Plant Archives Vol. 20 Supplement 1, 2020 pp. 1035-1038 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

EFFECT OF MURAITE OF POTASH ON GROWTH, YIELD AND AVAILABLE NUTRIENT UPTAKE OF BLACK GRAM (VBN-3) IN THE COASTAL SOILS OF TAMILNADU, INDIA

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Abstract

Field experiment was conducted at farmer's field in Sivapuri village, Chidambaram taluk, Cuddalore district, Tamilnadu, to study the effect of different levels of potassium on growth, yield and available nutrient and uptake of black gram. The treatments were T_1 - Absolute control, T_2 - Control (-K), T_3 - 12.5 kg of K_2O ha^{-1}, T_4 - 25 kg of K_2O ha^{-1}, T_5 -37.5 kg of K_2O ha^{-1}, T_6 -50 kg of K_2O ha^{-1}, T_7 - 62.5 kg of K_2O ha^{-1}, T_8 - 75 kg of K_2O ha^{-1}. The results of the experiment indicated that application of T_6 - 50 kg ha^{-1} of K_2O significantly enhanced the higher the growth characters, yield attributes of black gram, further were reduced.

Key words : Blackgram, Yield attributes, Nutrient uptake, Potassium.

Introduction

Blackgram (*Vigna mungo* L. Hepper) is the third important pulse crop of India which is cultivated over a wide range of agro-climatic zones of the country. It grows well in both abnormal and normal weather situation. It occupies about 3.25 million ha area in the country producing 1.5 million tones of seed with average productivity of 462 kg/ha. Kota district of Rajasthan occupies 13441 ha area with average productivity of 800 kg/ha of urd which is slightly higher against the Rajasthan average productivity of 516 kg/ha (GOR, 2012). Black gram is cultivated in 4.56 lakh hectares of area with a production of 2.36 lakh tonnes and the average productivity is 518 kg ha^{-1} in Tamilnadu. The average productivity of pulses in Tamilnadu is very low when compared to India's average of 610 kg ha^{-1}. Production of black gram is low in general due to poor management and low soil fertility status. Madhya Pradesh, Maharashtra, Uttar Pradesh, Tamil Nadu, Orissa and Gujarat are the main black gram growing states of India. The productivity potential of pulses is not realized and the reasons for low productivity of blackgram are large scale cultivation under rainfed and marginal lands and may be under low input conditions (Rathore, 2002). Among all the yield limiting factors, fertility management is imperative to ensure better crop production on exhausted soils as nutrients play a vital role in increasing the seed yield in pulses (Chandrasekhar and Bangarusamy, 2003). Potassium 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. Potassium 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 it is the major cation in maintenance of cation-anion balances (Marschner, 1995).

