was laid out in Randomized Block Design with six treatments and each replicated four times. The graded potassium level treatments comprised as T_1- RDF (20:40 N P_2O_5 kg ha^{-1}), T_2- RDF + 20 kg K_2O ha^{-1}, T_3- RDF + 30 kg K_2O ha^{-1}, T_4- RDF + 40 kg K_2O ha^{-1}, T_5- RDF + Foliar spray of KCL 2% (At flowering), T_6- RDF + Foliar spray of KCL 2% (At flowering and time of pod formation). The fertilizers were applied as per treatments. The recommended dose of fertilizer (20 kg N and 40 kg P_2O_5) was applied through urea (46% N) and Diammonium phosphate (18:46 N:P_2O_5). The 20, 30 and 40 kg K_2O ha^{-1} was applied through Muriate of Potash (60% K) at the time of sowing. Foliar spray of KCL at 2% by using knap-sack sprayer was done at flowering and pod formation stage. All the growth and yield attributes were recorded using standard procedure and grain yield was calculated at 12% moisture content.

Results and Discussion

A. Growth parameter

The data presented in Table 1 revealed that among the graded potassium level treatment with application of RDF + 40 kg K_2O ha^{-1} (T_4) recorded significantly higher plant height (57.74 cm), number of branches $plant^{-1}$ (8.92), dry matter $plant^{-1}$(17.05 g) and chlorophyll content index (33.20) which was significantly superior over the treatment of T_1 - RDF (20:40 N:P_2O_5 kg ha^{-1}). However, it was found statistically at par with the treatment of T_3 - RDF + 30 kg K_2O ha^{-1}. However, treatment with application of RDF + 20 kg K_2O ha^{-1} (T_2) significantly influenced growth character and it being statistically at par with treatment RDF + Foliar spray of KCL 2% (At flowering and time of pod formation) (T_6). The effects of various graded levels of potassium on days to 50% flowering and days to maturity were found non significant in greengram.

Increase in growth parameters might be due to the potassium application, may be attributed due to strong exchange mechanism in soil, greater cell division and elongation, efficient nodulation and CO_2 assimilation. High root shoot ratio is associated with potassium uptake. Similar results were also obtained by Govindan and Thirumurugan (2000) [7], Sahai 2004), Asghar *et al*. (2006) [3], Hussain *et al.* (2011) [2, 8].

B. Yield attributes and yield

The data pertains to Table 2 showed on yield contributing character and yield under various graded potassium level treatments administered significant. The findings revealed that the yield attributes *viz.*, pod length (8.06 cm), number of pods $plant^{-1}$ (16.76), number of seeds pod^{-1} (9.38), weight of seeds plant $^{-1}$ (4.78), test weight (32.50 g) as well as seeds yield (924 kg ha^{-1}), straw yield (1940 kg ha^{-1}) and biological yield (2864 kg ha^{-1}) were recorded significantly highest with application of RDF + 40 kg K_2O ha^{-1} than rest of graded potassium level treatments and it was par with application of RDF + 30 kg K_2O ha^{-1}. However, application of RDF + 20 kg K_2O ha^{-1} was at par with RDF + foliar spray of KCL 2% (At flowering and time of pod formation). The protein content (23.62%) was significantly highest with the treatment RDF + 40 kg K_2O ha^{-1} which was at par with treatment RDF + 30 kg K_2O ha^{-1}. The treatment of RDF + 20 kg K_2O ha^{-1} was recorded higher protein percent which was at par with treatment RDF + Foliar spray of KCL 2% (At flowering and time of pod formation).

Increase in yield attributes *viz.*, pod length, number of pods $plant^{-1}$, number of seeds pod^{-1}, weight of seeds plant $^{-1}$, test weight optimum might be due to potassium application may be attributed strong exchange mechanism in soil, greater cell division and elongation, efficient nodulation and CO_2 assimilation. The higher photosynthetic surface for longer duration in crops receiving K might have resulted in enhanced photosynthetic activity and thus more metabolites are directed for the development of crop. Increase in seeds yield, straw yield and biological yield is in accordance with essential requirement for K in plant biochemistry and physiology, in the increased pods $plant^{-1}$ process including photosynthesis, water relationship protein synthesis and requirement for K in at least 60 different enzyme systems in the plant. seed yield of greengram is resultant product of yield attributing characters. Beneficial effect of potassium application on the yield attributes have increased the seed yield. Increase in protein content may be due to application of potassium might be attributed to the favourable influence of these nutrient on metabolism and biological activity and it's stimulating effect on photosynthetic pigments and enzyme.

These results are in agreement with the findings of Borse *et al.* (2002) [5], Thalooth *et al.* (2006) [11], Farhad *et al.* (2010) [6], Abbas *et al.* (2011) [2], Hussain *et al.* (2011) [2, 8], Beg *et al.* (2013) [4] and Ibrahim and Bassyuni (2012).

