Impact of foliar application of nutrients on economics of Black gram (*Vigna mungo* L.)

ABSTRACT

The present experiment was laid out at research farm of R.A.K. College of Agriculture, Sehore (M.P.) during Kharif season of 2022. Results revealed that foliar spray application of nutrient shows significant effect on yield economics. Treatment T_7 **(**2% Spray of DAP + 0.5% Spray of $ZnSO_4$ at pre-flowering and pod initiation stage) found higher for yield and yield attributes *i.e.*grain yield (0.834 kg/plot and 7.86 q/ha respectively), silage yield (17.30q/ha), biological yield (25.16 q/ha), gross return (₹ 62550 ha^{-1}), net return ((₹ 36491 ha^{-1}) and B:C ratio (2.40). While, minimum values found with T_1 (Water spray at pre-flowering stage and pod initiation stage).

Keywords: B:C ratio, black gram, economics, foliar spray, yield.

Introduction:

Black gram, scientifically known as *Vigna mungo*, is an essential pulse crop within the legume family that plays a pivotal role in the diets and economies of many countries in South Asia. It is a vital source of protein and other essential nutrients and holds cultural and economic significance for the region (Suneja *et al*., 2011).

The United Nations declared the year 2016 as "International Year of Pulses" to increase the public awareness regarding the nutritional benefits of pulses aimed to improve food security and nutrition as part of sustainable food production (Mohanty and Satyasai, 2015). The World Health Organization (WHO) recommends 80 g pulse per day per person and the Indian Council of Medical Research (ICMR) recommends 47g pulse per day per person. Blackgram consists 22.3% of protein, 48.0% of carbohydrates, 154 mg of calcium, 300 mg phosphorus, 9.1 mg of iron, 1.4 g of 3.37 g of riboflavin, 0.42 g of thiamin and 2 mg niacin per 100 g of black gram (Asaduzzaman *et al*., 2010). Though pulses are rich in protein they are still being cultivated 95 per cent under rainfed condition and more than 78 per cent under energy starved condition. The main reasons for low productivity of blackgram is poor nutrient management practices and cultivation under moisture stress condition (Suhathiya and Ravichandran, 2018). Hence there is a need to increase the production potentaial of pulses. The growth phase of blackgram is often obstructed by the slow translocation of assimilates, poor pod setting due to flower abscission and lack of nutrient during critical stages of crop growth (Mahala *et al*., 2001).

About 70% of world's black gram production comes from India. In India, its total area, production and productivity is 4.63 million ha, 2.70 million tones and 570.27 kg/ha respectively (Agristats, 2022). In India blackgram is very popularly grown in Andhra Pradesh, Bihar, Madhya Pradesh, Maharashtra, U.P., West Bengal, Punjab, Haryana, and Karnataka .It is used as nutritive fodder especially for milch cattle. In Madhya Pradesh its total area, production and productivity is 130.7 lakh ha, 43.937 lakh tonnes and 341 kg/ha respectively (Anonymous 2022).

Foliar application is advantageous than soil application as it is most efficient way to feed the crop and stimulates root development and increases the resistance of the plant. Nutrients applied to the foliage are generally absorbed more rapidly and effectively than soil feeding. Foliar application provides a means of quickly correcting plant nutrient deficiencies, when identified on the plant. It often provides a convenient method of applying fertilizer materials especially those which are required in very small amounts and are highly soluble. When plant nutrients are applied straight to the foliage of plant, smaller quantities of the fertilizer material are required than when applying to the soil.

Materials and Methods:

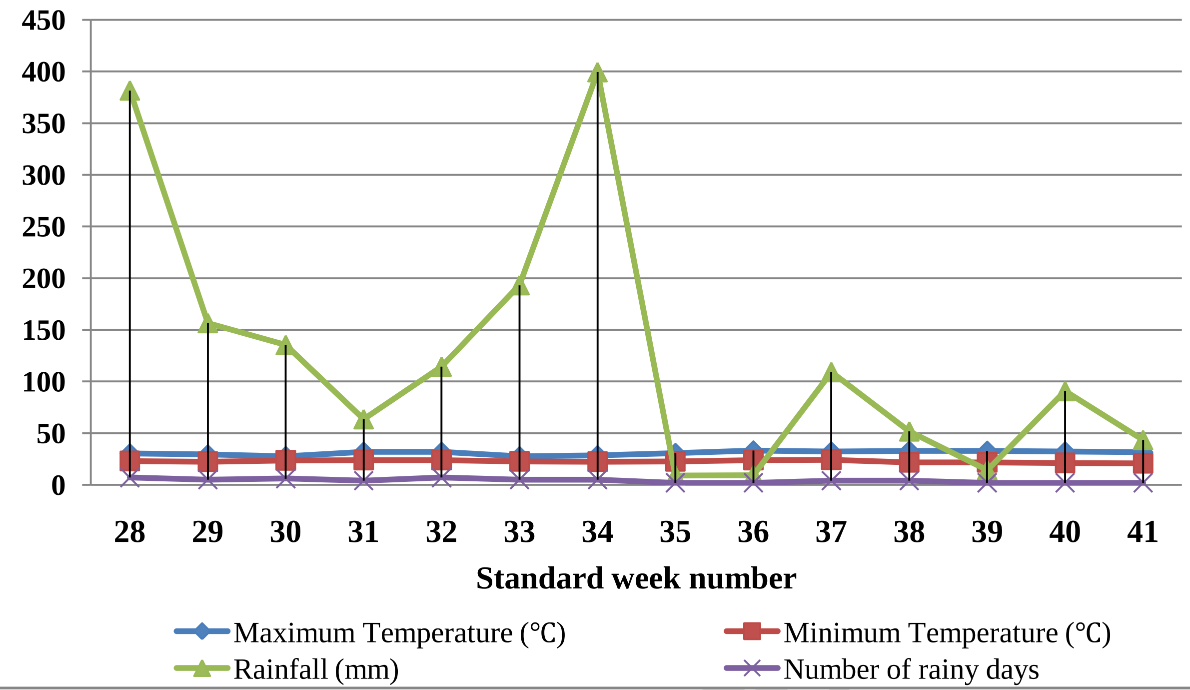
Experimental site

The present experiment was laid out at research farm of R.A.K. College of Agriculture, Sehore (M.P.) during Kharif season of 2022. The experimental area having fairly uniform topography, normal fertility status and soil homogeneity.

Climate and weather condition

Sehore is situated in the eastern part of Vindhyan Plateau in subtropical zone at the latitude of 23.1876° North and longitude of 77.0646° East at 498.77 m above mean sea level in Madhya Pradesh. The average rainfall varies from 1000 to1200 mm concentrated mostly from June to September. The mean annual maximum and minimum temperature are 31.16℃ and 18.50℃, respectively. The summer months are hot and May is the hottest month having a maximum temperature up to 45.60℃. Winter month experienced mild cold with an average temperature from 16.56℃ to 8.74℃, December is the coldest month as temperature reaches up to 5℃.

Fig. 1: Weekly meteorological data recorded at Sehore (M.P.) during crop season (From 9th July to 14 October 2022)



Treatment details T_1:- Water spray at pre-flowering stage and pod initiation stage, T_2:- 2% Spray of Urea at pre-flowering stage and pod initiation stage, T_3:- 2% Spray of DAP at pre-flowering stage and pod initiation stage, T_4:- 2% Spray of NPK (18:18:18) at pre-flowering stage and pod initiation stage, T_5:- 0.5% Spray of $ZnSO_4$ at pre-flowering stage and pod initiation stage, T_6:- 2% Spray of Urea + 0.5% Spray of $ZnSO_4$ at pre-flowering stage and pod initiation stage, T_7:- 2% Spray of DAP + 0.5% Spray of $ZnSO_4$ at pre-flowering and pod initiation stage, T_8:- 2% Spray of NPK (18:18:18) + 0.5% Spray of $ZnSO_4$ at pre-flowering and pod initiation stage.

Statistical analysis

The data obtained on various parameters were tabulated and subjected to statistical analysis by the method suggested by Fisher (1921).

Results and Discussion

Effect of foliar application of nutrients on yield

It was observed from the results that the treatment T_7 (2% Spray of DAP + 0.5% Spray of $ZnSO_4$ at pre-flowering and pod initiation stage) recorded significantly higher grain yield (0.834 kg $plot^{-1}$ and 786 kg ha^{-1} respectively) which was statistically similar with treatment T_8 (2% Spray of NPK (18:18:18) + 0.5% Spray of $ZnSO_4$ at pre-flowering and pod initiation) (0.804 kg $plot^{-1}$ and 756 kg ha^{-1} respectively) The lowest grain yield was recorded by treatment T_1 (Water spray at pre-flowering stage and pod initiation stage) i.e. 0.619 kg $plot^{-1}$ and 581 kg ha^{-1} respectively. It might be due to constant supply of nutrients due to foliar spray at reproductive stage of the crop and enhanced the yield components like number of pods/plant, number of seeds/pod, pod length and 100-seed weight, which had direct influence on the grain yield. It also might be due to increased uptake of nutrients by black gram by effective translocation of nutrients from source to reproductive area of crop. The findings are in agreement with earlier findings of Shashikumar *et al*., (2013) and Ramesh *et al*. (2016).

