Biological Forum – An International Journal **15(1): 632-637(2023)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Efficacy of Foliar Application of Nutrients and Growth Promoter (NAA) on Yield and Economics of Black Gram (*Vigna mungo* L.)

Khushboo Kumari[1*], R.P. Manjhi[2], Ashok Kumar Singh[2], Sheela Barla[2] and P. Mahapatra[3]

[1]PG Student, Department of Agronomy, BAU, Ranchi (Jharkhand), India.
[2]Assistant Professor, Department of Agronomy, BAU, Ranchi (Jharkhand), India.
[3]Assistant Professor, Department of Soil Science, BAU, Ranchi (Jharkhand), India.

(Corresponding author: Khushboo Kumari)*
(Received: 05 December 2022; Revised: 13 January 2023; Accepted: 19 January 2023; Published: 23 January 2023)
(Published by Research Trend)

ABSTRACT: A field experiment was carried out during kharif 2019 at Research Farm of Agronomy, Birsa Agricultural University, Kanke, Ranchi to assess the effect of foliar application of nutrients and growth promoter (NAA) on yield, yield attributes and economics of Blackgram. The experiment was carried out in RBD (Randomized Block Design) having twelve treatments replicated thrice. Maximum number of nodules per plant (34.78) was recorded in treatment T_3 (DAP @ 1% + NAA @40ppm along with RDF). Maximum number of pods per plant (35), number of grains per pod (4.73) and 1000-grain weight (35.39 g) were recorded highest with T_3. Maximum grain yield (1331 kg ha^{-1}), higher gross return (₹ 76,866 ha^{-1}), net return (₹ 53,919 ha^{-1}) and B:C ratio (2.35) was recorded with application of DAP @ 1% + NAA @ 40ppm along with RDF.

Keywords: Foliar application, DAP, Urdbean, growth promoter (NAA), yield attributes, economics.

INTRODUCTION

Pulses are often named as food legumes which rank second to cereals in production and consumption in our country. Pulses are integral part of human diet which is primary source of dietary protein, minerals, vitamins and energy, for the humankind. Being the inexpensive source of protein, they ensure nutritional security in our country and also play an essential role in upgrading the soil nutrient status through biological nitrogen fixation acting as a mini factory for boosting soil health (Pooniya *et al*., 2015). India is the major consumer and producer of pulses in the world accounting for about 19 per cent of the world's production out of 29 per cent of the world acreage. In India, pulses are cultivated in 29.27-million-hectare area with production 22.40 million tonnes and productivity of 765kg ha^{-1} (Anonymous, 2016). DES, 2016- 3rd Advance Estimate).

The important pulses grown in India are chickpea, red gram, green gram, black gram, cowpea, lentil and field pea etc. Among these pulses, black gram (*Vigna mungo* L.), is an important kharif season crop well suited under intensive cropping systems due to its short duration. In India, black gram is grown in an area of 3.47 mha with a production of 2.17 mt. In Jharkhand, it occupies an area of 128.6 ha with the production of 109.5 tonnes. The average productivity of black gram in Jharkhand (851 kgha^{-1}) (Anonymous, 2018) is high as compared to India's productivity 626 kgha^{-1} (Anonymous, 2016).

Black gram grown throughout India is a significant pulse crop in rainfed areas. Black gram or urdbean is grown as a sole crop, mixed crop, cash crop or crop under rainfed or semi–irrigated condition in *kharif* and zaid season. It contains 48.0% carbohydrates, 1.4 g fat, 22.3% protein, 154 mg calcium, 9.1 mg iron, 0.42 mg thiamin and 0.37 g riboflavin in per 100 g of blackgram (Asaduzzaman *et al*., 2010). Black gram is an essential part of balanced human nutrition due to high values of lysine and also rich in phosphoric acid.

