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RESEARCH PAPER

Effect of different levels of potassium on yield, quality, available nutrient and uptake of blackgram

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Abstract : A field experiment was conducted on PKVU-15 blackgram during the *Kharif* season of 2013 at Pulse Research Unit, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola to study the effect of potassium on yield, quality, available nutrient status and its uptake of blackgram. Yield quality, nutrient status and its uptake of blackgram were significantly increased due to increased level of potassium fertilizer. RDF + 40 kg K_2O ha^{-1} significantly improved the quality of seed, available nutrient status and nutrient uptake of blackgram over the application of RDF only. Treatment RDF + 40 kg K_2O ha^{-1} was at par with RDF + 30 kg K_2O ha^{-1} and RDF + 20 kg K_2O ha^{-1}, treatment RDF + Foliar spray of KCl 1.5 per cent (at flowering and 10-15 days after flowering) significantly improved the quality of blackgram and nutrient uptake over the application of RDF (20:40 N:P kg ha^{-1}) only. This treatment was at par with soil applied RDF+ 20 kg K_2O ha^{-1}.

Key Words : Blackgram, Foliar spray, Nutrient uptake, Quality, Potassium

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INTRODUCTION

Soil fertility and its evaluation is one area which needs immediate attention since, it is now established that an arrest in the productivity of several crops is due to ever decreasing soil fertility on one hand and an imbalanced application of plant nutrients on the other. The deficiency of several major and minor plant nutrients such as K, S, Ca, Zn, Fe and B are emerging in time and space (Rao, 2010 a and b; Rao and Vittal, 2007).

K application has been neglected in many developing countries, including India, which has resulted in soil K depletion in agricultural ecosystems and a decline in crop yields (Regmi *et al*., 2002; Panaullah *et al*., 2006). Higher yields and crop quality can be obtained at optimal N:K nutritional ratios. K is an essential macronutrient required for proper development of plants. In addition to activation of numerous enzymes, K plays an important role in the maintenance of electrical potential gradients across cell membranes and the generation of turgor. It is also essential for photosynthesis, protein synthesis and regulation of stomatal movement and is the major cation in the maintenance of cation-anion balances (Marschner, 1995).

N is probably the major agronomic stimulant to crop growth within the farmer's armoury. But to exploit its maximum use efficiently for increasing crop production, the crop must have access to, and take up, an adequate amount of K from the plant-available (exchangeable K) pool of K in the soil. This is because there is a strong interaction between these two nutrients in crop growth. Crop response to applied fertilizer N decreases when the exchangeable K content of a soil is below a critical target level. Because of this interaction, there is little point in applying large amounts of N when soil is low in available K, because N is used inefficiently and causes

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financial losses to the grower. There is also the risk that any excess unused fertilizer N lost from the soil will have adverse effects on the environment.

Among several strategies to improve NUE, balanced nutrition, particularly balancing N and K nutrition and tapping into the synergistic effect between N and K, is important both in irrigated as well as rainfed production system.

Blackgram 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. In contrast less work has been undertaken with the consideration of other plant nutrients, thus, now a days it is necessary to emphasize potassium study in pulses and blackgram crops in particular and that of cereals, oilseeds in general.

MATERIAL AND METHODS

A field experiment was conducted on PKVU-15 blackgram at Pulse Research Unit, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during the *Kharif* season of 2013. The total rainfall received during the crop season was 540.3 mm as against normal of 619.7 mm. Experimental soil was clayey in texture. The initial soil was low in available nitrogen (238 kg ha^{-1}), medium in available phosphorus (19.10 kg ha^{-1}) and high in potash (382 kg ha^{-1}). The soil was moderate in organic carbon (0.53 %) and slightly alkaline in nature with pH 8.1.

An experiment was laid out in Randomized Block Design with four replications and six treatments. Treatments consisted of RDF (20:40 N:P kg ha^{-1}) (T_1), RDF+ 20 kg K_2O ha^{-1} (T_2), RDF+ 30 kg K_2O ha^{-1} (T_3), RDF+ 40 kg K_2O ha^{-1} (T_4), RDF + foliar spray of KCL 1.5 per cent (at flowering and 10-15 days after flowering) (T_5) and RDF + foliar spray of KCL 1.5 per cent (at flowering) (T_6).