It might be due to the fact that DAP application contributed towards overall biomass production under rainfed condition and it also might be due to the enhancement in growth and yield parameter as well as uptake of nutrients by crop. Obviously, cumulative effects of these parameters might have contributed to increased grain yield potential of the black gram. This confirms the finding of Mondal *et al*. (2011), Sritharan *et al*. (2007), Sritharan *et al*. (2005), Bhowmick *et al*. (2014), Venkatesh *et al*., (2012), Mondal *et al*., (2012), Rajavel and Vincent (2009), Jeyakumar *et al*. (2008) and Malay and Bhowmick (2008). The similar results are also reported by Anu Lavanya (2011) in green gram, Sengupta *et al*. (2011) in soybean and Tahir *et al*. (2014) in mash bean.

Silage yield

Data on silage yield of black gram is affected by different foliar treatments. silage yield is directly related with increase in vegetative growth of the plant. It was observed from the data that the treatment T_7 recorded significantly higher silage yield (17.30 q/ha). The treatment T_8 (17.18 q/ha) and T_6 (16.54 q/ha) were found at par with treatment T_7 and rest of treatments found significantly lower straw yield. However, the lowest silage yield was recorded with treatment T_1 (14.45 q/ha) which was significantly inferior to the rest of the treatments. The increase in silage yield is directly related mainly to increase in the vegetative growth of the plant. It might be due to continuous supply of nutrients as basal and as nutrient spray which in turn increased the leaf area and dry matter accumulation resulting in higher straw yield. This is also attributed to higher nutrient uptake throughout the crop growth period. Similar finding is confirmed with the report of Mondal *et al*. (2011), Sritharan *et al*. (2007), Sritharan *et al*. (2005), Mondal *et al*., (2012), Rajavel and Vincent (2009) and Malay and Bhowmick (2008).

Biological yield

The biological yield of black gram was significantly affected due to different foliar nutrition treatments. The foliar nutrition with of treatment T_7 recorded significantly higher biological yield (25.16 q/ha) which was statistically at par with the treatment T_8 (24.74 q/ha) and T_6 (23.67 q/ha) and rest of treatments found significantly lower biological yield. However, the lowest straw yield was recorded with treatment T_1 (20.26 q/ha) which was significantly inferior to the rest of the treatments. The increased haulm yield might be due to continuous supply of nutrients which could have increased the leaf area and dry matter resulting in higher haulm yield (Kuttimani and Velayutham, 2011).

Table 1:- Effect of foliar application of nutrients on grain yield, haulm yield, biological yield and harvest index

Treatment	Seed yield (Kg plot^{-1})	Seed yield (q/ha)	Silage yield (q/ha)	Biological yield (q/ha)
T_1	0.619	581	1445	2026
T_2	0.721	677	1581	2258
T_3	0.749	702	1592	2294
T_4	0.681	640	1440	2080
T_5	0.705	662	1543	2204
T_6	0.761	712	1654	2367
T_7	0.836	786	1730	2516
T_8	0.804	756	1718	2474
S.Em (±)	**0.0200**	**18.89**	**36.96**	**53.59**
CD (5%)	**0.0607**	**57.29**	**112.10**	**162.54**

Effect of foliar application of nutrients on economics

Cost of Cultivation (₹ . ha^{-1})

Data embodied in Table 2 revealed that other treatment of fertilizers gave more income over water spray. The highest total cost of cultivation (₹ . 30459 ha^{-1}) was incurred under treatment 2% spray of NPK (18:18:18) + 0.5 % spray of ZnSO4 at pre-flowering and pod initiation stage (T_8) which was higher as compared to all the fertilizer treatments. Minimum cost of cultivation found in Control treatment (Water spray at pre-flowering stage and pod initiation stage) i.e. ₹ 24599 ha^{-1}.

Gross Return (₹ ha^{-1})

It can be interpreted from the data presented in table 2 and fig 1 that gross returns highest response was obtained with 2% Spray of DAP + 0.5% Spray of $ZnSO_4$ at pre-flowering and pod initiation stage i.e. ₹. 62550 ha^{-1} followed by 2% Spray of NPK (18:18:18) + 0.5% Spray of $ZnSO_4$ at pre-flowering and pod initiation stage (T_8) (₹. 60307 ha^{-1}). Gross return from water spray at pre-flowering stage and pod initiation stage was ₹ 46759 ha^{-1} was lower as compared to all the fertilizer spray. These were recorded highest due to treatment provided better nutritional environment resulted in higher productivity of grain as well as straw yield.