The yield of urdbean is less due to the fact that, the crop is mainly cultivated in rainfed conditions with inferior management practices and also due to various physiological as well as biochemical factors associated with the crop. Besides the inherited factor, the physiological factor *viz*., inadequate partitioning of assimilates, poor pod setting due to the flower abscission and inadequacy of nutrient during critical stages of crop growth play a significant role in declined black gram production was coupled with a number of diseases and pests (Mahala *et al*., 2001).

The productivity of pulse crop in our country including black gram is not sufficient to meet the demand of growing population. Hence, there is an ample scope for augmenting the productivity of black gram by proper agronomic practices.

Various strategies were initiated to boost up the productivity of urdgram. One of them is the foliar spray of organic and inorganic sources of nutrients for efficiently utilising genetic potential of the crop. Nutrients play a pivotal role in enhancing the seed yield in pulses (Chandrasekhar and Bangarusamy 2003). Foliar spray of nutrients ascribed with the advantage of prompt and efficient utilization of nutrients, reduction in leaching losses, losses due to fixation and helps in regulating the utilisation of nutrient by plants (Manonmani and Srimathi 2009).

Foliar application of nutrient and growth regulator at pre-flowering and post flowering stages resulted in the decrease in abscission of flower percentage in urdgram (Ganapathy *et al*., 2008).

MATERIALS AND METHODS

A field experimentation was carried out at the Agronomy Research Farm of Birsa Agricultural University, Kanke, Ranchi in the kharif season 2019 and was laid out in Randomized Block Design (RBD) replicated thrice with twelve number of treatments to study the efficacy of foliar application of nutrients and growth promoter (NAA) on yield and economics of black gram (*Vigna mungo* L.).

Black gram cultivation requires about 600-750 mm annual downfall during the growing season for optimal production. The crop obtained 139.9, 350.5 and 284.3 mm of rainfall during July, August and September respectively during the crop period.

Treatment consists of applying nutrients to the leaves along with the recommended dose of fertilizer i.e. T_1: RDF + Control (water spray), T_2: RDF + Urea @ 2%, T_3: RDF + DAP @ 1%, T_4: RDF + MOP @ 1%, T_5: RDF + $Mg(NO_3)_2$ @ 1%, T_6: RDF + H_3BO_3 @ 0.5%, T_7: RDF + NAA @ 40ppm, T_8: RDF + Urea @ 2% + NAA @40ppm, T_9: RDF + DAP @ 1% + NAA @40ppm, T_{10}: RDF + MOP @ 1% + NAA @40ppm, T_{11}: RDF + $Mg(NO_3)_2$ @ 1% + NAA @40ppm, T_{12}: RDF + H_3BO_3 @ 0.5% + NAA @40ppm. The entire field was divided into three blocks; each representing a replication. The variety WBU-109 released in 2008 by PORS, WB with an average yield of 12-14 q/ha. It possesses resistance against Yellow Mosaic Virus and matures in 75 days.

RESULTS AND DISCUSSIONS

Effect of foliar application of nutrients and growth promoter on yield and yield attributes of black gram. The data on number of flower and pod per plant of black gram was observed at 35, 40, 45, 50, 55 and 60 DAS as influenced by different treatments are shown in Table 1 and 2).

Maximum number of pods per plant (35) registered with the application of RDF (25:50:25 kg $N:P_2O_5:K_2O$ ha^{-1}) as basal + DAP @ 1% + NAA @40ppm spray (T9). The foliar application of DAP @ 1% + NAA @40ppm might have reduced flower abscission. This could have significantly increased the number of pods per plant. Increased supply of nutrients in the flower initiation stage of plant growth may have induced efficient translocation of photosynthates from source to sink. Decreased flower drop due to prolonged leaf assimilation activity could be another possible reason for a higher number of pods per plant.

Table 1: Effect of foliar application of nutrients and growth promoter on number of flower count.

