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EFFICACY OF NUTRIENT SPRAY ON GROWTH, YIELD AND ECONOMICS OF *ZAID* BLACK GRAM (*VIGNA MUNGO*)

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ABSTRACT

A field experiment was conducted on Black gram during the *Zaid* season 2024, at Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Prayagraj, (U.P.). The experiment was laid out in completely randomized block design with ten treatments each three replicated thrice. Treatments comprised of foliar spray of different nutrients. Treatments include T_1: Urea at 20g/l of water, T_2: DAP at 20g/l of water, T_3: Potassium nitrate at 20g/l of water, T_4: Potassium chloride at 2g/l of water, T_5: NPK (19-19-19) at 20g/l of water, T_6: Boron 0.25% spray at 2.5g/l of water, T_7: $ZnSO_4$ at 5g/l of water, T_8: Salicylic acid at 100 mg/l of water, T_9: Water spray and T_{10}: Control (20-40-20 kg/ha) each replicated thrice. The soil of the experimental site was found to be well drained and sandy loam in texture with neutral soil pH (7.2), high organic carbon (0.42%), medium available nitrogen (189 kg/ha), available phosphorous (27.2 kg/ha) and available potassium (221.8 kg/ha). Results revealed that higher plant height (18.71 cm) was obtained in the T_3 (Potassium nitrate at 20g/l of water), higher number of nodules/plant (21.00) were recorded with the T_6 (Boron at 2.5g/l of water). Foliar spray of urea at 20 g/l *i.e.* T_1 of water at pre flowering and pod initiation was found to be effective in obtaining higher productivity and economic profitability. Higher seed yield (511.67 kg/ha), stover yield (1816.93 kg/ha), gross returns (49683.85INR/ha), net returns (30333 INR/ha) and B:C ratio (1.57) was noticed with T_1 (Foliar spray of urea at 20 g/l of water) in black gram. It is concluded that foliar spray of urea at 20 g/l of water at pre-flowering and pod filling stage recorded highest yield and profitability in blackgram.

Keywords **:** Black gram, Foliar spray, Profitability, Urea, Yield.

Introduction

In India, black gram (*Vigna mungo* L.), also referred as urdbean, is a very important pulse crop that improves soil fertility through biological nitrogen fixation and makes a substantial contribution to both the agricultural economy and nutritional security of the country. (Ali and Gupta, 2012; Rao *et al*. 2015). Out of all the pulses grown in India, Black gram comes in third in terms of production, after pigeon pea and chickpea. Black gram contains 23-25% protein, 60-65% carbohydrates, 1-1.4% oil, 3-5% fibre and 4-5.5% ash on dry weight basis. In India, Black gram covers an area of around 6.96 lakh hectares, with an annual production of 20.55 lakh tonnes and an average productivity of around 600 kg/ha in 2023–2024 (Anonymous, 2024). In Uttar Pradesh the area under black gram during 2023-24 was 6.08 lakh hectares with a annual production of around 2.82 lakh tonnes with a average productivity of 465 kg/ha (Anonymous, 2023). Some of the primary factors that determine the productivity of black gram are the availability of nutrients that are essential for plant growth and productivity. Deficiencies in essential micronutrients and macronutrients may possess a significant impact on vegetative growth, pod formation, and vegetative growth (Singh *et al*. 2018). Conventional soil fertilization techniques frequently have inefficiencies as a consequence of nutrient losses through fixation, volatilization, and leaching, which results in inadequate nutrient absorption and higher cost of production (Mandal *et al*. 2019). To address these challenges, foliar application of nutrients has become

an effective strategy to enhance nutritional status of crops and optimizing production potential (Kumar *et al*. 2020). Furthermore, during the *Zaid* season, when water stress and temperature variations might impact the uptake of nutrients by roots, foliar feeding may be particularly beneficial (Sharma *et al*. 2022; Patel *et al*. 2023).

Considering the increasing demand for pulses, the potential of *Zaid* black gram cultivation, and the limitations of conventional fertilization methods, the present study aims to evaluate the efficacy of different foliar nutrient sprays on the growth, yield, and economic feasibility of black gram production.

