Indian Journal of Agronomy **67** (1): 97–100 (March 2022)

Research Communication

Effect of foliar application of nutrients on yield, nutrient uptake and economics of pre-winter blackgram (*Vigna mungo*)

N.M. DEBATA[1], M.R. SATAPATHY[2], R.K. PAIKARAY[3] AND S.N. JENA[4]

College of Agriculture, Odisha University of Agriculture and Technology, Bhubaneswar, Odisha 751 003

Received: January 2021; Revised accepted: November 2021

ABSTRACT

A field experiment was conducted at Agronomy Main Research Farm, Bhubaneswar, Odisha, during pre-winter season of 2019, to optimize nutrient-management practices through foliar feeding in 'Mahuri' blackgram [*Vigna mungo* (L.) Hepper] cultivar. The treatments were soil test-based fertilizer recommendation (STBFR), STBFR + 2% NPK (19 : 19 : 19) once, STBFR + 2% NPK (19 : 19 : 19) twice, STBFR + 0.2% Borax spray, STBFR + 0.5% $ZnSO_4$ spray, STBFR + 0.2% Borax + 0.5% $ZnSO_4$ spray, STBFR + 2% NPK + 0.2% Borax spray, STBFR + 2% NPK + 0.5% $ZnSO_4$ spray, STBFR + 2% NPK + 0.2% Borax + 0.5% $ZnSO_4$ spray, water spray (control). Application of STBFR + 2% NPK (19 : 19 : 19) + 0.2% Borax + 0.5% $ZnSO_4$ spray prior to anthesis resulted in the maximum seed yield (804 kg/ha) and stover yield (1,648 kg/ha). Maximum number of nodules/plant (12.2), pods/plant (33.4) and seeds/pod (7.73) were obtained from the same treatment. An uptake of 63.2 kg N, 6.25 kg P, 36.0 kg K, 0.75 kg Zn and 0.62 kg B/ha was recorded under the nutrient-management practice of STBFR + 2% NPK (19 : 19 : 19) + 0.2% Borax + 0.5% $ZnSO_4$ spray. Similarly, the maximum net returns of ₹21,224/ha and benefit : cost ratio of 1.89 were obtained under the same treatment.

***Key words*:** Blackgram, Economics, Foliar spray, Nutrient uptake, Seed yield, STBFR, Stover yield

India accounts for 24.2% of the total world area, i.e. 23.24 million ha and 22% of the world's production of pulses. Due to stagnant production, the net availability of pulses has come down from 60 g/day/capita in 1951 to 54.7 g/day/capita (20 kg/year/capita) in 2017 compared to 65 and 80 g/day/capita of the Indian Council of Medical Research (ICMR) and the World Health Organization (WHO). In Odisha, blackgram is cultivated in total area of 0.52 million ha, with total production of 0.25 million tones and average productivity is 482 kg/ha. The productivity of winter (*rabi*) blackgram is 508 kg/ha as compared to rainy season (*kharif*) productivity of 455 kg/ha (DA&FP, 2018). Nutrient deficiency in soil is the key factor for poor productivity of pulses. The soils of Odisha are more or less deficient in nitrogen-fixing bacteria, micronutrients like zinc and boron. There is a greater possibility for increasing pulse productivity in Odisha with balanced fertilization including micronutrients. Balanced fertilization may help in realizing higher yield but only basal application of soil test-based fertilizer recommendation (STBFR) becomes insufficient under intensive cultivation of high-yielding varieties (HYV). Under such a situation, the mid-correction of foliar application of major and micronutrients may prove beneficial for increasing higher productivity in pulses.

Zinc is one of the vital nutrients and is needed for the growth of plant, animals and humans. Zinc application promotes chlorophyll formation, starch sugar conversion, auxin metabolism, stem elongation. Boron is very important in cell-division and in pod and seed formation, regulation of specific metabolic pathways of sugar transport and hormone development (Ahmad *et al*., 2019).