Treatments	35 DAS	40 DAS	45 DAS	50 DAS	55 DAS	60 DAS
T_1: RDF* + Control (water spray)	3	7	8	9	8	3
T_2: RDF* + Urea @ 2% spray	4	9	9	9	9	4
T_3: RDF* + DAP @ 1%	4	10	10	10	9	3
T_4: RDF* + MOP @ 1%	4	9	10	10	9	4
T_5: RDF* + $Mg(NO_3)_2$@ 1%	3	9	9	9	10	4
T_6: RDF* + H_3BO_3@ 0.5%	4	9	10	10	10	4
T_7: RDF* + NAA @ 40ppm	4	10	9	10	9	5
T_8: RDF* + Urea @ 2% + NAA @40ppm	5	10	9	10	10	2
T_9: RDF* + DAP @ 1% + NAA @40ppm	5	9	10	10	9	4
T_{10}: RDF* + MOP @ 1% + NAA @40ppm	5	8	10	9	10	4
T_{11}: RDF* + $Mg(NO_3)_2$@ 1% + NAA @40ppm	4	9	10	10	10	3
T_{12}: RDF* + H_3BO_3@ 0.5% + NAA @40ppm	5	8	10	9	10	4
SEm±	0.49	0.90	0.79	0.69	0.42	0.97
CD(P=0.05)	NS	2.35	NS	NS	1.18	2.76
CV (%)	8.13	8.29	8.08	8.34	8.20	8.11

Table 2: Effect of foliar application of nutrients and growth promoter on number of pod count.

Treatments	35 DAS	40 DAS	45 DAS	50 DAS	55 DAS	60 DAS
T_1: RDF* + Control (water spray)	0	2	7	12	17	27
T_2: RDF* + Urea @ 2% spray	0	3	10	17	24	34
T_3: RDF* + DAP @ 1%	0	4	12	18	28	37
T_4: RDF* + MOP @ 1%	0	4	9	17	25	33
T_5: RDF* + $Mg(NO_3)_2$@ 1%	0	3	9	16	24	32
T_6: RDF* + H_3BO_3@ 0.5%	0	3	11	18	27	35
T_7: RDF* + NAA @ 40ppm	0	4	11	17	26	35
T_8: RDF* + Urea @ 2% + NAA @40ppm	0	4	12	19	30	37
T_9: RDF* + DAP @ 1% + NAA @40ppm	0	4	12	20	28	39
T_{10}: RDF* + MOP @ 1% + NAA @40ppm	0	4	9	17	25	34
T_{11}: RDF* + $Mg(NO_3)_2$@ 1% + NAA @40ppm	0	3	9	18	26	35
T_{12}: RDF* + H_3BO_3@ 0.5% + NAA @40ppm	0	5	12	18	27	36
SEm±	-	0.81	0.76	0.90	0.82	0.94
CD(P=0.05)	-	2.32	2.15	2.51	2.33	2.65
CV (%)	-	8.14	8.20	11.45	12.10	10.17

Since the number of pods is considered to be the main yield factor in the cultivation of black gram, foliar feeding of N through the urea source could increase the number of pods. This observation is supported by the report of Ganapathy *et al.* (2008). Similar finding was also reported by Venkatesh *et al.* (2012); Mondal *et al.* (2011); Sritharan *et al.* (2005); Reddy *et al.* (2005).

Table 3: Effect of foliar application of nutrients and growth promoter on yield attributes of black gram.

