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EFFECT OF SOIL AND FOLIAR POTASSIUM FERTILIZATION ON GROWTH AND YIELD OF BLACKGRAM

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ABSTRACT

A field experiment was conducted at S.V. Agricultural College Farm, Tirupati, Acharya N.G. Ranga Agricultural University, Andhra Pradesh, India during *rabi*, 2021-22 to study the effect of soil and foliar potassium fertilization on growth and yield of blackgram. The treatments consists of three potassium levels as first factor *viz*., 20, 30, 40 kg K_2O ha^{-1} and five foliar sprays as second factor *viz*., no foliar spray, water spray at flowering and pod development stages, 0.5% KNO_3 at flowering and pod development stages, 1% KCl at flowering and pod development stages and 1% KH_2PO_4 at flowering and pod development stages imposed in a randomized block design with factorial concept and replicated thrice. Among the potassium levels tried, soil application of 40 kg K_2O ha^{-1} resulted in taller plants, higher drymatter production, seed yield and haulm yield, which was comparable with soil application of 30 kg K_2O ha^{-1}. Among different foliar sprays tried, tallest plants, higher drymatter, seed yield and haulm yield were recorded with application of 1% KH_2PO_4 at flowering and pod development stages, which was on par with 1% KCl and 0.5% KNO_3 at flowering and pod development stages.

KEY WORDS: Blackgram, Potassium, Growth and Yield.

INTRODUCTION

In India, blackgram is a major pulse crop grown in both *kharif* and *rabi* seasons, as a sole crop or intercrop or fallow crop. It is famous for its nutritional quality having rich protein (26.20%), carbohydrates (56.60%), fats (1.20%), minerals, vitamins, amino acids and phosphoric acid (Shashikumar *et al*., 2013). Blackgram is mostly grown 'on marginal and submarginal lands' without proper inputs and management practices. Imbalanced nutrition is one of the 'major cause for the lower productivity of blackgram. Potassium application is being neglected inspite of its requirement in larger quantities by the blackgram, which is leading to the depletion of soil potassium reserves. Potassium removal from the soil is as much as or higher than nitrogen but still its use in fertilizer is negligible for blackgram (Chaudhari *et al*., 2018). However, because of field level potassium 'responses and awareness' of soil K depletion under intensive cereal-pulse cropping systems, the importance of potassium fertilization has recently gained importance.

Foliar nutrition provides an excellent way for the absorption of nutrients as it can be applied directly to the site of metabolism through translocation of nutrients from leaves to all parts there by helping in synchronizing flowering as well as pod setting. It increases yield from 12.00 to 25.00 % and on the other side more than 90.00% of the fertilizer applied is utilized by the plant. (Pooja and Meena, 2020). Foliar feeding of nutrients minimizes environmental pollution by reducing the amount of fertilizers added to 'the soil and also enhances the yield and quality of produce.'

MATERIAL AND METHODS

A field experiment was conducted during *rabi,* 2021-22 at Wetland Farm of S.V. Agricultural College, Tirupati, Acharya N. G. Ranga Agricultural University which is located in the Southern Agro-Climatic Zone of Andhra Pradesh, at 13.5°N latitude and 79.5°E longitude and at an altitude of 182.9 m above the mean sea level. The soil of the experimental field was sandy loam in texture, neutral in reaction, low in organic carbon (0.21 %) and available nitrogen (172.9 kg ha^{-1}), medium in available phosphorus (29 kg ha^{-1}) and available potassium (193.4 kg ha^{-1}). The experiment was laid out in randomized block design with a factorial concept and replicated thrice. Treatments include three potassium levels *viz.,* 20 kg K_2O ha^{-1} (K_1), 30 kg K_2O ha^{-1} (K_2) and 40 kg K_2O ha^{-1} (K_3) as the first factor and five foliar sprays *viz.,* No foliar spray