Foliar nutrition is a technique of feeding plants by applying liquid fertilizer directly to the leaves. Plants can absorb essential elements through stomata and epidermis. If used to supplement soil fertilization wisely, can be more efficient, economical, environment friendly and target oriented. Now-a-days, foliar feeding is widely adopted strategy in modern crop management to ensure optimum crop performance. Foliar application overcomes soil-fertilization limitations, soil unsuitable for fertilizer precipitation, the antagonism between certain nutrients, heterogenic soil unsuitable for low dosages and fixation. This is one of the

Based on a part of M.Sc. thesis of the first author, submitted to Odisha University of Agriculture and Technology, Bhubaneswar, Odisha in 2020 (unpublished)

[2]Corresponding author's Email: mrsouat@gmail.com

[1]M.Sc. Scholar, [2,4]Professor, [3]Professor and Head, Department of Agronomy, Odisha University of Agriculture and Technology, Bhubaneswar, Odisha 751 003

most efficient ways of supplying essential nutrients to a growing crop. The present study was, therefore, undertaken to evaluate the effect of foliar spray of N-P-K, Zn and B on yield, nutrient uptake and economics of blackgram.

The field experiment was conducted during pre-winter 2019 at Agronomy Main Research Farm, Department of Agronomy, Odisha University of Agriculture and Technology, Bhubaneswar during *pre-rabi* 2019. (20°26' N and 85º 80' E). Blackgram variety 'Mahuri' having a maturity period of 65–75 days, was tested in the experiment. The crop received a rainfall of 108.7 mm, which ensured good germination. The soil was sandy loam, acidic (*p*H 5.8), with low available nitrogen (241.4 kg/ha), medium available phosphorus (37.8 kg/ha), medium available potassium content (196 kg/ha) and was low in zinc (0.50 ppm) and boron (0.31 ppm) content. The experiment was conducted in randomized block design with 10 treatments, replicated thrice. The seed was sown on 20 September, 2019 and crop was harvested on 27 November, 2019. The previous crop was maize, grown for green cob purposes. The seeds were treated with rhizobium culture @ 20 gm/kg seed before sowing. The crop was sown with row-to-row spacing of 25 cm and plant-to-plant spacing of 10 cm. The treatments were soil test-based fertilizer recommendation (STBFR), STBFR + 2% NPK (19 : 19 : 19) once, STBFR + 2% NPK (19 : 19 : 19) twice, STBFR + 0.2% Borax spray, STBFR + 0.5% $ZnSO_4$ spray, STBFR + 0.2% Borax spray + 0.5% $ZnSO_4$ spray, STBFR + 2% NPK + 0.2% Borax spray, STBFR + 2% NPK + 0.5% $ZnSO_4$ spray, STBFR + 2% NPK + 0.2% Borax spray + 0.5% $ZnSO_4$ spray, water spray (control). A STBFR dose of 25-40-20 kg N, P_2O_5, K_20 kg/ha in form of urea, diammonium phosohpate and muriate of potash along with farm yard manure @ 5 t/ha to the control plot, were applied. Foliar application of NPK (19 : 19 : 19) was done at 30 days after sowing (DAS), i.e. at pre-flowering stage and subsequently after 15 days, i.e. 45 DAS. Foliar application of 0.5% $ZnSO_4$ and 0.2% Borax were done individually at 30 DAS. Data were analysed and the standard error of mean SE(m) and critical difference at 5% possibility level (P=0.05) were calculated as per the formulae (Gomez and Gomez, 1984) to interpret the results.

An increase in nodule number was observed up to 45 DAS and decreased thereafter, which might be due to degeneration of nodules. Application of STBFR + 2% NPK (19 : 19 : 19) + 0.2% Borax + 0.5% $ZnSO_4$ at 45 DAS resulted in significantly higher number of nodules/plant (12.20) owing to better micro-environment and nutrient availability near the root zone. Maximum nodule weight of 116.97 mg/plant was achieved under STBFR + 2% NPK (19 : 19 : 19) + 0.2% Borax + 0.5% $ZnSO_4$ treatment whereas the lowest nodule weight/plant was found in the control (Table 1).