Treatments	Yield attributes		
	No. of pods/plant	No. of seeds/pod	1000 seed weight (g)
T_1: RDF* + Control (water spray)	21	3.03	31.32
T_2: RDF* + Urea @ 2% spray	30	3.33	34.40
T_3: RDF* + DAP @ 1%	32	3.53	34.90
T_4: RDF* + MOP @ 1%	26	3.07	33.26
T_5: RDF* + $Mg(NO_3)_2$@ 1%	28	3.13	33.28
T_6: RDF* + H3BO3@ 0.5%	30	3.27	33.69
T_7: RDF* + NAA @ 40ppm	29	3.20	32.98
T_8: RDF* + Urea @ 2% + NAA @40ppm	33	4.60	35.24
T_9: RDF* + DAP @ 1% + NAA @40ppm	35	4.73	35.39
T_{10}: RDF* + MOP @ 1% + NAA @40ppm	27	3.13	33.26
T_{11}: RDF* + $Mg(NO_3)_2$@ 1% + NAA @40ppm	29	3.20	33.69
T_{12}: RDF* + H3BO3@ 0.5% + NAA @40ppm	31	3.47	34.11
SEm±	2.40	0.24	1.45
CD(P=0.05)	7.04	0.70	NS
CV (%)	14.25	5.67	4.24

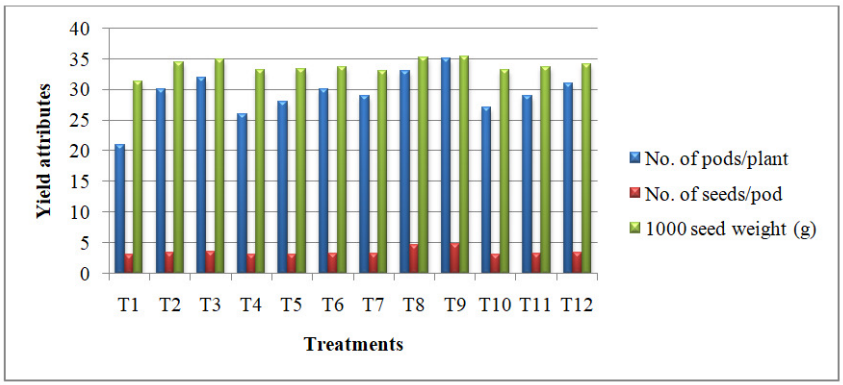

Fig. 1. Yield attributes as influenced by different foliar nutrient practices in black gram.

Table 4: Effect of foliar application of nutrients and growth promoter on grain, straw yield and harvest index of black gram.

Treatments	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Harvest index
T_1: RDF* + Control (water spray)	501	661	43.10
T_2: RDF* + Urea @ 2% spray	1085	1497	42.02
T_3: RDF* + DAP @ 1%	1112	1568	41.49
T_4: RDF* + MOP @ 1%	592	793	42.74
T_5: RDF* + $Mg(NO_3)_2$@ 1%	708	956	42.55
T_6: RDF* + H_3BO_3@ 0.5%	730	993	42.37
T_7: RDF* + NAA @ 40ppm,	559	743	42.92
T_8: RDF* + Urea @ 2% + NAA @40ppm	1267	1837	40.82
T_9: RDF* + DAP @ 1% + NAA @40ppm	1331	1997	40.00
T_{10}: RDF* + MOP @ 1% + NAA @40ppm	674	904	42.74
T_{11}: RDF* + $Mg(NO_3)_2$@ 1% + NAA @40ppm	745	1021	42.19
T_{12}: RDF* + H_3BO_3@ 0.5% + NAA @40ppm	927	1280	42.02
SEm±	90.03	125.15	4.72
CD(P=0.05)	264.04	367.03	NS
CV (%)	18.29	18.26	15.79

Application of RDF (25:50:25 kg N: P_2O_5:K_2O ha^{-1}) as basal + DAP @ 1% + NAA @40ppm spray at flower initiation stages of crop growth received maximum 1000 seed weight (35.39 g). The increased 1000 seed weight could be attributed to greater mobilisation of metabolites towards reproductive sinks. This confirms the finding of Mondal *et al.* (2011); Sritharan *et al.* (2005); Reddy *et al.* (2005).

Black gram crop fertilized with RDF (25:50:25 kg N: P_2O_5:K_2O ha^{-1}) as basal along with DAP @ 1% + NAA @40ppm spray (T_9) produced significantly higher grain yield (1331.00 $kgha^{-1}$) mainly because of increased nutrient intake and reduced nutrient losses. Thus, it reduced flower drop and ultimately improved pod set and resulted in higher seed yields.