Materials and Methods

Experimental Site and Soil analysis

The experiment was conducted during the *Zaid* season 2024, at Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Prayagraj (Uttar Pradesh) which is located at 25° 39' 42" N latitude, 81° 67' 56" E longitude and 98 m altitude above the mean sea level. The soil of the experimental field was found to be well drained and sandy loam in texture with neutral soil pH (7.2), high organic carbon (0.42 %), medium available nitrogen (189 kg/ha), available phosphorous (27.2 kg/ha) and available potassium (221.8 kg/ha).

Treatment and Crop Management

The experiment was laid out in Randomized block design with ten treatments each replicated thrice. Treatments comprised of Urea at 20g/l of water (T_1), DAP at 20g/l of water (T_2), Potassium nitrate at 20g/l of water (T_3), Potassium chloride at 2g/l of water (T_4), NPK (19-19-19) at 20g/l of water (T_5), Boron 0.25% spray at 2.5g/l of water (T_6), $ZnSO_4$ at 5g/l of water (T_7), Salicylic acid at 100 mg/l of water (T_8), Water spray (T_9) and Control (20-40-20 of N-P-K kg ha^{-1}) (T_{10}). The net plot size of each experimental plot was maintained at 5.7 m^2.

Details of Variety under Study

The black gram variety used in the experiment was Shekher-2. The variety was released from Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh. The variety matures in 70 days and suitable for growing in *Zaid* season in Punjab, Haryana and Uttar Pradesh.

Sowing and Fertilizer Application

To facilitate the sowing operation, the field was ploughed thoroughly using cultivator followed by harrowing with the help of rotovator and bought to fine tilth. The field was divided into main plots and subplots as per the layout. The seeds were sown with a seed rate of 20 kg/ha at 30 cm row spacing and 10 cm plant spacing. The recommended dose of fertilizer was 20-40-20N-P-K kg/ha which was supplied to crop through urea, single super phosphate and muriate of potash, respectively. Entire dose of nitrogen, phosphorous and potassium were applied as basal dose at the time of sowing as side placement. Deep furrows were made along with the seed rows at 4-5 cm deep using hand hoe for fertilizer application. As per treatments, first foliar application of nutrients was applied at 30 DAS at pre flowering stage and again it was applied at pod initiation stage of plant, which was coincided at 50 DAS of crop. To reduce the crop weed competition, first hand weeding was done at 20 DAS and second-hand weeding was done at 40 DAS with the help of Khurpi. As the crop was raised during *Zaid* season, six irrigations were given to meet the crop demand and to avoid the dry spells during the crop growth period.

Data Collection and Statistical analysis

The observations on growth attributes like Plant height, Number of branches per plant, plant dry weight (g/ plant), Crop growth rate (g/m^2/day), Relative growth rate (g/g/day) and Number of nodules per plant was recorded periodically at 15 days interval. Yield parameters like Number of pods per plant, Number of seeds per pod and test weight (g)were recorded at harvest. For estimation of grain and stover yield the entire produce from net plot area of 1m^2 (from demarcated area, excluding border rows) was harvested manually. After threshing grain were sun dried to bring the moisture of grain to 12% and then samples were weighed separately and obtained value was expressed in kg ha^{-1}. Harvest Index was calculated by taking the ratio of economic yield to biological yield (Donald, 1962). To determine the most profitable treatment various economic analysis, including Cost of cultivation (INR/ha), Gross returns (INR/ha), Net returns (INR/ha) and Benefit-cost ratio (B:C) were computed for black gram under different nutrient foliar sprays. The cost of cultivation for black gram was estimated by considering the costs of inputs (seeds, fertilizers, labour and other expenses) prevailed in the local markets. Net returns (INR/ha) and benefit-cost ratio (B:C) were calculated using the following formulae:

Net return = Gross returns (INR/ha)

– Cost of Cultivation INR/ha)

$$\text{B: C} = \frac{\text{Net returns (INR/ha)}}{\text{Total cost of cultivation (INR/ha)}}$$

The data recorded for different characteristics were subjected to statistical analysis by adopting the method of Analysis of Variance (ANOVA). The significance of comparison was tested. The significant difference values were computed for 5 percent probability of error. Wherever the variance ratio (F value) was found significant, critical difference (CD) values were computed for the comparison among the treatment means (Gomez and Gomez, 1984).

