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Effect of Foliar Nutrition and Crop Geometry on Cultivars of Blackgram in *Shiwalik* Foothills of Jammu

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ABSTRACT

Background: Rapid expansion in population increased the global food demand. To meet this surge in demand for food and to ensure food and nutritional security addition of pulses in the cropping system is a visible alternative. Pulses intensifies cropping intensity, enhances health and fertility status of the soil and acts as a good source of dietary protein *etc*. However, due to a wide gap between the potential and actual yield of pulses in rainfed areas. Hence, identification and adoption of best management practices has become a pre-requisite. The present study was undertaken as the information available on foliar nutrition and different crop geometries on performance of different blackgram genotypes in rainfed condition is meagre.

Methods: In this investigation conducted during *kharif* season of 2018 at Advanced Centre for Rainfed Agriculture, SKUAST-Jammu, Rakh Dhiansar. The experiment was laid out in factorial randomized block design with 3 factors and 3 replications. The factor-1 consisted of three blackgram cultivars (Uttara, PU-31 and Mash-114), factor 2 consisted of two crop geometries (30×10 cm and 45×10 cm) and factor-3 consisted of three foliar nutrition (Foliar spray of molybdenum as sodium molybdate @ 0.1% at 20 DAS, Foliar spray of 1.5% KCl at flowering and Foliar spray of molybdenum as sodium molybdate @ 0.1% at 20 DAS *fb* 1.5% KCl at flowering).

Result: The results from the present investigation indicated that adoption of Mash-114 at 30×10 cm crop geometry, supplemented with foliar application of molybdenum as sodium molybdate @ 0.1% at 20 DAS *fb* 1.5% KCl at flowering could be a viable technological proposition under rainfed conditions of Jammu.

Key words: Blackgram, Crop geometry, Foliar nutrition, Molybdenum, Nutrient uptake, Yield.

INTRODUCTION

Blackgram is an ancient and well known leguminous crop of Asia. It is popular because of its nutritional quality, green manuring value, nitrogen fixing capacity and short duration. Higher drought tolerance index (7.48) made blackgram most adaptable crop to rainfed areas (Baroowa and Gogoi, 2016). Blackgram seeds are highly nutritious where 100 g of blackgram is estimated to provide 347 kcal energy, 24% protein Gopalan *et al.* (2004). Blackgram constitutes 3.06 million hectares area with 1.70 million tonnes production contributing 9.91% to total pulse production in the country (IIPR, 2018_a). In Jammu and Kashmir, blackgram constitutes 13.2 (000' ha) area and 5.1 (000' tonnes) production ($IIPR_b$, 2018). Agronomic manipulation *viz*. selection of suitable cultivars, crop geometry and fertilizer application are most important factors of crop production. Adaptability of the cultivar to given set of environment is determined by its genetic makeup and when an adaptable cultivar was sown adopting an optimum crop geometry favours growth of both aerial and underground parts resulting in better utilization of solar radiation and nutrients. Further, in this case if we would supplement the nutrient demand of the crop it would help us in narrowing the potential yield gap paving a way towards food security. Since, the area being rainfed, resistance to abiotic stresses plays a crucial role and potassium was known for its significance in imparting abiotic stress resistance while, quality of pulses and nitrogen fixing ability are mainly depended on molybdenum. These positive influence of potassium and molybdenum are due to role of potassium in osmo-regulation and photosynthesis of plant Wang *et al.* (2013), while for molybdenum it is due to its constituency in nitrate reductase and nitrogenase enzymes involving in nitrate reduction, nitrogen fixation and nitrogen metabolism Singh *et al.* (2014).

Hence it becomes imperative to have knowledge on foliar sprays of potassium and molybdenum at various growth stages with respect to their independent effect and interaction effect on performance of different blackgram cultivars grown under different crop geometries, where information available is meagre. Hence, the present investigation was initiated to find out the effect of foliar

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nutrition under varying crop geometry on physio-morphological character, yield and nutrient uptake in different cultivars of blackgram.