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Material and Methods

Field experiment was conducted in the farmer's field at Sivapuri village near Chidambaram, Cuddalore district, Tamil Nadu. The experimental farm is geographically situated at 11°38' North latitude and 79°70' East longitude and at an altitude of ±5.79m above mean sea level and 6km away from Bay of Bengal. It is characterized by tropical climate with a mean annual rainfall of 1500mm distributed over 57 rainy days. Out of these, 22.97 percent (344.55 mm) is received during South-West monsoon (June-September), 69.13 percent (1036.95 mm) during North-East monsoon (October-December), 3.9 percent (58.50 mm) during winter season (January-February) and the remaining 4 percent (60.00 mm) during summer months (March-April). The maximum temperature ranges from 30.1°C to 39.2°C with a mean of 34.2°C, the minimum temperature ranges from 18.9°C to 28.6°C with a mean of 24.2°C and relative humidity ranges from 79 to 90 percent. The experimental design adopted in the study was randomized block design with three replications and eight treatments. The treatments were T_1 - Absolute control, T_2 - Control (-K), T_3 - 12.5 kg of K_2O ha^{-1}, T_4 - 25 kg of K_2O ha^{-1}, T_5 - 37.5 kg of K_2O ha^{-1}, T_6 - 50 kg of K_2O ha^{-1}, T_7 - 62.5 kg of K_2O ha^{-1}, T_8 - 75 kg of K_2O ha^{-1}. The soils of Sivapuri village was found to contain soil separates of 29.2, 39.4, 30.5 percent sand, silt and clay respectively. The soils are classified under the textural class clay loam. The bulk density, particle density, pH, electrical conductivity and cation exchange capacity of the soil were 1.38 Mg m^{-3}, 2.50 Mg m^{-3}, 7.60 dsm^{-1}, 0.86 dsm^{-1} and 22.4 c mol (p^+) kg^{-1} respectively. Organic carbon content of the soil was 3.9 g kg^{-1}. Available N, P and K content of the soil were 235.0, 14.0 and 170 kg ha^{-1} respectively, available sulphur content was 8.5 mg kg^{-1} and the exchangeable calcium, magnesium, potassium and sodium contents were 8.8, 8.2, 3.8 and 0.9 c mol (p^+) kg^{-1} respectively. 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 0-30cm 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 and calculated by following formulae.

$$Nutrient uptake by\ plant\,(Kg\,ha^{-1}) = \frac{Nutrient content}{100} \times DMP$$

Nutrient uptake by plant (kg ha^{-1}) = Nutrient content % / 100 × DMP

Results and Discussion

The results obtained from the present investigation as well as relevant discussion are discussed below:

Plant height (cm)

The treatments T_1 recorded the lowest plant height of 22.1cm and the treatment T_6 recorded the highest plant height of 37.8 cm. (Table 1). However, the treatment T_5 which recorded 35.4cm was on par with treatment T_8 (35.8 cm). The other treatments T_3, T_4, T_7 recorded plant height of 30.1, 32.2 and 36.1cm which were found to be statistically significant. The treatment T_2 recorded a plant height of 26.5cm at harvest. Potassium plays a crucial role in meristematic growth through its effect on the synthesis of phyto hormones. Among various plant hormones, cytokinin plays an important role in growth of plant. Beneficial effects of K on growth and yield attributes have been reported by Brar *et al.,* (2004).

Table 1: Effect of levels of potassium on growth parameters in blackgram.

Treatments		Plant height (cm)	Number of branches $plant^{-1}$	Leaf area index
T_1	Absolute Control	22.1	7.16	1.85
T_2	Control (- K)	26.5	8.27	2.13
T_3	12.5 kg of K_2O ha^{-1}	30.1	10.7	2.31
T_4	25 kg of K_2O ha^{-1}	32.2	12.5	2.42
T_5	37.5 kg of K_2O ha^{-1}	35.4	14.0	2.55
T_6	50 kg of K_2O ha^{-1}	37.8	16.8	3.07
T_7	62.5 kg of K_2O ha^{-1}	36.1	15.5	2.65
T_8	75 kg of K_2O ha^{-1}	35.8	14.5	2.59
SEd		0.78	0.85	0.20
CD (0.05)		1.51	1.75	1.36

Number of branches $plant^{-1}$

The treatments T_1 recorded the lowest number of branches $plant^{-1}$ of 7.16 and the treatment T_6 recorded the highest number of branches of $plant^{-1}$ 16.8 (Table 1). However the treatment T_5 which recorded 14.0 was on par with treatment T_8 (14.5).The other treatments T_3, T_4 and T_7 recorded number of branches $plant^{-1}$ of 10.7, 12.5 and 15.5 which were found to be statistically significant. The treatment T_2 recorded a number of branches $plant^{-1}$

Table 2: Effect of levels of potassium on Grain yield and Haulm yield (kg ha^{-1}).