Results and Discussion

Growth attributes

Foliar spray of different nutrients did not show any significant difference on other growth attributes *viz.,* Number of branches per plant, Plant dry weight (g/ plant), Crop growth rate (g/m^2/day) and Relative growth rate (g/g/day) except Plant height (cm) and Number of nodules per plant.

Data presented in Table No. 1 clearly showed that significantly higher plant height (18.71 cm) was obtained with the foliar spray of Potassium nitrate at 20g/l of water (T_3). The higher plant height in the above-mentioned treatments might be owing to internode elongation and rapid growth of shoots. Nitrogen and potassium, being major nutrients, might have played a crucial role in cell division and contribute to accelerate a variety of metabolic processes such as biological N-fixation, photosynthesis and stomatal regulation. Similar results of higher plant height with the foliar spray of potassium nitrate were also reported by Singh *et al*. (2016) and Mund *et al*. (2024). The results were also in close conformity with the findings reported by Shivashankar and Singh (2022).

Significantly higher Number of nodules per plant (21.00) were recorded with the Boron 0.25% spray at 2.5g/l of water (T_6). Higher Number of nodules per plant under the respective treatment might be attributed to increased rhizobial activity in the rhizosphere, which was resulted in the establishment of a greater number of nodules as well as active nodules. It might also be also due to better nutrient translocation those lead to improved root elongation and development of the plant. The results were in close conformity with the findings reported by Debata *et al*. (2022).

Yield attributes and yield of black gram

Yield attributes of black gram *viz.,* Number of pods per plant, Number of seeds per pod and Test weight (g) and yield were influenced due to different nutrient foliar sprays (Table 2). Significantly maximum Number of pods per plant (20.47) were recorded under the foliar spray of urea at 20 g/l of water (T_1). Higher Number of pods per plant under the mentioned treatment might be due to improved plant nutrient availability, better translocation of nutrients to the pods which were sprayed during the pre-flowering and pod initiation might have resulted in increased number of pods per plant. Other possible explanation for increased number of pods per plant was decrease in the flower drop caused by prolonged assimilatory activity of the leaves. The results obtained are in conformity with the findings of Ebrahim *et al.* (2011) and Choudhary and Yadav (2011) who reported that foliar spray of urea resulted in better growth attributes thereby yield attributes in pulses. Thakur *et al*. (2017) and Ramesh *et al*. (2020) also reported that foliar spray of urea resulted in significantly maximum number of pods per plant as compared to control in black gram.

Grain Yield (kg/ha)

From the data (Table 2) it is evident that grain yield of black gram was significantly influenced due to various foliar nutrient sprays. Significantly higher grain yield (511.67 kg/ha) was obtained with the foliar spray of urea at 20g/l of water (T_1). Increased grain yield in the respective treatment might be attributed to effective supply of nutrients and capacity to manage the crop's nutrient needs more effectively and improved photosynthates translocation from source to sink. The findings of Vanangamundi *et al*. (2004) demonstrated that foliar spray of urea showed a significant impact on yield of black gram. It was also noticed that foliar application of urea had a beneficial effect in reducing leaf senescence and resulted in higher dry matter production and productivity. The results were in close conformity with the findings reported by Sritharan *et al*. (2015).

Stover Yield (kg/ha)

Different foliar nutrient sprays had a significant effect on stover yield of black gram. Significantly higher stover yield (1816.93 kg/ha) was noticed with the foliar application of urea at 20g/l of water (T_1). Higher stover yield under the respective treatment might be directly related to seed yield. Stover yield is primarily increased due to better plant height and higher accumulation of dry matter. Results reported by Pandey *et al*. (2023).

Economics of black gram

Data with respect to economics (Table 3 and Fig. 1) revealed that cost of cultivation varied among the different treatments. Minimum cost of cultivation was incurred in the control treatment (T_{10}). Gross returns (INR/ha), net returns (INR/ha) and B:C ratio affected significantly due to foliar application of different nutrients. Significantly highest gross returns (49683.85

INR/ha), net returns (30333 INR/ha) and B:C ratio (1.57) was obtained with the foliar application of urea at 20g/l of water (T_1). The maximum gross returns, net returns and B:C ratio under the respective treatment might be attributed to the enhanced crop growth and productivity of black gram with the foliar application of urea. Similar results of higher gross returns, net returns and B:C ratio was obtained with foliar application of urea along with the recommended dose of fertilizers was reported by Pratihar *et al*. (2023).