MATERIALS AND METHODS

The field experiment was conducted during rainy (*kharif*) season of 2018 at Advanced Centre for Rainfed Agriculture, SKUAST-Jammu, Rakh Dhiansar (32°-37´ N, 74°-55´ E, 332 m above mean sea level). The soil of the experimental site was sandy loam in texture, slightly acidic (pH 6.47), low in organic carbon (0.36%), available nitrogen (173.48 kg/ha), medium in available phosphorus (15.21 kg/ha), available potassium (121.23 kg/ha) and available molybdenum (0.087 ppm). The experiment was laid out in Factorial Randomized Block Design with 3 factors and 3 replications. The factor-1 consisted of three blackgram cultivars (Uttara, PU-31 and Mash-114), factor 2 consisted of two crop geometries (30×10 cm and 45×10 cm) and factor-3 consisted of three foliar nutrition (Foliar spray of molybdenum as sodium molybdate @ 0.1% at 20 DAS, Foliar spray of 1.5% KCl at flowering and Foliar spray of molybdenum as sodium molybdate @ 0.1% at 20 DAS *fb* 1.5% KCl at flowering).

The recommended full dose of nitrogen (15 kg/ha) and phosphorus (40 kg/ha) was applied through DAP in all the treatments as basal at the time of sowing. The foliar spray of molybdenum at 20 DAS through sodium molybdate @ 0.1% and foliar spray of KCl during 50% of flowering through muriate of potash @ 1.5% were applied as per the treatment schedule. The crop was established by using a seed rate of 20 kg/ha when sown at 30×10 cm spacing, while 13kg/ha when sown at 45×10cm spacing. The crop was cultivated under rainfed conditions and hence no irrigations were provided. The data on plant height (cm), number of branches per plant and dry matter accumulation per plant (g) were recorded at harvest. Similarly, data on root nodules per plant, leaf area index (LAI) and SPAD readings were recorded at 60 DAS. In case of LAI all the green leaves of randomly selected plants for dry matter accumulation were categorized into small, medium and large and leaf area was recorded using leaf area meter. The leaf area index of the leaves was calculated as a ratio of leaf area to ground area (Watson, 1947). However, yield parameters (such as grain yield, stover yield and harvest index) were recorded at harvest *viz.* 14-10-18 (PU-31), 22-10-18 (Uttara), 27-10-18 (Mash-114) and nutrient uptake studies (such as N uptake, K uptake and Mo uptake) were observed at physiological maturity *viz.* 7-10-18 (PU-31), 12-10-18 (Uttara), 17-10-18 (Mash-114), respectively. All these observations were statistically analyzed adopting a standard analysis of variance and their CD were worked out at 5 per cent probability level (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Influence of cultivars, crop geometry and foliar nutrition on morphological characters of blackgram

Morphology of the plant is manifested in terms of plant height (cm), number of branches per plant, number of root nodules per plant, dry matter accumulation (g/m^2). The data pertaining to all these parameters were found to be significant. Among cultivars, Mash-114 was found to be significantly superior in all morphological characters over Uttara and PU-31 respectively (Table 1). While, Uttara

Table 1: Effect of cultivars, crop geometry and foliar nutrition on morphological characters of blackgram.

