# Impact of Foliar Application of Nutrients and Plant Growth Regulators on Growth, Yield, and Profitability of Mung Bean (*Vigna radiata* L.)

# Abstract

A field experiment was conducted at experimental farm, Department of Agronomy, A field experiment was conducted at experimental farm, Department of Agronomy, Faculty of Agriculture and Veterinary Sciences, Mewar University Gangrar, Chittorgarh (Rajasthan) during Rabi season of 2023-24 to effect of Nutrients and Plant Growth regulators on growth and yield of Mung bean variety “SML-832‟ was used in this study. The result revealed that the maximum growth parameters such as plant height (51.22 cm), dry matter accumulation (24.33 g), number of primary branches per plant (8.12), number of nodulation (35.85) and yield parameter such as number of pods per plant (17.10), number of seed per pod (9.20), grain yield (10.95 q/ha), straw yield (20.02 q/ha) and biological yield (30.97 q/ha) with application of T9-Urea @ 2% + Salicylic acid @ 75 ppm spray at flower initiation + Nitrobenzene @ 500 ppm at flower initiation. It was concluded that the treatment T9-Urea @ 2% + Salicylic acid @ 75 ppm spray at flower initiation + Nitrobenzene @ 500 ppm at flower initiation increases growth and yield of mung bean.

**Key words: -Plant growth regulators; Mung bean; Profitability & Nodulation**

# 1. Introduction

“Pulses are commonly known as food legumes which are secondary to cereals in production and consumption in India. The World Health Organization (WHO) recommends a per capita consumption of pulses at 80 gram per day and the Indian Council of Medical Research (ICMR) has recommended a minimum consumption of 47 gram. India is the largest producer and consumer of pulses in the world accounting for 32 per cent of world area and 25 per cent of production. Mung bean (*Vigna radiata* L.) contains about 25 per cent protein, this being about two third of the protein content of soybean, twice that of wheat and thrice that of rice. The protein is comparatively rich in lysine, which is deficient in cereal grains” (Amutha et al., 2012).

“India is one of the important mung bean growing countries in Asia with an area 8.7 million hectares and production of 8.83 million tonnes with a productivity of 1014 kg ha-1” (Anonymous., 2020). Foliar feeding is often the most effective and economical way to improve plant nutrient deficiency. Supplemental nutrition plays a crucial role in increasing seed yield in pulses. Foliar application of nutrients is considered to be an efficient and economic method of supplementing the nutrient requirement of the crop which in turn leads to enhanced yield. The productivity of this crop is very low because of its cultivation on marginal and sub marginal lands of low soil fertility where little attention is paying to adequate fertilization. However, yield potential of summer green gram is quite high yet at farmers’ field, its yield is low. In summer green gram, a high reduction in yield has been reported to occur due to non-use of fertilizers.

“Foliar feeding is often the most effective and economical way to improve plant nutrient deficiency” (Dixit *et al*. 2007). “Supplemental nutrition plays a crucial role in increasing seed yield in pulses” (Chandrashekar and Bangarusamy, 2003). “Foliar application of nutrients is considered to be an efficient and economic method of supplementing the nutrient requirement of the crop which in turn leads to enhanced yield. In addition, foliar application of nutrients was found to be more advantageous than soil application with the elimination of losses through leaching and fixation. It thus increases photosynthetic rate and nutrient translocation from the leaves to the developing seeds” (Manomani and Srimathi, 2009). “Foliar spray of nutrients is the fastest way to boost up crop growth. Under rainfed condition when the availability of moisture becomes scarce the application of fertilizers as foliar spray resulted in efficient absorption and usage. Though foliar spray is not a substitute to soil application but it certainly be considered as a supplement to soil application. If foliar nutrition is applied it reduces the cost of cultivation which in turn reduces the amount of fertilizer thereby reducing the loss and also economizing crop production”. (Amutha *et al*. 2012).