Sowing of blackgram was taken up on14th June, 2013. The sowing was undertaken by drilling method keeping 45 cm distances between two rows, while plant to plant distance was maintained 10 cm. Recommended package of practices were followed. Seed of blackgram was treated with Trico derma @ 5g kg^{-1} and seeds were inoculated with *Rhizobium* and PSB culture @ 25 g kg^{-1} of seeds. Observations on yield attributes were recorded at harvest of crop.

The data recorded pertaining to grain yield, nutrient uptake and quality parameters were analyzed statistically for interpreting the results. In order to know the nutrient status of the experimental site, the soil samples to the depth of 0-30 cm were randomly collected from the experimental site before sowing and after harvesting of crop. For nutrient uptake, the plant samples were collected at the time of harvesting. The analysis of soil and plant samples was carried out as per the standard methods.

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Yield :

The data pertaining to yield attributes revealed that, the highest grain and straw yield (1202 kg ha^{-1}) and (2230 kg ha^{-1}), respectively was observed in treatment RDF +40 kg K_2O ha^{-1} this treatment was at par with RDF +30 kg K_2O ha^{-1} and RDF +20 kg K_2O ha^{-1}. Treatment RDF + Foliar spray of KCl 1.5 per cent (at flowering and 10-15 days after flowering) was recorded significantly higher grain and straw yield over the RDF alone control treatment, this treatment was at par with soil applied RDF +20 kg K_2O ha^{-1}. Increase in grain yield might may be due to grain yield is resultant product of yield attributing characters, increase in straw yield with the application RDF + K_2O might have attributed to the higher photosynthetic activity in blackgram plant leading to better supply of carbohydrates resulted in more number of branches and dry matter. Similar results were obtained by Farhad *et al.* (2010); Hussain *et al.* (2011) and Thesiya *et al.* (2013).

Quality :

The data shown in the Table 1 revealed that, application of RDF + 40 kg K_2O ha^{-1} and RDF + foliar spray of KCl 1.5 per cent (at flowering and 10-15 days after flowering) recorded significantly higher protein content (22.16%) and (20.47), respectively over the RDF alone control treatment. Treatment RDF + 40 kg K_2O ha^{-1} was at par with RDF + 30 kg K_2O ha^{-1} and RDF + 20 kg K_2O ha^{-1}, treatment RDF + foliar spray of KCL 1.5 per cent (at flowering and 10-15 days after flowering) was at par with soil applied RDF + 20 kg K_2O ha^{-1}, 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 activity which in turn encourage vegetative growth and yield of plants and consequently protein content per cent. These results are in agreement with the findings of Farhad *et al.* (2010); Hussain *et al.* (2011) and Ibrahim and Bassyuni (2012).

Available N, P, K :

The data pertaining to nutrient status of soil revealed that, application of RDF + K_2O recorded higher available N, P and K than only RDF applied treatment. Application of RDF + 40 kg K_2O ha^{-1} recorded significantly higher available N, P and K, RDF + 40 kg K_2O ha^{-1} was at par with RDF + 30 kg K_2O ha^{-1} and RDF + 20 kg K_2O ha^{-1}. Increase in NPK because potassium have synergistic effect on nitrogen therefore, increased the availability of nitrogen in soil, phosphorus

content increased due to the application of potassium which indicate better phosphorus use efficiency. Similar results were noted by Borse *et al.* (2002) and Ibrahim *et al.* (2012).

N, P and K uptake :

The data shown in the Table 2 revealed that, application of RDF + K_2O recorded higher N, P and K uptake than the application of RDF only. Highest total uptake of N (64.44 kg ha^{-1}), P (8.77 kg ha^{-1}) and K (25.25 kg ha^{-1}) in blackgram was recorded with application of RDF + 40 kg K_2O ha^{-1} this treatment was at par with RDF + 30 kg K_2O ha^{-1}. Treatment RDF + foliar spray of KCl 1.5 per cent (at flowering and 10-15 days after flowering) also significantly increased the uptake of NPK over the application of RDF only; this treatment was at par with soil applied RDF + 20 kg K_2O ha^{-1} (Table 3). Similar findings were also reported by Singh and Kumai (1990) and Singh *et al.* (1993).