Treatments		Grain yield (kg ha^{-1})	Haulm yield (kg ha^{-1})
T_1	Absolute Control	652	806
T_2	Control (- K)	900	1154
T_3	12.5 kg of K_2O ha^{-1}	944	1197
T_4	25 kg of K_2O ha^{-1}	984	1280
T_5	37.5 kg of K_2O ha^{-1}	1030	1353
T_6	50 kg of K_2O ha^{-1}	1080	1483
T_7	62.5 kg of Kcl ha^{-1}	1060	1428
T_8	75 kg of K_2O ha^{-1}	1045	1400
SEd		9.4	26.5
CD (0.05)		19.6	55.3

of 8.27 at harvest. The results of this experiment were in accordance with these Buriro *et al.,* (2015), who noticed with the application of K, the plants grew vigorously to produce more branches plant^{-1}.

Leaf area index:

The treatments T_1 recorded the lowest leaf area index of 1.85 and the treatment T_6 recorded the highest leaf area index of 3.07 (Table 1). However the treatment T_5 which recorded 2.55 was on par with treatment T_8 (2.59). The other treatments T_3, T_4 and T_7 recorded leaf area index of 2.31, 2.42 and 2.65 which were found to be statistically significant. The treatment T_2 recorded a leaf area index of 2.13. This might be due to optimum supply of nutrients which increased the plant growth, leaf number, leaf length and breadth. Similar results were also observed by Geetha and Velayutham (2009) and Nazir Hussain *et al.,* (2011).

Grain yield and Haulm yield (kg ha^{-1})

The treatments T_1 recorded the lowest grain yield and haulm yield of 652 and 806 kg ha^{-1} (Table 2). Treatment T_6 recorded the highest grain yield and haulm yield of 1080 and 1483 kg ha^{-1}. However the treatment T_5 which recorded (1030 and 1353 kg ha^{-1}) was on par with treatment T_8 (1045 and 1400 kg ha^{-1}). The other treatments T_3, T_4 and T_7 recorded grain and haulm yields of 944, 984, 1060 kg ha^{-1} and 1197, 1280, 1428 kg ha^{-1} which were found to be statistically significant. The treatment T_2 recorded a grain yield and haulm yield of 900 and 1154 kg ha^{-1}. It was clearly observed that yield increased with the optimum dose of potassium (50 kg ha^{-1}). Similar results were reported by Chaudhry and Mahmood (1999). Leaf area index and photosynthetic rate as a perfect and prolonged nutrient management which might have contributed to higher haulm yield as reported by Singh *et al.,* (2007) and Suriyalashmi, (2013).

N,P,K uptake by grain(kg ha^{-1})

The treatments T_1 recorded the lowest nitrogen, phosphorus and potassium uptake by grain of 16.7, 0.93 and 6.75 kg ha^{-1} and the treatment T_6 recorded the highest and nitrogen, phosphorus and potassium uptake by grain of 42.6, 8.56 and 22.2 kg ha^{-1} (Table 3). However the treatment T_5 which recorded 38.9, 5.89 and 19.2 kg ha^{-1} was on par with treatment T_8 (39.0, 6.02, 19.9 kg ha^{-1}). The other treatments T_3, T_4 and T_7 recorded nitrogen, phosphorus and potassium uptake by grain of (32.1, 2.53, 15.1 kg ha^{-1}), (35.3, 4.08, 18.8 kg ha^{-1}) and (40.5, 7.14, 20.0) kg ha^{-1} respectively which were found to be statistically significant. The treatment T_2 recorded a nitrogen and phosphorus, potassium uptake by grain 27.4, 1.83 and 12.3 kg ha^{-1} at harvest. In addition, mineralization of immobilized nutrients by legumes increased their availability to residual crops and increased nutrients uptake by crop. Similar results were documented by Patil *et al.,* (2010) and Suriyalashmi, (2013).