Treatments	Plant height at harvest (cm)	Number of branches per plant at harvest	Dry matter accumulation at harvest (g)	Root nodules per plant (60 DAS)
C (Cultivars)				
C1 (Uttara)	52.86	8.14	128.30	35.02
C2 (PU-31)	47.31	7.60	75.66	32.78
C3 (Mash-114)	60.10	9.09	158.56	38.70
SE(d) ±	1.11	0.08	5.53	0.36
CD (5%)	2.26	0.16	11.23	0.73
S (Crop geometry)				
S1 (30×10cm)	54.46	8.14	129.39	35.01
S2 (45×10 cm)	52.39	8.47	112.29	36.44
SE(d) ±	0.91	0.07	4.52	0.30
CD (5%)	1.84	0.13	9.17	0.60
F (Foliar nutrition)				
F1 (Foliar spray of molybdenum as sodium molybdate @ 0.1% at 20 DAS)	53.41	8.37	122.52	35.98
F2 (Foliar spray of 1.5% KCl at flowering)	51.13	7.61	106.01	32.25
F3 (Foliar spray of molybdenum as sodium molybdate @ 0.1% at 20 DAS *fb* 1.5% KCl at flowering)	55.73	8.86	133.98	38.27
SE(d) ±	1.11	0.08	5.53	0.36
CD (5%)	2.26	0.16	11.23	0.73

performed significantly better over PU-31. This might be due to cultivar's genetic makeup and its capacity to adapt to a particular environmental condition in which it getting established. Similar findings were reported by Jadhav *et al.* (2014) and Aggarwal *et al.* (2014) in blackgram.

The data pertaining to crop geometry treatments reported that all other morphological characters recorded during the experiment, except plant height (cm) and dry matter accumulation (g/m^2) found that 45×10 cm spacing to be significantly superior over 30×10 cm (Table 1). The greater root proliferation with wider crop geometry might have contributed towards increased number of root nodules per plant and further, improved nutrient absorption in the presence of ideal soil moisture resulting in higher number of branches per plant. The vice-versa was observed with respect to plant height and dry matter accumulation per sq. meter (g/m^2). This might be due to inter row competition between the plants encouraged self-thinning of branches and enhanced vertical growth of the plant while in case of dry matter production closer spacing might have attributed higher plant population leading towards substantially higher nutrient accumulation. These findings are in conformity with Kalsaria *et al.* (2017) and Prabhamani and Potdar, (2018)

The data pertaining to foliar nutrition presented in Table 1 explains that all the morphological characters were significantly influenced by foliar nutrition and among foliar spray treatments, spray of molybdenum as sodium molybdate @ 0.1% at 20 DAS *fb* KCl @ 1.5% at flowering recorded significantly higher plant height (cm), dry matter production (g/m^2), more number of branches per plant and more number of root nodules per plant with application of foliar spray of molybdenum as sodium molybdate @ 0.1% at 20 DAS *fb* KCl @ 1.5% at flowering over alone application of foliar spray of KCl @ 1.5% at flowering at all the stages of crop growth except at 20 DAS while, at par results were found with alone application of molybdenum as sodium molybdate @ 0.1% at 20 and 40 DAS. The probable reason for this might be because of the fact that molybdenum is a structural component of nitrogenase and this enzyme actively involved in nitrogen fixation by root nodule bacteria of leguminous crop and followed by application of potassium at reproductive stage might have helped in strengthening the stalk and known to improve the plant vigour by it role in activation of enzymes and its involvement in ATP production which is probably more important in regulating the rate of photosynthesis further added to the effect caused by molybdenum. These findings are in line with Shinde *et al.* (2017) and Praveena *et al.* (2018).

Influence of cultivars, crop geometry and foliar nutrition on physiological parameters of blackgram

Agronomic manipulation undergone in this experiment was potent enough to alter the physiology of the plant to certain extent. The physiological parameters like LAI, CGR and SPAD were found to be significantly influenced by cultivars, crop geometry and foliar nutrition treatments adopted in this investigation.

Mash-114 recorded maximum LAI, CGR and SPAD readings over other cultivars under comparison. Considering all the physiological parameters the LAI showed a periodic increase in all the cultivars. While, such an increase was more pronounced in Mash-114 followed by Uttara and PU-31. The maximum growth rate was recorded withMash-114 and minimum was with PU-31, respectively as presented in Table 2. This might be due to genotypic variation among the cultivars.

Table 2: Effect of cultivars, crop geometry and foliar nutrition on physiological characters of blackgram.