# 2. Materials and Methods

A field experiment was conducted during Rabi season of 2023-24 at experimental farm, Department of Agronomy, Faculty of Agriculture and Veterinary Sciences, Mewar University Gangrar, Chittorgarh (Rajasthan). Soil of the experimental field was sandy loam in texture, saline in reaction with a pH value of 7.6, poor in organic carbon (0.32%), deficient in available zinc (0.48 ppm) and iron (1.2 ppm) low in available nitrogen (176 kg/ha) and phosphorus (20.2 kg/ha) but medium in available potassium (320 kg/ha). The experiment was laid out in randomized block design with three replications consisting of nine treatments *viz.* The experiment was laid out in randomized block design with three replications and ten treatments *i.e.* T1-Control, T2- Urea @ 2% spray at flower initiation, T3-Salicylic acid @ 75 ppm at flower initiation, T4-N: P: K (19:19:19) @ 2% at flower initiation, T5-Urea @ 2% + Salicylic acid @ 75 ppm spray at flower initiation, T6-Boron @ 250 ppm spray at flower initiation, T7-Nitrobenzene @ 500 ppm at flower initiation, T8-ZnSo4 @ 2% spray at flowering and pod initiation and T9-Urea @ 2% + Salicylic acid @ 75 ppm spray at flower initiation + Nitrobenzene @ 500 ppm at flower initiation. The required quantities of fertilizers as per treatments were applied. The doses of NPK were applied in the form of urea, diammonium phosphate, murate of potash respectively. The half dose of nitrogen gives basal dose and remain two split doses after irrigation and full dose of phosphorus and potassium at basal dose.

**3. Results and Discussion**

**3.1 Growth attributes**

The data are presented regarding to plant height are presenting in Table 1. The data revealed that the maximum plant height at 20 DAS was obtained with T9-Urea @ 2% + Salicylic acid @ 75 ppm spray at flower initiation + Nitrobenzene @ 500 ppm at flower initiation (13.88 cm). The minimum plant population at 20 DAS was recorded with T1-Control (10.85 cm). The data revealed that the maximum plant height at 60 DAS was obtained with T9-Urea @ 2% + Salicylic acid @ 75 ppm spray at flower initiation + Nitrobenzene @ 500 ppm at flower initiation (49.80 cm). The minimum plant population at 60 DAS was recorded with T1-Control (43.52 cm). The data revealed that the maximum plant height at harvest was obtained with T9-Urea @ 2% + Salicylic acid @ 75 ppm spray at flower initiation + Nitrobenzene @ 500 ppm at flower initiation (51.22 cm). The minimum plant population at harvest was recorded with T1-Control (45.25 cm). Similar result also reported by Deshmukh *et al.* (2008), Ganapathy *et al.* (2008) and Gupta *et al.* (2010).

The data are presented regarding to dry matter accumulation are presenting in Table 2. The data revealed that the maximum dry matter accumulation per plant at 35 DAS was obtained with T9-Urea @ 2% + Salicylic acid @ 75 ppm spray at flower initiation + Nitrobenzene @ 500 ppm at flower initiation (6.20 g). The minimum dry matter accumulation per plant at 35 DAS was recorded with T1-Control (4.45 g). The data revealed that the maximum dry matter accumulation per plant at 50 DAS was obtained with T9-Urea @ 2% + Salicylic acid @ 75 ppm spray at flower initiation + Nitrobenzene @ 500 ppm at flower initiation (13.25 g). The minimum dry matter accumulation per plant at 50 DAS was recorded with T1-Control (9.22 g). The data revealed that the maximum dry matter accumulation per plant at harvest was obtained with T9-Urea @ 2% + Salicylic acid @ 75 ppm spray at flower initiation + Nitrobenzene @ 500 ppm at flower initiation (24.33 cm). The minimum dry matter accumulation per plant at harvest was recorded with T1-Control (19.25 g). Similar concluded also observed by Ali and Mahmoud (2013), Doss *et al*. (2013) and Shashi *et al*. (2013).

The data are presented regarding too number of primary branches per plant and number of nodules per plant are presenting in Table 2. The data revealed that the maximum number of primary branches per plant was obtained with T9-Urea @ 2% + Salicylic acid @ 75 ppm spray at flower initiation + Nitrobenzene @ 500 ppm at flower initiation (8.12). The minimum number of primary branches per plant was recorded with T1-Control (6.02). The data revealed that the maximum number of nodules per plant was obtained with T9-Urea @ 2% + Salicylic acid @ 75 ppm spray at flower initiation + Nitrobenzene @ 500 ppm at flower initiation (35.85). The minimum number of nodules per plant was recorded with T1-Control (29.30). same findings also noticed by Rahman *et al.* (2014), Kumar (2015), Naidu *et al.* (2015) and Karthikeyan *et al.* (2020).