Nutrient management with STBFR + 2% NPK + 0.2% Borax + 0.5% $ZnSO_4$ spray resulted in the higher pods/plant (33.37), being at par with STBFR + 2% NPK + 0.2% Borax spray and STBFR + 2% NPK + 0.5% $ZnSO_4$ spray (Table 1). The water-spray plot (control) contributed towards minimum pods/plant. Deepak *et al*. (2019) observed promising improvement, when NPK application was aided with micronutrient spray. The yield was more as prolonged assimilatory activity of leaves resulted in low flower drop and higher number of pods/plant. Application of STBFR + 2% NPK + 0.2% Borax + 0.5% $ZnSO_4$ spray resulted in the highest number of seeds/plant, i.e. 7.73. This might be owing to increase in assimilatory activity along with efficient translocation of photosynthates and positive influence of boron on flower development, pollengrain formation, pollen viability, pollen-tube growth for proper pollination and seed development were responsible for higher seeds/pod. Praveena *et al*. (2018) observed similar results 0'[tfrdewain greengram. The higher test weight was obtained with STBFR + 2% NPK + 0.2% Borax + 0.5% $ZnSO_4$ spray owing to higher metabolic activity and adequate nutrient supply (Table 1). All these higher yield attributing characters were due to impact of different nutrient management practices to meet the nutrient demand of the crop at critical stages.

Application of STBFR + 2% NPK (19 : 19 : 19) + 0.5% $ZnSO_4$ + 0.2% Borax spray resulted in the maximum seed yield (804 kg/ha), and the minimum seed yield was observed in the control (Table 1). This might be the effect of nutrient management through foliar application of NPK, Zn and B which provided balanced nutrition to the crop. Stover yield of blackgram, as influenced by nutrient management practices through foliar spray, showed a variation of stover yield from 1,160 kg/ha to 1,648 kg/ha (Table 1). Maximum stover yield (1,648 kg/ha) was recorded with the nutrient-management practice of STBFR + 2% NPK + 0.2% Borax + 0.5% $ZnSO_4$ spray (Table 1). The higher harvest index (34.05%) was recorded with STBFR + 0.2% Borax spray and the lowest in the control.

Maximum net returns of ₹21,224/ha and benefit : cost ratio (1.89) were comprehended with STBFR + 2% NPK once + 0.2% borax + 0.5 % ZnSO4 spray at pre-flowering stage, whereas the minimum with the control (Table 1). Spraying with 2% NPK spray twice at pre-flowering stage and subsequent 15 days after recorded less benefit : cost ratio of 1.46 than single spray at pre-flowering stage (1.59).

The nutrient-uptake capability of a plant is dependent on availability of each added and inherent source of minerals in the soil, absorption capacity, ramification and distribution of plant roots, which lead to crop yield. Maximum total nitrogen uptake of 63.19 kg/ha was recorded with STBFR + 2% NPK + 0.2% Borax + 0.5% $ZnSO_4$ spray

Table 1. Yield attributes, yield and economics of Blackgram as affected by foliar application of nutrients

Treatment	Nodules/ plant at 45 DAS	Nodule fresh weight/plant at 45 DAS (mg)	Pods/ plant	Seeds/ pod	Test weight (g)	Seed yield (kg/ha)	Stover yield (kg/ha)	Harvest index (%)	Net returns (₹×10³/ha)	Benefit: cost ratio
Soil test based fertiliser recommendation (STBFR)	10.3	99.1	18.3	5.47	30.0	525	1,235	29.8	7.90	1.56
STBFR + 2% NPK (19 : 19 : 19) once	10.7	102.9	28.0	5.63	30.3	667	1,346	33.1	13.83	1.59
STBFR + 2% NPK (19 : 19 : 19) twice	10.8	102.2	28.3	5.60	30.1	667	1,340	33.3	11.86	1.46
STBFR + 0.2% Borax spray	10.7	102.9	27.4	5.83	30.2	712	1,380	34.1	18.11	1.81
STBFR + 0.5% $ZnSO_4$ spray	10.5	100.9	25.3	5.70	30.2	710	1,440	33.0	17.93	1.82
STBFR + 0.2% Borax + 0.5% $ZnSO_4$ spray	10.9	104.9	29.3	6.63	30.4	718	1,448	33.2	18.25	1.83
STBFR + 2% NPK + 0.2% Borax spray	10.9	106.8	32.2	7.02	32.0	780	1,562	33.3	19.91	1.84
STBFR + 2% NPK + 0.5% $ZnSO_4$ spray	10.7	105.5	30.5	6.87	31.9	768	1,586	32.4	19.17	1.80
STBFR + 2% NPK + 0.2% Borax + 0.5% $ZnSO_4$ spray	12.2	117.0	33.4	7.73	32.2	804	1,648	33.8	21.22	1.89
Water spray (control)	10.1	97.1	12.4	5.13	28.3	343	1,160	22.8	2.20	1.13
SEm±	0.24	2.82	0.71	0.24	0.69	21.4	39.8	0.82		
CD(P=0.05)	0.72	8.38	2.24	0.73	2.24	64.2	118.6	2.54		