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(F_1), Water spray at flowering and pod development stages (F_2), 0.5 % KNO_3 at flowering and pod development stages (F_3), 1% KCl at flowering and pod development stages (F_4) and 1% KH_2PO_4 at flowering and pod development stages (F_5), as the second factor. The crop was sown at 30 cm × 10 cm spacing with a seed rate of 25 kg ha^{-1}. The variety TBG-104 was sown on 23rd of October and recommended dose of the fertilizer 20 kg N : 50 kg P_2O_5 ha^{-1} was applied uniformly to all the treatments. All the other recommended practices were also adopted as per the crop requirement. The collected data were statistically analyzed following the analysis of variance for randomised block design with factorial concept as given by Panse and Sukhatme (1985).

RESULTS AND DISCUSSION

Plant height and Leaf area index

At harvest, soil application of 40 kg K_2O ha^{-1} (K_3) recorded the highest plant height and leaf area index, which was on par with soil application of 30 kg K_2O ha^{-1} (K_2). Significantly lowest plant height was recorded with soil application of 20 kg K_2O ha^{-1} (K_1). Among the different foliar fertilization treatments, foliar application of 1% KH_2PO_4 at flowering and pod development stages (F_5) recorded the highest plant height and leaf area index, which was however comparable with foliar application of 1% KCl at flowering and pod development stages (F_4) and 0.5% KNO_3 at flowering and pod development stages (F_3) (Table 1). The plant stature and leaf area index was lower with no foliar spray (F_1), which was on par with water spray at flowering and pod development stages (F_2).

The increase in plant height with an application of potassium, either through soil or through foliar fertilization, could be attributed to the reason that potassium is known to augment cell division and cell expansion in plants by stimulating the biological activity of photosynthetic pigments and enzymes which in turn promotes the vegetative growth of the plant. These results are in line with Hussain *et al*. (2011) and Thalooth *et al*. (2006). Foliar application of nutrients at the hour of need might have enabled the plants to maintain high chlorophyll content, leaf area per plant and ultimately higher leaf area index

Dry matter production

With regard to the different potassium levels tried, the highest dry matter production was recorded with soil application of 40 kg K_2O ha^{-1} (K_3), followed by soil application of 30 kg K_2O ha^{-1} (K_2) with no significant difference between them. Significantly lowest dry matter production was recorded with soil application of 20 kg K_2O ha^{-1} (K_1).

Among the foliar sprays tried, the highest dry matter production was recorded with foliar application of 1% KH_2PO_4 at flowering and pod development stages (F_5), which was on par with foliar application of 1% KCl at flowering and pod development stages (F_4) and 0.5% KNO_3 at flowering and pod development stages (F_3). Significantly lowest dry matter production was noticed with no foliar spray (F_1), followed by water spray at flowering and pod development stages (F_2) (Table 1).

Nitrogen and potassium are synergistic with each other, that helps to improve nitrogen content and use efficiency, that aids in maintaining higher auxin levels in plant with soil and potassium fertilization, which in turn might have resulted in better plant height, leaf area and chlorophyll content. Increased plant height and leaf area might have resulted in a better interception, absorption and utilization of radiant energy, leading to a higher photosynthetic rate and ultimately higher accumulation of dry matter by the plants. The results are in line with those results observed by Shashikumar *et al*. (2013) in blackgram and Maheswari and Karthik (2017).

Seed yield

Among the different potassium levels, soil application of 40 kg K_2O ha^{-1} (K_3) recorded the highest seed yield, which was on par with soil application of 30 kg K_2O ha^{-1} (K_2). The seed yield of blackgram was significantly lowest with soil application of 20 kg K_2O ha^{-1} (K_1).