**3.2 Yield attributes and yield**

The data are presented regarding to yield attributes are presenting in Table 3. The data revealed that the maximum number of pods per plant was obtained with T9-Urea @ 2% + Salicylic acid @ 75 ppm spray at flower initiation + Nitrobenzene @ 500 ppm at flower initiation (17.10). The minimum number of pods per plant was recorded with T1-Control (13.25). The data revealed that the maximum number of seed per pod was obtained with T9-Urea @ 2% + Salicylic acid @ 75 ppm spray at flower initiation + Nitrobenzene @ 500 ppm at flower initiation (9.20). The minimum number of seed per pod was recorded with T1-Control (7.15). Similar result also confirmed by Sritharan *et al*. (2005), Chaudhary and Yadav (2011), Venkatesh *et al.* (2012) and Beg *et al*. (2013).

The data are presented regarding to yields are presenting in Table 3. and depicted in Figure 1.0. The data revealed that the maximum grain yield was obtained with T9-Urea @ 2% + Salicylic acid @ 75 ppm spray at flower initiation + Nitrobenzene @ 500 ppm at flower initiation (10.95 q/ha). The minimum grain yield was recorded with T1-Control (8.05 q/ha). The data revealed that the maximum straw yield was obtained with T9-Urea @ 2% + Salicylic acid @ 75 ppm spray at flower initiation + Nitrobenzene @ 500 ppm at flower initiation (20.02 q/ha). The minimum straw yield was recorded with T1-Control (15.65 q/ha). The data revealed that the maximum biological yield was obtained with T9-Urea @ 2% + Salicylic acid @ 75 ppm spray at flower initiation + Nitrobenzene @ 500 ppm at flower initiation (30.97 q/ha). The minimum biological yield was recorded with T1-Control (23.70 q/ha). The data also supported by Gowda *et al.* (2014), Rahman *et al.* (2014), Siva *et al.* (2017), Thakur *et al.* (2020) and Kushwah *et al.* (2023).

# Conclusion

On the basis of one-year experimentation it was concluded that the treatment T9-Urea @ 2% + Salicylic acid @ 75 ppm spray at flower initiation + Nitrobenzene @ 500 ppm at flower initiation increases growth and yield of mung bean. So, it was concluded that the treatment Urea @ 2% + Salicylic acid @ 75 ppm spray at flower initiation + Nitrobenzene @ 500 ppm at flower initiation superior among all treatments for better yield and profitability.

# Table 1 Effect of foliar application of nutrient and plant growth regulators on plant height of mung bean

|  |  |  |  |
| --- | --- | --- | --- |
| **Treatments** | **Plant height (cm)** | | |
| **20 DAS** | **60 DAS** | **At harvest** |
| T1-Control | 10.85 | 43.52 | 45.25 |
| T2- Urea @ 2% spray at flower initiation | 13.12 | 48.08 | 49.58 |
| T3-Salicylic acid @ 75 ppm at flower initiation | 12.55 | 45.45 | 46.96 |
| T4-N: P: K (19:19:19) @ 2% at flower initiation | 12.85 | 45.85 | 47.15 |
| T5-Urea @ 2% + Salicylic acid @ 75 ppm spray at flower initiation | 13.35 | 48.36 | 49.85 |
| T6-Boron @ 250 ppm spray at flower initiation | 12.05 | 45.00 | 46.25 |
| T7-Nitrobenzene @ 500 ppm at flower initiation | 13.02 | 46.25 | 47.63 |
| T8-ZnSo4 @ 2% spray at flowering and pod initiation | 12.32 | 45.15 | 46.45 |
| T9-Urea @ 2% + Salicylic acid @ 75 ppm spray at flower initiation + Nitrobenzene @ 500 ppm at flower initiation | 13.88 | 49.80 | 51.22 |
| S. Em. ± | 0.25 | 0.59 | 0.88 |
| CD at 5% | 0.76 | 1.75 | 2.64 |