C. Economics

The data on economics of greengram under graded potassium level treatments are presented in table 3. The experimental findings revealed that gross monetary returns(44489 Rs.ha^{-1}), net monetary returns(26358 Rs.ha^{-1}) and B:C ratio(2.45) was observed highest with treatment RDF + 40 kg K_2O ha^{-1} and followed by RDF + 30 kg K_2O ha^{-1},RDF + 20 kg K_2O ha^{-1} and RDF + Foliar spray of KCL 2% (At flowering and time of pod formation).

Table 1: Growth parameter of greengram as influenced by various treatments

Treatments	Plant height (cm)	Number of branches $plant^{-1}$	Dry matter (g) $plant^{-1}$	Chlorophyll content Index (%)	Days to 50% flowering	Days to maturity
T_1– RDF (20:40 N:P_2O_5 kg ha^{-1})	48.58	7.68	12.55	26.10	41.72	68.29
T_2 – RDF + 20 kg K_2O ha^{-1}	54.34	8.46	15.11	31.07	41.63	68.12
T_3 – RDF + 30 kg K_2O ha^{-1}	56.02	8.64	16.36	32.05	41.60	68.02
T_4 – RDF + 40 kg K_2O ha^{-1}	57.74	8.92	17.05	33.20	41.56	67.91
T_5 – RDF + Foliar spray of KCL 2% (at flowering)	50.90	7.98	14.39	27.98	41.77	68.26
T_6 – RDF + Foliar spray of KCL 2% (at flowering and time of pod) formation)	52.71	8.22	13.44	30.18	41.69	68.18
SE (m) ±	0.96	0.13	0.32	0.68	0.36	0.14
CD at 5%	2.88	0.40	0.97	2.04	NS	NS

GM	53.38	8.31	14.82	30.10	41.66	68.13

Table 2: Yield contributing character and yield of greengram as influenced by various treatments

Treatments	Pod length (cm)	No. of pods plant^{-1}	No. of seeds pod^{-1}	Weight of seeds plant^{-1} (g)	Test wt. (1000) seeds (g)	Seed yield (kg ha^{-1})	Straw Yield (kg ha^{-1})	Biological yield (kg ha^{-1})
T_1 – RDF (20:40 N:P_2O_5 kg ha^{-1})	7.52	14.90	8.62	3.72	31.05	715	1558	2273
T_2 – RDF + 20 kg K_2O ha^{-1}	7.82	15.96	9.04	4.36	31.64	842	1794	2636
T_3 – RDF + 30 kg K_2O ha^{-1}	7.96	16.22	9.20	4.54	32.14	880	1848	2728
T_4 – RDF + 40 kg K_2O ha^{-1}	8.06	16.76	9.38	4.78	32.50	924	1940	2864
T_5 – RDF + Foliar spray of KCL 2% (at flowering)	7.60	15.33	8.73	4.02	31.26	773	1624	2393
T_6 – RDF + Foliar spray of KCL 2% (at flowering and time of pod formation)	7.75	15.54	8.86	4.20	31.48	817	1709	2526
SE (m) ±	0.07	0.20	0.09	0.08	0.12	22	40	66
CD at 5%	0.20	0.60	0.27	0.24	0.36	66	120	200
GM	7.78	15.78	8.97	4.27	31.68	825	1745	2570

Table 3: Gross monetary returns (Rs.ha^{-1}), Net monetary returns (Rs.ha^{-1}), Benefit: cost ratio of greengram as influenced by various treatments

Treatments	Cost of cultivation (Rs.ha^{-1})	Gross monetary returns (Rs.ha^{-1})	Net monetary Returns (Rs.ha^{-1})	Benefit cost ratio
T_1 – RDF (20:40 N:P_2O_5 kg ha^{-1})	16998	34512	17514	2.03
T_2 – RDF + 20 kg K_2O ha^{-1}	17565	40581	23016	2.31
T_3 – RDF + 30 kg K_2O ha^{-1}	17848	42372	24524	2.37
T_4 – RDF + 40 kg K_2O ha^{-1}	18131	44489	26358	2.45
T_5 – RDF + Foliar spray of KCL 2% (at flowering)	17528	37221	19693	2.12
T_6 – RDF + Foliar spray of KCL 2% (at flowering and time of pod formation)	18058	39328	21270	2.18
SE (m) ±	-	966	966	-
CD at 5%	-	2911	2911	-
GM	17688	39751	22063	2.24

Conclusion

On the basis of above finding it can be concluded that application of RDF + 40 kg K_2O ha^{-1} significantly enhanced the growth contributing characters *viz.*, plant height, number of branches plant^{-1}, dry matter partitioning, chlorophyll content index of greengram. The highest yield and yield attributing characters *viz.*, pod length, number of pods plant^{-1}, number of seed pod^{-1}, weight of seeds plant $^{-1}$, test weight, seeds yield, straw yield and biological yield of greengram were recorded with application of RDF + 40 kg K_2O ha^{-1}. Protein percent of greengram was found higher in treatment RDF + 40 kg K_2O ha^{-1}. Economics of experiment was recorded maximum with application of RDF +40 kg K_2O ha^{-1}.

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