NAA may have increased the rate of assimilation as evidenced by rise in chlorophyll content and Hill activity in the leaves. It is assumed that increase in yield of crop by application of NAA might occur through enhancement of assimilatory rate in conjunction with increased production of sugar, starch and protein content in the leaf followed production at several growth stages were largely found responsible for variance observed by accumulation of these biochemical components into major sink. The difference in dry matter yield and yield components might be because DAP application contributed towards overall biomass production under non-irrigated condition and it also could be due to the improvement in growth and yield parameter as well as absorption of nutrients by crop. This confirms the finding of Mondal *et al.* (2011); Sritharan *et al.* (2005); Bhowmick *et al.* (2014); Venkatesh *et al.* (2012); Rajavel and Vincent (2009); Jeyakumar *et al.* (2008); Malay and Bhowmick (2008).

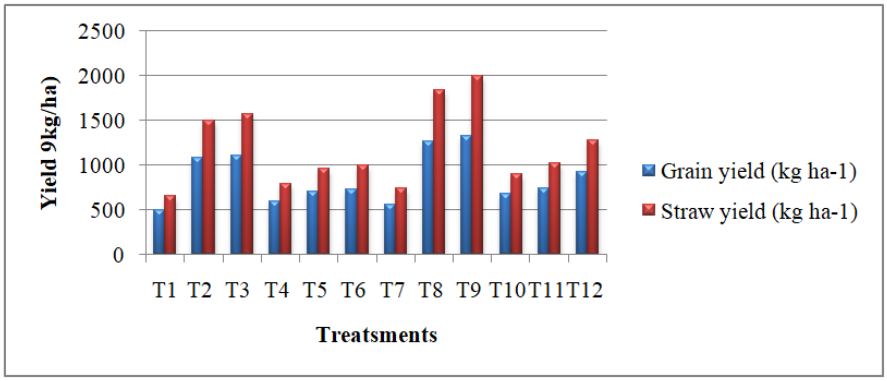

Fig. 2. Grain and straw yield as influenced by different foliar nutrient practices in black gram.

Application of RDF (25:50:25 kg N: P_2O_5:K_2O ha^{-1}) as basal along with DAP @ 1% + NAA @40ppm spray (T_9) produced significantly higher straw yield (1997 $kgha^{-1}$). The rise in straw yield is directly associated to the rise in vegetative growth of the plant. It was largely because of the maximum plant height. It could be because of uninterrupted supply of nutrients as basal and as nutrient application which in turn enhanced the leaf area and dry matter accumulation resulting in higher straw yield. Similar finding is confirmed with the report of Mondal *et al*. (2011); Sritharan *et al*. (2005); Rajavel and Vincent (2009); Malay and Bhowmick (2008).

The harvest index did not vary much among the treatments and found non-significant. The maximum harvest index was recorded with application of RDF (25:50:25 kg N: P_2O_5: K_2O ha^{-1}) as basal + water (control) (43.10 %). This may be because nitrogen and phosphorous are responsible in affecting the yield attributing characters like pods per plant and seeds per pod, which eventually influenced the grain yield and straw yield.

Effect of foliar application of nutrients and growth promoter on economics of black gram production. Performance of crop production system is assessed not only on the basis of crop yield but on their economic return also. Net return and benefit: Cost ratios are the ways to assess the economic viability of any crop production system.

Table 5: Effect of foliar application of nutrients and growth promoter on economics of black gram.