**Table 2 Effect of foliar application of nutrient and plant growth regulators on dry matter accumulation, number of primary branches per plant and number of nodules per plant of mung bean**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Treatments** | **Dry matter accumulation per plant (g)** | | | **Number of primary branches per plant** | **Number of nodules per plant at 40 DAS** |
| **35 DAS** | **50 DAS** | **At harvest** |
| T1-Control | 4.45 | 9.22 | 19.25 | 6.02 | 29.30 |
| T2- Urea @ 2% spray at flower initiation | 5.55 | 12.33 | 23.00 | 7.52 | 31.12 |
| T3-Salicylic acid @ 75 ppm at flower initiation | 5.12 | 11.85 | 20.10 | 7.65 | 32.20 |
| T4-N: P: K (19:19:19) @ 2% at flower initiation | 5.35 | 12.00 | 20.35 | 7.85 | 35.12 |
| T5-Urea @ 2% + Salicylic acid @ 75 ppm spray at flower initiation | 5.95 | 12.80 | 23.12 | 7.90 | 33.63 |
| T6-Boron @ 250 ppm spray at flower initiation | 5.00 | 11.80 | 19.85 | 7.60 | 33.02 |
| T7-Nitrobenzene @ 500 ppm at flower initiation | 5.45 | 12.20 | 20.32 | 7.82 | 33.45 |
| T8-ZnSo4 @ 2% spray at flowering and pod initiation | 5.05 | 11.90 | 20.25 | 7.88 | 33.00 |
| T9-Urea @ 2% + Salicylic acid @ 75 ppm spray at flower initiation + Nitrobenzene @ 500 ppm at flower initiation | 6.20 | 13.25 | 24.33 | 8.12 | 35.85 |
| S. Em. ± | 0.22 | 0.31 | 0.45 | 0.09 | 0.75 |
| CD at 5% | 0.66 | 0.92 | 1.35 | 0.27 | 2.24 |

**Table 3 Effect of foliar application of nutrient and plant growth regulators on yield attributes and yield of mung bean**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Treatments** | **Number of pods per plant** | **Number of seed per plant** | **Grain yield (q/ha)** | **Straw yield (q/ha)** | **Biological yield**  **(q/ha)** |
| T1-Control | 13.25 | 7.15 | 8.05 | 15.65 | 23.70 |
| T2- Urea @ 2% spray at flower initiation | 16.20 | 8.45 | 9.75 | 18.15 | 27.90 |
| T3-Salicylic acid @ 75 ppm at flower initiation | 16.00 | 8.40 | 9.70 | 17.35 | 27.05 |
| T4-N: P: K (19:19:19) @ 2% at flower initiation | 16.55 | 8.70 | 10.15 | 17.45 | 27.60 |
| T5-Urea @ 2% + Salicylic acid @ 75 ppm spray at flower initiation | 16.70 | 8.95 | 10.45 | 19.52 | 29.97 |
| T6-Boron @ 250 ppm spray at flower initiation | 15.80 | 8.10 | 9.50 | 17.00 | 26.50 |
| T7-Nitrobenzene @ 500 ppm at flower initiation | 16.20 | 8.30 | 9.80 | 17.52 | 27.32 |
| T8-ZnSo4 @ 2% spray at flowering and pod initiation | 15.90 | 8.30 | 9.60 | 17.20 | 26.80 |
| T9-Urea @ 2% + Salicylic acid @ 75 ppm spray at flower initiation + Nitrobenzene @ 500 ppm at flower initiation | 17.10 | 9.20 | 10.95 | 20.02 | 30.97 |
| S. Em. ± | 0.19 | 0.17 | 0.27 | 0.63 | 1.03 |
| CD at 5% | 0.57 | 0.50 | 0.82 | 1.89 | 3.08 |

**Figure 1 Effect of foliar application of nutrient and plant growth regulators on yields of mung bean**

**Disclaimer (Artificial intelligence)**

Option 1:

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

Option 2:

Author(s) hereby declare that generative AI technologies such as Large Language Models, etc. have been used during the writing or editing of manuscripts. This explanation will include the name, version, model, and source of the generative AI technology and as well as all input prompts provided to the generative AI technology

Details of the AI usage are given below:

1.

2.

3.

**References**

Ali E.A. and Mahmoud M. 2013. Effect of foliar spray by different salicylic acid and zinc concentrations on seed yield and yield components of mung bean in sandy soil. *Asian Journal of Crop Science*, **5**(1):33-40.

