**Original Research Article**

**Impact of different nutrient management practices on *kharif* mung bean (*Vigna radiata* L*.*)**

**Abstract**

A field experiment on green gram was carried out at the Instruction Farm of Invertis University Bareilly, Uttar Pradesh, India during *kharif* season 2024. The soil of the experimental field was sandy loam in texture, low in organic carbon and available nitrogen, but medium in available phosphorus and available potassium having slightly alkali pH (7.35) with an electrical conductivity of 0.312. The experiment was arranged in a randomized block design having 10 treatments *viz;* T1- Control, T2- Farm practices (DAP) @ 100 kg/ha, T3- FYM @ 5 t/ha + DAP @ 100 kg/ha + Rhizobium @625 ml/Kg seed, T4- FYM @5 t/ha + DAP @100 Kg/ha + Rhizobium culture @625 ml/kg seed + 2 % foliar spray of nano urea @40 and 50 DAS, T5 – FYM @5 t/ha + DAP @100 kg/ha + Rhizobium @625 ml/kg seed + N:P:K (18:18:18) @ 0.5 % foliar spray @ 40 and 50 DAS, T6- FYM @5 t/ha + DAP (18:46) @100 kg/ha + NPK Consortia @20 ml/kg seed, T7- T6+ Foliar spray 1.5 % Nano DAP @40 and 50 DAS, T8- FYM @5 t/ha + N:P:K (12:32:16) @100 kg/ha + NPK Consortia @20 ml/kg seed + NPK (18:18:18) @0.5 % foliar spray @40 and 50 DAS + Biostimulant spray @625 ml/ha @40 and 50 DAS, T9- T6 + foliar spray NPK (18:18:18) @0.5% 40 and 50 DAS, T10- FYM @5 t/ha + NPK (12:32:16) @100 kg/ha + Seed treatment with PSB @625 ml/ha+ foliar Spray of 1.5% Nano DAP @ 40 and 50 + Fe2So4 of 0.5% @ 40 and 50 DAS with three replication. The results noted that among the different nutrient management practices, application of FYM @5 t/ha + N:P:K (12:32:16) @100 kg/ha + NPK Consortia @20 ml/kg seed + NPK (18:18:18) @0.5 % foliar spray @40 and 50 DAS + Biostimulant spray @625 ml/ha @40 and 50 DAS had maximum plant height (52.49 cm), Number of branches/plants (12.95) and dry matter accumulation (13.98 g/plant) at harvest stage. However, significantly maximum pods/plant (14.5), pod length (8.3 cm), grains/pod (11.1), test weight (33.4 g), grain yield (15.9 q/ha), straw yield (29.3 q/ha), biological yield (44.8 q/ha), protein content (24.94 %) and protein yield (336.71 kg/ha) was recorded under the application of FYM @5 t/ha + N:P:K (12:32:16) @100 kg/ha + NPK Consortia @20 ml/kg seed + NPK (18:18:18) @0.5 % foliar spray @40 and 50 DAS + Biostimulant spray @625 ml/ha @40 and 50 DAS than other treatment combinations.