Treatments	Cost of cultivation (₹/ha)	Gross return (₹/ha)	Net return (₹/ha)	B:C ratio
T_1: RDF* + Control (water spray)	22682	28888	6206	0.27
T_2: RDF* + Urea @ 2% spray	22757	62594	39837	1.75
T_3: RDF* + DAP @ 1%	22838	64168	41330	1.81
T_4: RDF* + MOP @ 1%	22781	34141	11360	0.50
T_5: RDF* + $Mg(NO_3)_2$@ 1%	26582	40834	14252	0.54
T_6: RDF* + H_3BO_3@ 0.5%	22972	42107	19135	0.83
T_7: RDF* + NAA @ 40ppm	22791	32235	9444	0.41
T_8: RDF* + Urea @ 2% + NAA @40ppm	22866	73138	50272	2.20
T_9: RDF* + DAP @ 1% + NAA @40ppm	22947	76866	53919	2.35
T_{10}: RDF* + MOP @ 1% + NAA @ 40ppm	22890	38870	15980	0.70
T_{11}: RDF* + $Mg(NO_3)_2$@ 1% + NAA @40ppm	26691	42976	16285	0.61
T_{12}: RDF* + H_3BO_3@ 0.5% + NAA @40ppm	23081	28888	30398	1.32
SEm±	-	5194.52	2372.96	0.09
CD(P=0.05)	-	15233.63	6959.03	0.27
CV (%)	-	18.29	15.99	14.49

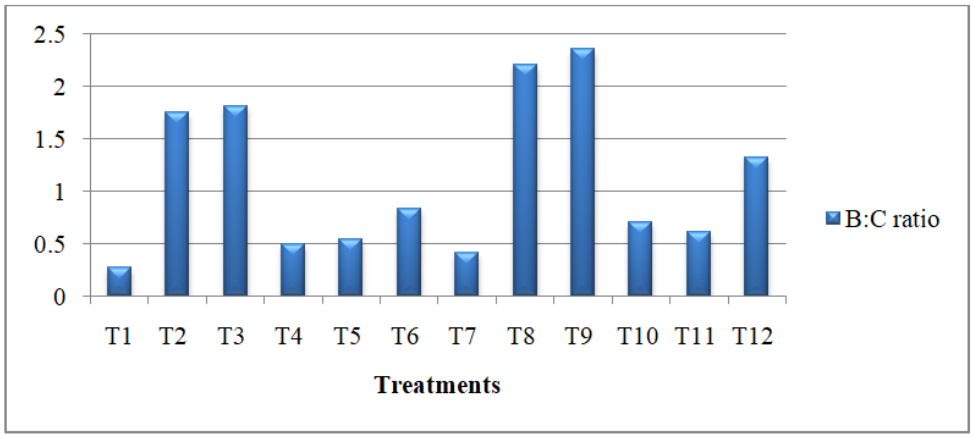

Fig. 3. B:C ratio as influenced by different foliar nutrient practices in black gram.

Economics of black gram production depends on various factors namely input cost, labour requirements and most importantly the weather conditions prevailing during the crop period. The highest benefit-cost ratio (2.35) was registered in RDF (25:50:25 kg N: P_2O_5:K_2O ha^{-1}) as basal along with DAP @ 1% + NAA @40ppm spray (T_9) which signifies that the DAP @ 1% + NAA @40ppm spray is the economical cultural practice in attaining good grain yield with least production cost. These finding are well supported by the work of Gupta *et al.* (2011); Deshmukh *et al.* (2008); Thakare *et al.* (2006).

CONCLUSIONS

Based on the results of the above findings, it may be concluded that foliar application of DAP @ 1% + NAA @ 40ppm at 30DAS and 45 DAS along with RDF (25:50:25::N: P_2O_5:K_2O kg ha^{-1}) produced higher yield attributing characters like grain yield as well as straw yield with highest net return and benefit cost ratio making it more productive economically viable for the farmers in Jharkhand.

FUTURE SCOPE

As foliar application is a method of prompt correction of nutrient deficiency in plants, it can also be applied in combination with insecticides, fungicides, herbicides etc for environment friendly cultivation of black gram also saves cost of cultivation.