Net Return (₹ ha^{-1})

The data on net return of black gram as influenced by foliar application of different nutrients has been presented in Table 2 and depicted graphically in Fig 1 Net return varied significantly due to foliar application of different nutrients. Net return (₹. 36491 ha^{-1}) recorded under % Spray of DAP + 0.5% Spray of $ZnSO_4$ at pre-flowering and pod initiation stage (T_7) was found significantly superior than all other treatments and followed by 2% Spray of Urea + 0.5% Spray of $ZnSO_4$ at pre-flowering stage and pod initiation stage (₹. 31753 ha^{-1}). While the lowest net return (₹. 22160 ha^{-1}) was obtained in control (water spray at flower initiation-T_1. This was due to higher gross return of treatment other than control. These finding are well supported by the work of Gupta *et al*., (2011), Deshmukh *et al*. (2008) and Thakare *et al*. (2006). Similar observations were also recorded by Yakadri and Ramesh (2002), Chandrasekhar and Bangarusamy (2003), Shashikumar *et al*. (2013), Maheswari and Karthik (2017).

4.4.4 Benefit : Cost

A close analysis of data indicated that Benefit : Cost ratio varied significantly among foliar application of different nutrients. Highest Benefit : Cost ratio of 2.40 was found out under 2% Spray of DAP + 0.5% Spray of $ZnSO_4$ at pre-flowering and pod initiation stage (T_7) than all other treatments, followed by 2% Spray of Urea + 0.5% Spray of $ZnSO_4$ at pre-flowering stage and pod initiation stage (T_6), 2% Spray of DAP at pre-flowering stage and pod initiation stage and 2% Spray of Urea at pre-flowering stage and pod initiation stage. Lowest Benefit: Cost ratio of 1.90 was found in control plot (water spray at flower initiation-T_1). This was due to higher gross return as compare to cost of cultivation. These finding are well supported by the work of Gupta *et al*., (2011), Deshmukh *et al*. (2008) and Thakare *et al*.

(2006). Similar observations were also recorded by Yakadri and Ramesh (2002), Chandrasekhar and Bangarusamy (2003), Shashikumar *et al*. (2013), Maheswari and Karthik (2017).

Table 2:- Effect of foliar application of nutrients on economics of black gram

Treatment	Cost of Cultivation (₹ ha^{-1})	Gross Return (₹ ha^{-1})	Net Return (₹ ha^{-1})	B:C Ratio
T_1	24599	46759	22160	1.90
T_2	24835	54197	29362	2.18
T_3	25679	56024	30345	2.18
T_4	30079	51040	20961	1.70
T_5	24979	52927	27948	2.12
T_6	25215	56968	31753	2.26
T_7	26059	62550	36491	2.40
T_8	30459	60307	29847	1.98

Conclusion

Blackgram is the most important pulse crop cultivated in India. It is cultivated majorly under rainfed condtion in energy starved situation. Hence there is a need to increase the production potential of blackgram under rainfed condition. From the present investigation application of 2% Spray of DAP + 0.5% Spray of $ZnSO_4$ at pre-flowering and pod initiation stage (T_7) can be recommended to produce the economically sound yield under rainfed condition.

References

Agricultural Statistics at a Glance. (2022). Directorate of Economics and Statistics, Ministry of Agriculture, Government of India.

Anonymous (2022). Directorate of Economics and statistics. Krishi.bih.nic.in

Anonymous (2022). Ministry of Agriculture and farmers welfare, Govt. of India.

AnuLavanya, G and Ganapathy, M. (2011) Effect of DAP, NAA and residual effect of inorganic fertilizers andorganic manures on growth and yield of green gram in rice based cropping sequence. *Journal of Agricultural Technology*, **7**(3): 599-604.

Asaduzzaman, M.; Sultana, S.; Roy, T.S. and Masum, S.M. (2010). Weeding and plant spacing effects on the growth and yield of blackgram. *Bangladesh Res. Publication J*., **4**(1): 62-68.

Bhowmick, M.K.; Dhara, M.C.; Duary, B.; Biswas, P.K. and Bhattacharyya, P. (2014). Improvement of lathyrus productivity through seed priming and foliar nutrition under rice-utera system. *Journal of Crop and Weed*, **10**(2): 277-280.

Chandrashekar, C.N. and Bangarusamy, U. (2003). Maximizing the yield of mungbean by foliar application of growth regulating chemicals and nutrients. *Madras Agricultural Journal*, **90**(1-3):142-145.

Deshmukh, S.G.; Kale, H.B and Solunke, P.S. (2008). Influence of graded fertility levels and urea spray on growth, yield and economics of rajmah. *Annals.of Plant Physiol*., **22**(2): 189-191.