Conclusion

Based on one year of experimentation, foliar spray of urea at 20g/l of water *i.e* (T_1) at pre-flowering and pod filling stage proved most effective in maximizing both yield and economic returns from black gram cultivation.

Table 1: Effect of different foliar nutrient spray on growth attributes of black gram

Treatments	At 60 DAS					
	Plant height (cm)	Number of branches /plants	Plant dry weight (g/plant)	CGR ($g/m^2/day$)	RGR (g/g/day)	Number of nodules /plants
T_1: Urea at 20g/l of water	18.08	7.93	3.47	5.10	0.07	17.73
T_2: DAP at 20g/l of water	17.19	7.73	3.59	5.42	0.08	19.13
T_3: Potassium nitrate at 20g/l of water	18.71	8.20	3.85	6.24	0.09	19.27
T_4: Potassium chloride at 2g/l of water	17.31	7.73	3.88	5.97	0.08	18.33
T_5: NPK (19-19-19) at 20g/l of water	17.85	7.53	3.83	6.07	0.08	18.53
T_6: Boron at 2.5g/l of water	16.32	8.00	3.59	5.34	0.07	21.00
T_7: $ZnSO_4$ at 5g/l of water	17.58	7.73	3.47	4.96	0.07	17.47
T_8: Salicylic acid at 100 mg/l of water	17.63	7.60	3.55	5.45	0.08	17.07
T_9: Water spray	16.51	7.93	3.82	6.44	0.11	20.27
T_{10}: NPK-20:40:20 Kg/ha (Control)	16.97	7.87	3.67	5.79	0.08	18.27
SEm±	0.41	0.38	0.24	0.57	0.01	0.77
CD (p=0.05)	1.22	NS	NS	NS	NS	2.31

Table 2: Effect of different foliar nutrient spray on yield attributes and yield of black gram

Treatments	Number of pods /plants	Number of seeds /pods	Test Weight (g)	Grain Yield (kg/ha)	Stover Yield (kg/ha)	Harvest Index (%)
T_1: Urea at 20g/l of water	20.47	5.47	45.94	511.67	1816.93	21.70
T_2: DAP at 20g/l of water	18.27	5.87	40.72	446.17	1525.10	22.35
T_3: Potassium nitrate at 20g/l of water	18.27	5.47	41.36	492.37	1691.20	22.36
T_4: Potassium chloride at 2g/l of water	17.67	5.20	42.38	364.27	1324.53	21.08
T_5: NPK (19-19-19) at 20g/l of water	18.27	5.47	41.19	400.57	1381.23	22.40
T_6: Boron at 2.5g/l of water	18.60	5.33	41.16	426.27	1462.53	23.13
T_7: $ZnSO_4$ at 5g/l of water	17.73	5.20	44.67	464.27	1700.57	21.78
T_8: Salicylic acid at 100 mg/l of water	17.80	5.47	39.83	323.93	1272.47	20.69
T_9: Water spray	18.00	5.20	41.02	339.13	1254.37	21.54
T_{10}: NPK-20:40:20 Kg/ha (Control)	18.80	5.47	41.67	301.13	1171.93	19.92
SEm±	0.51	0.18	2.89	23.40	51.30	1.23
CD (p=0.05)	1.52	NS	NS	69.6	152.5	NS

Table 3: Effect of different foliar nutrient spray on economics of black gram

Treatments	Cost of cultivation (INR/ha)	Gross returns (INR/ha)	Net returns (INR/ha)	B:C
T_1: Urea at 20g/l of water	19351.30	49683.85	30333	1.57
T_2: DAP at 20g/l of water	19551.30	43205.20	22343	1.14
T_3: Potassium nitrate at 20g/l of water	21051.30	47695.40	25203	1.20
T_4: Potassium chloride at 2g/l of water	19291.30	35433.07	15010	0.78
T_5: NPK (19-19-19) at 20g/l of water	21751.30	38813.47	15900	0.73
T_6: Boron at 2.5g/l of water	19626.30	41289.07	20325	1.04
T_7: $ZnSO_4$ at 5g/l of water	19363.80	45185.13	24304	1.26
T_8: Salicylic acid at 100 mg/l of water	19951.30	31698.93	10641	0.53
T_9: Water spray	19251.30	33030.73	12619	0.66
T_{10}: NPK-20:40:20 Kg/ha (Control)	18351.30	29445.87	10045	0.55