Amutha, R., Nithila, S. and Shiva Kumar. 2012. Management of source limitation by foliar spray of nutrients and growth regulators in Black gram*. International J. Plant Sci*., **7**(1): 65-68.

Beg, M.Z., Ahmad, Sohrab and Shrivastava and Deepak Kumar. 2013. Foliar application of potassium on urdbean. *Indian J. Sci.,***2**(2):67-70.

Chandrasekhar, C. N. and Bangarusamy, U. 2003. Maximizing the yield of mung bean by foliar application of growth regulating chemicals and nutrients. *Madras Agric. J.,***90**(1-3): 142-14

Chaudhary G.L. and Yadav L.R. 2011. Effect of fertility levels and foliar nutrition on cowpea productivity. *Journal of Food Legumes*, **24**(1):67-68.

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. *Annals. of Plant Physiol.*, **22**(2):189-191.

Dixit, Mohan, Pradeep. and Elamathi, S. 2007. Effect of foliar application of DAP, micronutrients and NAA on growth and yield of green gram. *Journal of Legume Research*, **30**(4): 305-07.

Doss, A., Anand, S.P. and Keerthiga, M. 2013. Effect of foliar application of DAP, Potash and NAA on growth yield and some biochemical constituents of *Vigna mungo* (L.) Hepper. Wudpecker. *Journal of Agricultural Research* vol., **2**(7):206-20.

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.

Gowda, Mukund, K., Halepyati, A.S., Koppalkar, B. G. and Rao, Satyanarayana. 2014. Response of pigeon pea to application of micronutrients through soil and foliar spray of macronutrients on yield, economics and protein content. *Karnataka Journal of Agricultural Science*, **27**(4): 460-63.

Gupta., Kajal Sengupta and Hirak Banarjee. 2010. Effect of foliar application of nutrients and brassinolide on summer green gram (*Vigna radiate*) crop. *Int. J. Tropical Agri*., 28:1-2.

Karthikeyan, A., Vanathi, J., Babu, S., & Ravikumar, C. (2020). Studies on the effect of foliar application of organic and inorganic nutrients on the phenotypic enhancement of black gram cv. vamban-6. *Plant Archives*, **20**(2), 1161-1164.

Kumar Deepak, 2015. Effect of foliar application of nutrients on growth and yield of blackgram [*Vigna mungo (L.) Hepper*]. M.Sc. thesis. PDKV.

Kushwah, N., Singh, D., Bhadauriya, J. S., Chauhan, A. P. S., & Singh, R. P. (2023). Impact of Foliar Application of Nutrients on Economics of Black Gram (*Vigna mungo* L.). *Journal of Experimental Agriculture International*, **45**(11), 245-252.

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

Naidu, T.C.M., Rao, Nageswara., Siva, D. and Rani, Ashoka, Y. 2015. Effect of foliar nutrition on antioxidant enzymes, photosynthetic rate, dry matter production and yield of mung bean under receding soil moisture condition. *International Journal of Pure and Applied Bioscience,* **3**(1): 115-23.

Rahman, Inayat., Afzal, Aftab., Iqbal, Zafar., Ijaz, Farhana, Shad, Salma., Manan, Shafiul. and Afzal, Muhammad. 2014. Response of common bean to basal applied and foliar feeding of different nutrient application. *American Eurasian Journal of Agricultural and Environmental Science*, **14**(9): 851- 54.

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

Siva, J., Hemalatha, M. and Joseph, M. 2017. Effect of sowing methods and foliar nutrition for maximizing the productivity of rice fallow black gram (*Vigna mungo* L.). *Int. J. Curr. Microbial. App. Sci*. **6**(6): 105-110.

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

Thakur, V., Patil, R. P., Patil, J. R., Suma, T. C., & Umesh, M. R. (2020). Influence of foliar nutrition on growth and yield of black gram under rainfed condition. *Journal of Pharmacognosy and phytochemistry*, **6**(6), 33-37.

Venkatesh, M.S., Basu, P.S. and Vedram. 2012. Foliar application of nitrogenous fertilizers for improved productivity of chickpea under rainfed conditions. *Legume Research*, **35**(3): 231-34.