Fisher, R.A. (1921). Some remarks on the method formed in a article on the quantitative analysis of plant growth. *A. Appl. Bio*. 7: 367-372.

Jeyakumar; Yelu, G.; Rajendran, C.; Amutha, R.; Savery, M.A.J.R. and Chidambaram. S. (2008). Varied response of blackgram to certain foliar applied chemical and plant growth regulator. *Legume Res. Int. J*., **31**:105-109.

Kuttimani, R and Velayutham, A. (2011). Foliar application of nutrients and growth regulators on yield and economics of green gram. *Madras Agricultural Journa*l, **98**(4-6): 141-143.

Mahala, C.P.S.; Dadheech, R.C. and Kulhari, R.K. (2001). Effect of plant growth regulators on growth and yield of blackgram (*Vigna mungo* L.) at varying level of phosphorous. *Crop Res*., **18**(1): 163-165.

Maheswari, U. M.; and Karthik, A. (2017). Effect of foliar nutrition on growth, yield attributes and seed yield of pulse crops. *Advances in Crop Science Technology*, **5**(3): 278.

Malay, K. and Bhowmick. (2008). Effect of foliar nutrition and basal fertilization in lentil under rainfed conditions. *J. Food Leg*., **21**(2): 115-116.

Mohanty, S. and Satyasai, K. J. (2015). Feeling the pulses. NABARD Rural pulse, 10: 1-4.

Mondal, M.M.A.; Rahman, M.A., Akter, M.B. and Fakir, M.S.A. (2011). Effect of foliar application of nitrogen and micronutrients on growth and yield of mungbean. *Legume Research*, **34**(3):166-171.

Rajavel, M. and Vincent, S. (2009). Influence of nutrients and hormones on yield maximization of black gram. *Journal of Ecobiology*, **24**(4): 387- 394.

Ramesh, T.; Rathika., S.; Parthipan, T. and Ravi, V. (2016). Productivity enhancement in black gram through refinement of nutrient management under rice fallow condition. Agril. Res. Communication Centre, **39**(1): 106-109.

Sengupta, K and Tamang, D. (2015). Response of green gram to foliar application of nutrients and Brassinolide. *Journal Crop and Weed*. **11** (1): 43-45.

Shashikumar, R.; Basavarajappa, S.R.; Salakinkop, Manjunatha H.; Basavarajappa, M.P. and Patil H.Y. (2013). Influence of foliar nutrition on performance of Black gram (*Vigna mungo* L.), nutrient uptake and economics Under dry land ecosystems. *Legume Research*, **36**(5):422- 428.

Sritharan, N.; Anitha, R. and Mallika, V. (2007). Foliar spray of chemicals and plant growth regulator on growth attributes and yield of black gram (*Vigna mungo* L.). *Plant Archives*, **7**(1): 353-355.

Sritharan, N; Aravazhi, A. and Vanangamudi, M. (2005). Study the morphological physiological and biochemical effects of foliar spray of nutrients and plant growth regulators on yield and productivity of black gram. *Madras Agricultural Journal*, **92**(4-6):301-307.

Suhathiya, K and Ravichandran, M. (2018). Effect of foliar application of DAP and micronutrients on crop growth attributes and yield of rice fallow blackgram (*Vigna mungo* L.). *Int. J. Adv. Res. Biol. Sci*., **5**(4): 72-76.

Suneja, Y.; Grewal, S.K.; Gupta, A.K. and Kaur, N. (2011). Levels of nutritional constituents and antinutritional factors in black gram (*Vigna mungo* L. Hepper). *Food Research International*, **44**(2):621-628.

Tahir, M.; Maqbool, R.; Majeed, A.; Rehman, A.U. and Zafar, M.A. (2014). Potential of foliar applied DAP and K in achieving maximum productivity of black gram. Pakistan. *Journal of Agronomy*, **7**(3): 147-49.

Thakare, G. K.; Chore, C.N.; Deotale, R.D.; Kamble, P.S.; Pawar, B. S. and Lende, R.S. (2006). Influence of nutrients and hormones on biochemical and yield and yield attributing parameters of soybean. *J. Soils and Crops*, **16**(1): 210-216.

Venkatesh, M.S; Basu, P.S and Vedram (2012). Effect of foliar application of nitrogenous fertilizers on productivity of chickpea under rainfed conditions. *Legume Research*, **35** (3): 231-234.

Yakadri, M. and Ramesh, T. (2002). Effect of soil application of potassium and DAP spray in blackgram (*Vigna mungo* L.). *Madras Agric. J*., **89**(9): 1.