Treatments	LAI (60 DAS)	CGR (40-60 DAS)	SPAD readings (60 DAS)
C (Cultivars)			
C1 (Uttara)	1.504	4.07	36.74
C2 (PU-31)	0.993	2.25	33.19
C3 (Mash-114)	1.757	5.03	39.98
SE(d) ±	0.059	0.19	1.08
CD (5%)	0.120	0.39	2.19
S (Crop geometry)			
S1 (30×10cm)	1.530	4.08	35.60
S2 (45×10 cm)	1.282	3.49	37.67
SE(d) ±	0.048	0.16	0.88
CD (5%)	0.098	0.32	1.79
F (Foliar nutrition)			
F1 (Foliar spray of molybdenum as sodium molybdate @ 0.1% at 20 DAS)	1.443	3.82	36.63
F2 (Foliar spray of 1.5% KCl at flowering)	1.034	3.28	34.35
F3 (Foliar spray of molybdenum as sodium molybdate @ 0.1% at 20 DAS *fb* 1.5% KCl at flowering)	1.776	4.25	38.94
SE(d) ±	0.059	0.19	1.08
CD (5%)	0.120	0.39	2.19

Plant stature with broader leaves was observed when blackgram was raised at wider spacings. Though broader leaves and better plant stature have direct relationship with LAI, it could not compensate the cumulative leaf area obtained with more number of plants per unit area in closer spacing (Table 2). This might have attributed for maximum LAI with closer spacing of 30×10 cm. In relation to CGR the more plant population per unit area with closer spacing could not be able enough to compensate the higher growth rate per plant basis at wider spacing. The SPAD readings gave an image of chlorophyll content which was significantly higher at wider spacing. This might be due to pronounced nutrient uptake at wider spacing.

The all physiological parameters were positively influenced by foliar spray of molybdenum as sodium molybdate @ 0.1% at 20 DAS *fb* KCl @ 1.5% at flowering over alone application is presented in the Table 2. This might be due to the role of additional nutrition on cell division and cell elongation facilitating better crop growth.

Influence of cultivars, crop geometry and foliar nutrition on yield parameters of blackgram

The yield is considered as the direct manifestation of a crop's capacity of production. It is a major trait through which a cultivar is selected. Grain yield, stover yield and harvest index obtained from cultivar Mash-114 was found to be significantly higher as compared to Uttara while the cultivar Uttara was significantly higher over PU-31. This might be due to greater vegetative growth and better light interception due to higher leaf area index by that cultivar which later on contributed towards higher dry matter partitioning towards economic part. These findings are in line with Dash and Rautaray, (2017)

Modifying the crop geometry is known to bring about a change in competition levels among the plants which could be an important cause for variation in yield parameters between the two crop geometries adopted in this experiment. Among the crop geometries, the grain yield, stover yield was significantly higher with closer spacing of 30×10 cm. More biomass production might have contributed towards significantly higher stover yield with closer spacing. While, in case of grain yield although wider spacing could be observed superior with respect to yield attributes but this could not compensate more plant population per unit area. Similar findings were observed by Murade *et al.* (2014) in blackgram.

Data pertaining to effect of foliar nutrition is presented in Table 3 revealed that foliar spray of molybdenum as sodium molybdate @ 0.1% at 20 DAS *fb* 1.5% KCl at flowering performed better and played a significant role in obtaining higher seed and stover yield. The probable reason may be that the spray of molybdenum helps in differed metabolic process which also helps in more productive organs. Besides this, application of KCl at flowering might resulted in greater accumulation of carbohydrates, protein and their translocation to productive organs which in turn improved all growth and yield attributing characters, resulting in more seed and stover yield.

Influence of cultivars, crop geometry and foliar nutrition on nutrient uptake of blackgram

Among the cultivars, Mash-114 registered a significant increase in N, K and Mo uptake over cultivars (Table 4). Higher biomass production especially root proliferation trait of the cultivar might have contributed towards higher nutrient uptake. Similar findings were observed by Tungoe *et al.* (2018).