REFERENCES

Anonymous (2016). Ministry of Agriculture and Farmers Welfare, Govt. of India.

Anonymous (2016). Agricultural statistics at glance, Directorate of Economics and Statistics. Department of Agriculture and Co-operation, Ministry of Agriculture and Farmers Welfare, Govt. of India.

Anonymous (2018). Ministry of Agriculture and Farmers Welfare, Govt. of India.

Asaduzzaman, M., Sultana, S., Roy, T. S. and Masum, S. M. (2010). Weeding and plant spacing effects on the growth and yield of blackgram (*Vigna mungo* L.). *Bangladesh Research 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.

Chandrasekhar, C. N. and Bangarusamy, U. (2003). Maximizing the yield of mung bean (*Vigna radiata* L.). by foliar application of growth regulating chemicals and nutrients. *Madras Agric. J.*, *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 rajma (*Phaseolus vulgaris* L.). *Annals. of Plant Physiol*., *22*(2), 189-191.

Ganapathy, M., Baradhan, G. and Ramesh, N. (2008). Effect of foliar nutrition on reproductive efficiency and grain yield of rice fallow pulses. *Leg. Res*., *31*(2), 142-144.

Gupta, S. C., Sanjeevkumar and Khandwe (2011). Effect of biofertilizer and foliar spray of urea on symbiotic traits, nitrogen uptake and productivity of chickpea (*Cicer arietinum* L.). *J. Food legume*, *24*(2), 155-157.

Jeyakumar, P., Velu, G., Rajendran, C., Amutha R. and Chidambaram, S. (2008). Varied responses of black gram (*Vigna mungo* L.) to certain foliar applied chemicals and plant growth regulators. *Legume Res.*, *31*(2), 110-113.

Mahala, C. P. S., Dadheech, R. C. and Kulhari, R. K. (2001). Effect of plant growth regulators on growth and yield of black gram (*Vigna mungo* L.) at varying levels of phosphorus. *Crop Res., 18*(1), 163-165.

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

Manonmani, V. and Srimathi, P. (2009). Influence of mother crop nutrition on seed and quality of black gram (*Vigna mungo* L.). *Madras Agric. J., 96*(16), 125-128.

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 in mung bean (*Vigna radiata* L.). *Legume Res*., *34*(3), 166-171.

Pooniya, V., Choudhary, A. K., Dass, A., Bana, R. S., Rana, K. S., Rana, D. S., Tyagi, V. K and Puniya, M. M. (2015). Improved crop management practices for sustainable pulse production: An Indian perspective. *Indian Journal of Agricultural Sciences, 85*(6), 747-758.

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

Reddy, M., Padmaja, B., Rao, L. J. and Radhakrishna, K. V. (2005). Effect of foliar spray of urea on nitrogen

uptake and yield of urdbean (*Vigna mungo* L.) under rainfed conditions. *Indian J. Dryland Agric. Res. Develop*., *20*(2), 151-154.

Sritharan, Anitha, A. and Mallika, V. (2005). Effect of foliar sprays of nutrients and plant growth regulators (PGRs) for yield maximization in black gram (*Vigna mungo* L.). *Madras Agric. J*., *92*(4-6), 301-307.

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 bio-chemical and yield and yield attributing parameters of soybean (*Glycine max* L.). *J. Soils and Crops*, *16*(1), 210-216.

Venkatesh, M. S., Basu, P. S. and Vedram (2012). Effect of foliar application of nitrogenous fertilizers for improved productivity of chickpea (*Cicer arietinum* L.) under rainfed conditions, *Legume Res*., *35*(3), 231-234.

How to cite this article: Khushboo Kumari, R.P. Manjhi, Ashok Kumar Singh, Sheela Barla and P. Mahapatra (2023). Efficacy of Foliar Application of Nutrients and Growth Promoter (NAA) on Yield and Economics of Black Gram (*Vigna mungo* L.). *Biological Forum – An International Journal, 15*(1): 632-637.