Conclusion :

It can be concluded that significantly highest yield and uptake of NPK was deliberated with treatment of fertilizer consisting recommended dose of fertilizer with 40 kg ha^{-1} of potassium application. It was followed by treatment where potassium was applied to an extent of 30 kg ha^{-1} and 20 kg ha^{-1}. RDF + foliar spray of KCl 1.5 per cent (at flowering and 10-15 days after flowering) was significantly increased the yield and uptake of NPK over the application of RDF only, this treatment was at par with soil applied RDF+20 kg K_2O ha^{-1}.

Table 1 : Yield and quality of blackgram as influenced by various treatments

Treatments	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Protein content (%)
T_1 – RDF (20:40 N:P_2O_5 kg ha^{-1})	966	1882	18.98
T_2 – RDF + 20 kg K_2O ha^{-1}	1114	2152	21.34
T_3 – RDF + 30 kg K_2O ha^{-1}	1170	2190	21.83
T_4 – RDF + 40 kg K_2O ha^{-1}	1202	2230	22.16
T_5 – RDF + Foliar spray of KCL 1.5% (at flowering and 10-15 days after flowering)	1100	2140	20.47
T_6 – RDF + Foliar spray of KCL 1.5% (at flowering)	1004	1947	19.50
S.E. ±	29.68	28.19	0.47
C.D. (P=0.05)	89.46	84.98	1.43

Table 2 : Available N, P and K in soil as influenced by various treatments

Treatments	Available N (kg ha^{-1})	Available P (kg ha^{-1})	Available K (kg ha^{-1})
T_1 – RDF (20:40 N:P_2O_5 kg ha^{-1})	245.75	20.55	379.37
T_2 – RDF + 20 kg K_2O ha^{-1}	255.35	23.51	392.67
T_3 – RDF + 30 kg K_2O ha^{-1}	259.5	24.26	394.63
T_4 – RDF + 40 kg K_2O ha^{-1}	261.5	24.66	395.9
T_5 – RDF + Foliar spray of KCL 1.5% (at flowering and 10-15 days after flowering)	248.75	21.02	379.14
T_6 – RDF + Foliar spray of KCL 1.5% (at flowering)	247.25	20.93	379.42
S.E. ±	2.15	0.40	1.16
C.D. (P=0.05)	6.48	1.19	3.51

Table 3 : N, P and K uptake as influenced by various treatments

Treatments	N uptake (kg ha^{-1})			P uptake (kg ha^{-1})			K uptake (kg ha^{-1})		
	Grain	Straw	Total	Grain	Straw	Total	Grain	Straw	Total
T_1 – RDF (20:40 N:P_2O_5 kg ha^{-1})	29.31	5.67	34.98	2.53	1.93	4.46	6.27	9.60	15.87
T_2 – RDF + 20 kg K_2O ha^{-1}	38.00	16.58	54.59	4.11	3.39	7.49	8.75	13.50	22.24
T_3 – RDF + 30 kg K_2O ha^{-1}	40.86	18.33	59.19	4.54	3.61	8.15	9.53	14.75	24.27
T_4 – RDF + 40 kg K_2O ha^{-1}	42.64	21.80	64.44	4.81	3.96	8.77	9.93	15.32	25.25
T_5 – RDF + Foliar spray of KCL 1.5% (at flowering and 10-15 days after flowering)	36.01	13.61	9.62	3.61	3.00	6.60	8.23	12.62	20.86
T_6 – RDF + Foliar spray of KCL 1.5% (at flowering)	31.29	7.44	38.73	2.81	2.19	5.01	6.84	11.10	17.95
S.E. ±	1.13	2.37	2.71	0.24	0.21	0.29	0.24	0.68	0.70
C.D. (P=0.05)	3.40	7.15	8.14	0.73	0.64	0.88	0.74	2.04	2.11

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