Table 3: Effect of cultivars, crop geometry and foliar nutrition on yield parameters of black gram.

Treatments	Grain yield (kg/ha)	Stover yield (kg/ha)	Harvest Index (%)
C (Cultivars)			
C1 (Uttara)	779	2453	24.10
C2 (PU-31)	636	2288	21.75
C3 (Mash-114)	909	2728	24.99
SE (d) ±	31	60	0.71
CD (5%)	62	122	1.45
S (Crop geometry)			
S1 (30×10cm)	842	2616	24.34
S2 (45×10 cm)	712	2363	23.15
SE (d) ±	25	49	0.59
CD (5%)	51	100	NS
F (Foliar nutrition)			
F1 (Foliar spray of molybdenum as sodium molybdate @ 0.1% at 20 DAS)	789	2439	24.44
F2 (Foliar spray of 1.5% KCl at flowering)	624	2223	21.92
F3 (Foliar spray of molybdenum as sodium molybdate @ 0.1% at 20 DAS *fb* 1.5% KCl at flowering)	912	2807	24.65
SE(d) ±	31	60	0.71
CD (5%)	62	122	1.45

Table 4: Effect of cultivars, crop geometry and foliar nutrition on nutrient uptake at physiological maturity of black gram.

Treatments	N uptake (kg/ha)	K uptake (kg/ha)	Mo uptake (g/ha)
C (Cultivars)			
C1 (Uttara)	29.42	18.81	1.02
C2 (PU-31)	17.54	11.86	0.63
C3 (Mash-114)	37.15	24.11	1.29
SE(d) ±	2.51	1.62	0.12
CD (5%)	5.10	3.28	0.24
S (Crop geometry)			
S1 (30×10cm)	30.20	19.84	1.09
S2 (45×10 cm)	25.87	16.67	0.87
SE(d) ±	2.05	1.32	0.10
CD (5%)	4.17	2.68	0.20
F (Foliar nutrition)			
F1 (Foliar spray of molybdenum as sodium molybdate @ 0.1% at 20 DAS)	28.23	18.11	0.95
F2 (Foliar spray of 1.5% KCl at flowering)	22.61	14.07	0.67
F3 (Foliar spray of molybdenum as sodium molybdate @ 0.1% at 20 DAS *fb* 1.5% KCl at flowering)	33.27	22.60	1.33
SE(d) ±	2.51	1.62	0.12
CD (5%)	5.10	3.28	0.24

Among different crop geometry treatments closer 30 × 10 cm enhanced the uptake of N, K and molybdenum compared to wider spacing of 45×10cm (Table 4). This might due to increase in root length that which attributed to increase the root activity, under higher plant population, which enabled increase in absorption of nutrients from soil.

Foliar spray of molybdenum at 20 DAS expected to increase initial crop growth which inturn resulted in more photosynthetic rate of the crop thus resulting in more uptake of nutrients which was further enhanced by application of KCl at 50% flowering could be a possible reason for enhanced nutrient uptake through foliar spray of molybdenum as sodium molybdate @ 0.1% at 20 DAS *fb* 1.5% KCl at flowering over alone application Similar finding were recorded by Geetha and Velayatham (2016).

CONCLUSION

It can be concluded from the present investigation that the sowing of Mash-114 with foliar application of molybdenum as sodium molybdate @ 0.1% at 20 DAS *fb* 1.5% KCl at flowering when planted at 30×10 cm spacing could be a viable technological proposition under rainfed conditions of Jammu. However, a multilocation trial may further consolidate our knowledge regarding this.

REFERENCES

Aggarwal, N., Singh, G., Ram H., Khanna, V. (2014). Effect of post-emergence application of imazethapyr on symbiotic activities, growth and yield of blackgram (*Vigna mungo*) cultivars and its efficacy against weeds. Indian Journal of Agronomy. 59: 421-426.