Foliar application of different potassium salts at flowering and pod development stages increased the seed yield over no foliar spray (F_1) and water spray at flowering and pod development stages (F_2). Among the different foliar sprays, the highest seed yield was recorded with foliar spray of 1% KH_2PO_4 at flowering and pod development stages (F_5), which was statistically on par with foliar spray of 1% KCl at flowering and pod development stages (F_4) and 0.5% KNO_3 at flowering and pod development stages (F_3). Significantly lowest seed yield of blackgram was recorded with no foliar spray (F_1), which was on par with water spray at flowering and pod development stages (F_2) (Table 1).

Table 1. Effect of soil and foliar potassium fertilization on growth and yield of blackgram

Treatments	Plant height at harvest (cm)	Leaf area index at harvest	Drymatter production at harvest (kg ha^{-1})	Seed yield (kg ha^{-1})	Haulm yield (kg ha^{-1})
Potassium levels (K)					
K_1 : 20 kg K_2O ha^{-1}	40.5	1.58	3616	1572	1682
K_2 : 30 kg K_2O ha^{-1}	43.3	1.94	3978	1702	1856
K_3 : 40 kg K_2O ha^{-1}	45.0	2.03	4130	1724	1884
SEm±	0.93	0.043	115.2	34.6	41.3
CD (P = 0.05)	**2.6**	**0.11**	**334**	**100**	**120**
Foliar nutrition (F)					
F_1 : No foliar spray	39.6	1.50	3492	1514	1695
F_2 : Water spray at flowering and pod development stages	40.1	1.53	3562	1557	1705
F_3 : KNO_3 @ 0.5 % at flowering and pod development stages	44.0	1.99	4016	1707	1871
F_4 : KCl @ 1 % at flowering and pod development stages	45.1	2.06	4174	1770	1876
F_5 : KH_2PO_4 @ 1 % at flowering and pod development stages	45.9	2.13	4295	1780	1891
SEm±	1.20	0.054	148.7	44.7	53.3
CD (P = 0.05)	**3.5**	**0.14**	**431**	**175**	**154**
Interaction (K × F)					
SEm±	2.08	0.094	257.5	77.4	92.3
CD (P = 0.05)	NS	NS	NS	NS	NS

The positive effect of soil and foliar potassium application on seed yield could be due to the availability of more potassium ions, which might have enhanced the photosynthesis process by activating ATPase enzyme, which plays a major role in photosynthesis and facilitated better partitioning of photosynthates, that led to increased growth and yield attributes and finally seed yield. These results were corroborated with the findings of Vekaria *et al*. (2013), Sakpal (2015) and Goud *et al*. (2014).

Haulm yield

The haulm yield of blackgram was significantly influenced by soil and foliar potassium fertilization, while the interaction effect was not statistically traceable.

With regard to the potassium levels tried, the highest haulm yield was recorded with soil application of 40 kg K_2O ha^{-1} (K_3), followed by 30 kg K_2O ha^{-1} (K_2) with no significant difference between them. Significantly lowest haulm yield was recorded with soil application of 20 kg K_2O ha^{-1} (K_1). Among the foliar sprays, the highest haulm yield was recorded with foliar application of 1% KH_2PO_4 at flowering and pod development stages (F_5), which was on par with foliar application of 1% KCl at flowering and pod development stages (F_4) and 0.5 % KNO_3 (F_3) at flowering and pod development stages. Significantly lowest haulm yield was noticed with no foliar spray (F_1), which was at par with water spray at flowering and pod development stages (F_2) (Table 1). The positive effect of potassium on haulm yield might be due to the pronounced role of potassium in photosynthesis, cell elongation and efficiently assimilate translocation that ultimately increased dry matter production as reflected in the form of higher haulm yield. Similar results were shown by Sakpal (2015) and Takankhar *et al*. (2017).

It can be concluded that from the above study application of RDF (20 : 50 kg N, P_2O_5 kg ha^{-1} + soil application of 40 kg K_2O or 30 kg K_2O ha^{-1} along with the foliar spray of 1% KH_2PO_4 or 1% KCl or 0.5% KNO_3 at flowering and pod development stages improved the growth and yield of blackgram.

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