N,P,K uptake by haulm(kg ha^{-1}):

The treatments T_1 recorded the lowest nitrogen, phosphorus and potassium uptake of 10.5, 0.93 and 11.4 kg ha^{-1} by haulm and the treatment T_6 recorded the highest nitrogen, phosphorus and potassium uptake of 30.2, 7.05 and 31.6 kg ha^{-1} by haulm (Table 4). However the treatment T_5 which recorded nitrogen, phosphorus and potassium uptake of 27.0, 5.17 and 27.0 kg ha^{-1} by haulm was on par with treatment T_8 (27.8, 5.81, 27.8 kg ha^{-1}). The other treatments T_3, T_4 and T_7 recorded nitrogen, phosphorus and potassium uptake of (21.0, 2.25, 22.1 kg ha-1), (24.9, 3.21, 25.8 kg ha^{-1}) and (28.2, 6.50, 29.5 kg ha^{-1}) by haulm respectively which were found to be statistically significant. The treatment T_2 recorded a

Table 3: Effect of levels of potassium on Nitrogen, Phosphorus and Potassium uptake (kg ha^{-1}) by haulm in blackgram.

Treatments	Nitrogen uptake by haulm (kg ha^{-1})	Phosphorus uptake by haulm (kg ha^{-1})	Potassium uptake by haulm (kg ha^{-1})
T_1 Absolute Control	22.1	7.16	1.85
T_2 Control (- K)	26.5	8.27	2.13
T_3 12.5 kg of K_2O ha^{-1}	30.1	10.7	2.31
T_4 25 kg of K_2O ha^{-1}	32.2	12.5	2.42
T_5 37.5 kg of K_2O ha^{-1}	35.4	14.0	2.55
T_6 50 kg of K_2O ha^{-1}	37.8	16.8	3.07
T_7 62.5 kg of K_2O ha^{-1}	36.1	15.5	2.65
T_8 75 kg of K_2O ha^{-1}	35.8	14.5	2.59
SEd	0.78	0.85	0.20
CD (0.05)	1.51	1.75	1.36

Table 4: Effect of levels of potassium on Nitrogen, Phosphorus and Potassium uptake (kg ha^{-1}) by grain in blackgram.

Treatments	Nitrogen uptake by grain (kg ha^{-1})	Phosphorus uptake by grain (kg ha^{-1})	Potassium uptake by grain (kg ha^{-1})
T_1 Absolute Control	16.7	0.93	6.75
T_2 Control (- K)	27.4	1.83	12.3
T_3 12.5 kg of K_2O ha^{-1}	32.1	2.53	15.1
T_4 25 kg of K_2O ha^{-1}	35.3	4.08	18.8
T_5 37.5 kg of K_2O ha^{-1}	38.9	5.89	19.2
T_6 50 kg of K_2O ha^{-1}	42.6	8.56	22.2
T_7 62.5 kg of K_2O ha^{-1}	40.5	7.14	20.0
T_8 75 kg of K_2O ha^{-1}	39.0	6.02	19.9
SEd 0.98	0.67	1.01	
CD (0.05)	2.01	1.38	2.08

nitrogen, phosphorus and potassium uptake of 17.7, 1.57 and 18.8 kg ha^{-1} by haulm at harvest. This increase in uptake by blackgram haulm may be ascribed to higher grain and haulm production due to K addition (Brar *et al.,* 2004, Dinesh Pratap Singh, 2017, Singh *et al.,* 2016).

Conclusion

Potassium is essential for photosynthesis, protein synthesis and regulation of stomata movement and it is the major cation in maintenance of cation-anion balances. Application of potassium in the form of muriate of potash significantly increased the growth components *viz.,* plant height, number of branches plant^{-1}, leaf area index of crop growth. Potassium significantly influenced the grain and haulm yield of black gram. Optimum levels of potassium (MOP) increased the grain and haulm significantly. It can be concluded that significantly highest yield and uptake of NPK was deliberated with treatment of fertilizer consisting recommended dose of fertilizer with 50 kg ha^{-1} of potassium application.

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