Baroowa, B. and Gogoi, N. (2016). The effect of osmotic stress on anti-oxidative capacity of blackgram (*Vigna mungo* L.). Experimental Agriculture. 1: 1-16.

Dash, S.R. and Rautaray, B.K. (2017). Growth parameters and yield of green gram varieties (*Vigna radiate* L.) in east and south east coastal plains of Odisha, India. International Journal of Current Microbiology and Applied Sciences. 6: 1517-1523.

Geetha, P. and Velayutham, A. (2016). Yield attributes, yield and uptake of nutrients as influenced by basal and foliar application of nutrients on rice fallow blackgram. Indian Journal of Agricultural Research. 50: 122-125.

Gomez, K.A. and Gomez, A.A. (1984). Statistical procedure for agricultural research (2nd Edn.) International Rice Research Institute. Los Banos, Philippines. John Willy and Sons. New York. pp. 324.

Gopalan, C., Ramasastri, B.V., Balasubramanian, S.C. (2004). Nutritive Value of Indian Foods, National Institute of Nutrition. Indian Council of Medical Research, Hyderabad. pp. 47-48.

IIPR [Indian Institute of Pulse Research]. (2018a). http://iipr.res.in/e-pulse-data-book-country-wise.html. (Accessed Online: 1, April 2018).

IIPR [Indian Institute of Pulse Research]. (2018b). http://iipr.res.in/e-pulse-data-book-state-wise.html. (Accessed Online: 17, April 2018).

Jadhav, P.B., Kamble, D.R., Jadhav, K.T., Gadpale, D.L. (2014). Performance of blackgram [*Vigna mungo* (L.) Hepper] varieties to different sowing dates. Advance Research Journal of Crop Improvement. 5: 166-171.

Kalsaria, R.N., Venkariya, P.D., Hadiyal, J.G., Ichchhuda, P.K. (2017). Effect of spacing, fertility levels and bio-fertilizers on growth and yield of summer greengram [*Vigna radiata* (L.) Wilczek]. Journal of Pharmacognosy and Phytochemistry. 6: 934-937.

Murade, N.B., Patil, D.B., Jagtap, H.D., More, S.M. (2014). Effect of spacing and fertilizer levels on growth and yield of urdbean. The Bioscan. 9: 1545-1547.

Prabhamani, P.S. and Potdar, M.P. (2018). Response of cowpea (*Vigna unguiculata* L.) genotypes to sowing windows and planting geometry under northern transitional zone of Karnataka. International Journal of Pure and Applied Bioscience. 6: 820-827.

Praveena, R., Ghosh, G., Singh, V. (2018). Effect of foliar spray of boron and different zinc levels on growth and yield of *kharif* greengram (*Vigna radiata*). International Journal of Current Microbiology and Applied Sciences. 7: 1422-1428.

Shinde, P., Doddagoudar, S.R., Vasudevan, S.N. (2017). Influence of seed polymer coating with micro nutrients and foliar spray on seed yield of chickpea (*Cicer arietinum* L.). Legume research. 40: 704-709.

Singh, A.K., Khan, M.A., Srivastava, A. (2014). Effect of boron and molybdenum application on seed yield of mungbean. Asian Journal of Bio Science. 9: 169-172.

Tungoe, R., Gohain, T., Kinkon, N. (2018). Response of blackgram [*Vigna mungo* (L.) Hepper] to spacing and fertilizer doses under rainfed conditions. Agricultural Science Digest. 38: 27-31.

Wang, M., Zheng, Q., Shen Q., Guo, S. (2013). The critical role of potassium in plant stress response. International Journal of Molecular Sciences. 14: 7370-7390.

Watson, D.J. (1947). Comparative physiological studies in the growth of field crops: I. Variation in net assimilation rate and leaf area between species and varieties, and within and between years. Annals of Botany. 11: 41-76.