DAS, Days after sowing

Table 2. Total nutrient uptake (N, P, K, Zn and B) of blackgram as influenced by foliar application of nutrients

Treatment	Nitrogen uptake (kg/ha)	Phosphorus uptake (kg/ha)	Potash uptake (kg/ha)	Zinc uptake (kg/ha)	Boron uptake (kg/ha)
Soil test based fertiliser recommendation (STBFR)	42.0	3.63	26.0	0.47	0.39
STBFR + 2% NPK (19 : 19 : 19) once	49.8	4.32	29.0	0.56	0.47
STBFR + 2% NPK (19 : 19 : 19) twice	49.4	4.46	28.9	0.59	0.49
STBFR + 0.2% Borax spray	52.8	4.61	30.0	0.61	0.52
STBFR + 0.5% $ZnSO_4$ spray	51.5	4.83	31.1	0.61	0.50
STBFR + 0.2% Borax + 0.5% $ZnSO_4$ spray	53.8	5.04	31.4	0.64	0.54
STBFR + 2% NPK + 0.2% Borax spray	59.8	5.56	34.0	0.63	0.52
STBFR + 2% NPK + 0.5% $ZnSO_4$ spray	58.5	5.83	34.5	0.70	0.59
STBFR + 2% NPK + 0.2% Borax + 0.5% $ZnSO_4$ spray	63.2	6.25	36.0	0.75	0.62
Water spray (control)	34.3	2.88	23.4	0.39	0.31
SEm±	3.59	0.34	2.26	0.03	0.03
CD (P=0.05)	11.48	0.89	7.01	0.1	0.09

(Table 2). This might be owing to consequence of enhanced availability of nitrogen to the crop, greater biomass production, higher number of nodules/plant, higher chlorophyll content and leaf nitrogen due to escalating photosynthesis. The same treatment also exhibited the highest uptake of both phosphorus and potassium of 6.25 kg/ha and 35.95 kg/ha (Table 2). Application of STBFR + 2% NPK + 0.2% Borax + 0.5% $ZnSO_4$ spray proved to be the significant, contributing maximum zinc (0.75 kg/ha) and boron (0.62 kg/ha) uptake (Table 2).

On the basis of the present study, it can be inferred that the nutrient management with STBFR+ 2% NPK (19 : 19 : 19) once + 0.2% borax + 0.5% $ZnSO_4$ spray in pre-winter blackgram is sufficient for getting higher productivity in the present soil condition of low nitrogen status. The result requires further investigation to find out the optimum nutrient management in blackgram through foliar application schedule.

REFERENCES

Ahmad, S., Hussain, N., Ahmed, N. and Syed Muhammad, Z. 2019. Influence of boron nutrition on physiological parameters and productivity of cotton (*Gossypium hirsutum* L.) crop. *Pakistan Journal of Botany* **51**(2): 401–408.

Deepak, K., Singh, R.P. and Vidya, S. 2019. Effect of foliar application of nutrients on yield and economics of blackgram [*Vigna mungo* (L.) Hepper] under rainfed vertisols of central India. *Journal of Pharmacognosy and Phytochemistry* **8**(1): 2,373–2,376.

DA&FP. 2018. *Odisha Agriculture Statistics 2017–18*. Department of Agriculture and Farmers Empowerment, Government of Odisha, Bhubaneswar, Odisha.

Gomez, K.A. and Gomez, A.A. 1984. Statistical Procedures for Agricultural Research. A Willey Interscience Publication, New York, USA. pp.76-83.

Praveena, R., Ghosh, G. and 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**(8): 1,422–1,428.