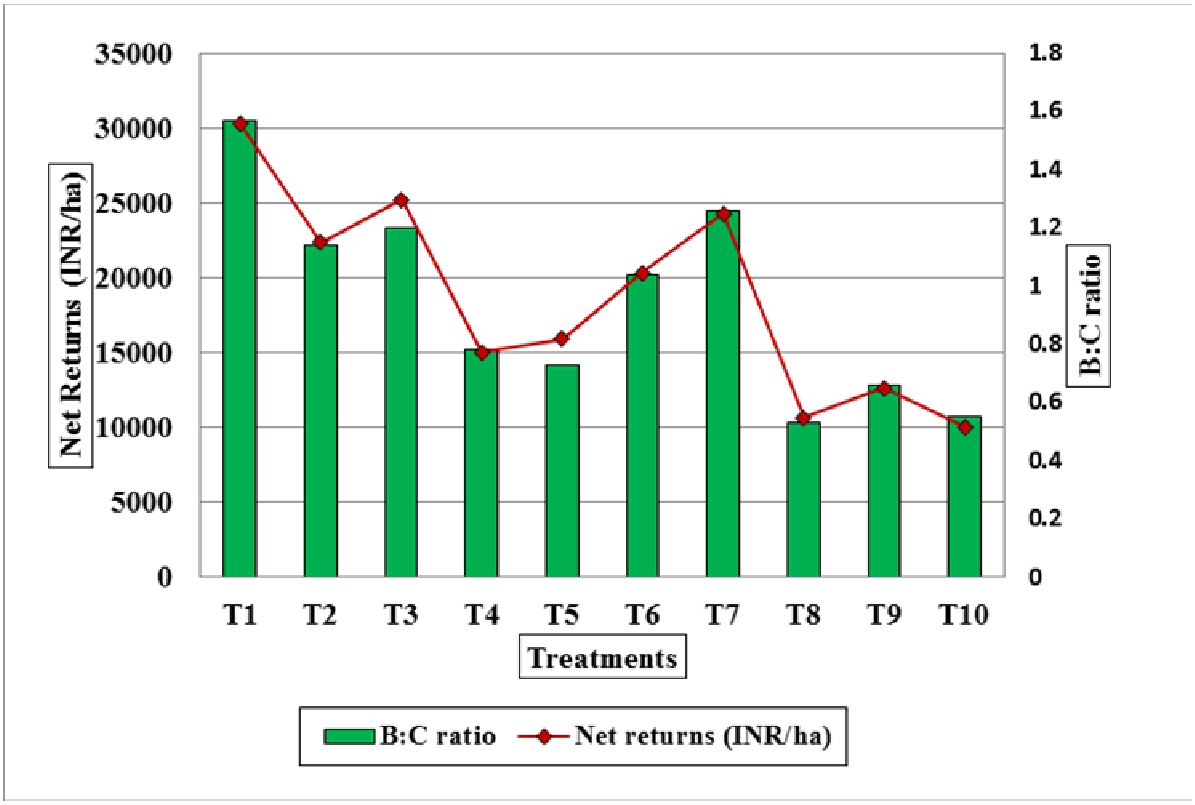

Fig. 1 : Effect of different foliar nutrient spray on economics of black gram.

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References

Ali, M., Gupta, S. (2012). *Pulses in India, Retrospect and Prospects*. *Indian Council of Agricultural Research.*

Anonymous. (2023). Crop-wise Area, Production and Productivity of Black gram from 2022-2023, DPD, GoI, Bhopal. DES, GoI, Min. of Agri. & FW (DA&FW), pp,5.

Anonymous. (2024). Center for Agriculture and Rural Development Policy Research (CARP), ANGRAU Black gram Outlook Report- June to May 2023-24. pp, 1-2.

Choudhary, G. L., Yadav, L. R. (2011). Effect of fertility levels and foliar nutrition on cowpea productivity. *Journal of food Legume*, **24**(1), 67-68.

Debata, N. M., Satapathy, M. R, Paikaray, R. K., Jena, S. N. (2022). Effect of foliar application of nutrients on yield, nutrient uptake and economics of pre-winter blackgram (*Vigna mungo*). *Indian Journal of Agronomy*, **67**(1), 97-100.

Donald, C. M. (1962). In search of yield. *Journal of the Australian Institute of Agricultural Science,* **28**, 171-178.

Ebrahim, A. Reza, K. D., Shirin, M. Hamid, R. B., Maral, M. (2011). Effect of urea under foliar spraying on yield and yield components of cowpea. *World Applied Sciences Journal,* **13**(6), 1445-1449.

Gomez, K. A., Gomez, A. A. (1984). *Statistical Procedures for Agricultural Research* (2nd ed.). John Wiley & Sons.

Kumar, P. Sharma, R. Singh, V. (2020) Effect of foliar fertilization on pulse productivity. *Journal of Agronomy and Crop Science,* **206**(3), 456-462.

Mandal, B. Das, S. Saha, S. (2019) Efficiency of foliar nutrient sprays in legume crops. *Agricultural Reviews,* **40**(1), 25-33.

Mund, R. K., Umesha, C. Gurjar, J. P. (2024). Effect of nitrogen and foliar application of potassium on growth and yield of chickpea (*Cicer arietinum* L.). I*nternational Journal of Advanced Biochemistry Research*, **8**(7), 894-897.

Pandey, V. S., Kumar, H. Purushottam, Dwivedi, D. K., Mishra, A. Singh, D. Mishra, *et al.* (2023). Effect of Foliar Application of Different Chemicals on Yield and Yield Attributes of Black gram [*Vigna mungo* (L.) Hepper] under Rainfed Condition. *International Journal of Plant and Soil Science*, **35**(21), 672-678.

Patel, A. Sharma, R. Verma, S. (2023). Foliar nutrition and its impact on crop yield and nutrient efficiency, Insights from recent studies. *International Journal of Agronomy and Crop Science*, **28**(4), 345-362.

Pratihar, D. Mondal, R. Benerjee, S. (2023). Effect of foliar nutrition on growth and yield of green gram (*Vigna radiata* L.) in red and lateritic soils of West Bengal. *Journal of Food Legumes*,**36**(1), 93-97.

Ramesh, T. Rathika, S. Sangeetha, S. Satheesh, S. Ponpradeepa, M. Pavithra, A.M. (2020). Enhancement of Black Gram Productivity through Foliar Spray of Nutrients and Growth Hormones. *International Journal of Current Microbiology and Applied Sciences*, **9**(12).

Rao, S. R., Reddy, B.V., Reddy, R.P., (2015). Nutrient management strategies for improving black gram yield. *Indian Journal of Pulses Research,* **28**(2), 156-162.

Sharma, D. Meena, H. R., Choudhary, A. (2022). Sustainable nutrient management practices for pulse crops. *Agricultural Research Journal*, **39**(3), 201-215.

Singh, B. Kumar, R. (2016). Effect of integrated nutrient management on growth, yield and nutrient uptake of cluster bean (*Cyamopsis tetragonoloba*) under irrigated conditions. *Agriculture Science Digest*, **36**(1), 35-39.

Singh, B. Yadav, D. Verma, K. (2018). Foliar application of nutrients and its impact on yield of pulse crops. *International Journal of Plant Sciences,* **13**(1), 89-97.

Shivashankar, K. Adesh, Singh. (2022). Effect of foliar potassium application and irrigation scheduling on growth, yield, nutrient uptake and nutrient use efficiency of Summer mungbean. *The Pharma Innovation Journal*, **11**(12), 6156-6161.

Sritharan, N., Rajavel, M., Senthil, K.R. (2015). Physiological approaches, Yield improvement in blackgram. *Legume Research*, **38**(1), 91-95

Thakur, V., Patil, R. P., Patil, J.R., Suma, T.C., Umesh, M. R. (2017). Physiological approaches for yield improvement of Black gram under rainfed condition. *International Journal of Current Microbiology and Applied Sciences Pharmacognosy and Phytochemistry,* **6**(11), 4114-4122.

Vanangamudi, Mallika, S. N., Gowri, S. Lini, A (2004). Foliar spray for yield maximization in black gram and green gram. *Journal Agricultural Resource Managemen*t, **3**(1), 54-61.