***Keywords***: Farm yard manure (FYM), *Rhizobium*, Nano urea, Nano DAP, NPK consortia, Biostimulant and PSB

**Introduction**

 Green gram (*Vigna radiata* L*.****)*** is also known as mung bean or golden bean, is a significant pulse crop in tropical and subtropical region. Mung bean is a short duration legume crop, cultivated during the summer season that belongs to the Fabaceae family. It is a valuable crop due to its high protein content, short duration and adaptability to various agro-climatic conditions [1]. It ranks 3rd among all pulses that are grown in India after chickpea and pigeon pea. Pulses are an important component of Indian diet being a good source of protein. It contains 24.5% protein with large amount of lysine (460 mg/g N) and tryptophan (60 mg/g N), it also contains quantity of ascorbic acid and riboflavin (0.21 mg/100 g). The presence of some antinutritional factors such as tannins (366.6 mg/100 mg), phytic acid (441.5 mg/100 g), trypsin inhibitors, hemagglutinin, proteinase inhibitors and polyphenols (462.5 mg/100 g) were reported in mung bean, which affect the digestion and bioavailability of full nutrition. In India, green gram is grown over an area about 33.91 lakh ha with a production of 17.47 lakh tonnes and productivity of 515 kg/ha [2]. The mung bean crop is increasingly adopted by farmers because of its short duration nature which makes it suitable for intensive crop rotation. Despite nutritional benefits, it helps in reducing soil erosion; enhance fertility of the soil through atmospheric nitrogen fixation [3]. Farmers use imbalanced chemical fertilizers for individual crop without considering integrated nutrient management approach. As a result, productivity and soil biodiversity has been affected. Recently, the growth and yield of mung bean has been affected by poor management and low soil fertility [4]. Farm yard manure, decomposed mixture of dung and urine of farm animals along with their litter and left over material from roughages or fodder fed to the cattle, supplies all major (N, P and K) and micro (Fe, Mn, Cu and Zn) nutrients necessary for plant growth. The entire amount of nutrients contained in FYM is not made available to the crop it has been applied and this depends upon rate of mineralization. Therefore, integrated use of both organic manures and inorganic fertilizers is the most effective method to maintain a healthy and sustainably productive soil [5]. Foliar nutrition recognized as an important method of fertilizer application since foliar nutrient usually penetrate the leaf cuticle or stomata and enter the cells facilitating easy and rapid utilization of nutrients leading no wastage and quick supply of food and thereby reduce the requirement of fertilizers. Foliar nutrition can hasten the growth of a crop suddenly [6]. Bio-fertilizers play an important role in increasing availability of nitrogen and phosphorus. Inoculation of seeds with Rhizobium culture is a low-cost method of nitrogen fertilization in legume and has been found beneficial to enhance the soil quality by providing more biological fixation of atmospheric nitrogen which may be helpful in boosting up production [7].

**Material and method**

The field experiment was conducted at the Instruction Farm (at a latitude of 28° 29’ North and longitude of 79° 49’ East with an elevation of 6252 m above mean sea level) of Invertis University Bareilly, Uttar Pradesh, India during *kharif* season 2024 on sandy loam soil. The soil of the experimental field was low in organic carbon (0.45 %) and available nitrogen (189.3 kg/ha), but medium in available phosphorus (18.5 kg/ha) and potassium (198.85.6 kg/ha) having slightly alkali pH (7.5) with an electric conductivity of 0.309. Experimental field was moist, well- drained with uniform topography. The experiment was arranged in a randomized block design having 10 treatments *viz;* T1- Control, T2- Farm practices (DAP) @ 100 kg/ha, T3- FYM @ 5 t/ha + DAP @ 100 kg/ha + Rhizobium @625 ml/Kg seed, T4- FYM @5 t/ha + DAP @100 Kg/ha + Rhizobium culture @625 ml/kg seed + 2 % foliar spray of nano urea @40 and 50 DAS, T5 – FYM @5 t/ha + DAP @100 kg/ha + Rhizobium @625 ml/kg seed + N:P:K (18:18:18) @ 0.5 % foliar spray @ 40 and 50 DAS, T6- FYM @5 t/ha + DAP (18:46) @100 kg/ha + NPK Consortia @20 ml/kg seed, T7- T6+ Foliar spray 1.5 % Nano DAP @40 and 50 DAS, T8- FYM @5 t/ha + N:P:K (12:32:16) @100 kg/ha + NPK Consortia @20 ml/kg seed + NPK(18:18:18) @0.5 % foliar spray @40 and 50 DAS + Bio stimulant spray @625 ml/ha @40 and 50 DAS, T9- T6 + foliar spray NPK (18:18:18) @0.5% 40 and 50 DAS, T10- FYM @5 t/ha + NPK (12:32:16) @100 kg/ha + Seed treatment with PSB @625 ml/ha+ foliar Spray of 1.5% Nano DAP @ 40 and 50 + Fe2So4 of 0.5% @ 40 and 50 DAS with three replication. Plant height was recorded with the help of a meter scale, dry matter accumulation was recorded in each plot, two plants form the sample rows (second row from both north and west side of the plot) was cut from the ground surface with the help of sickle at all the stages of crop growth and sun dried for 2-3 days. After sun drying, these plants were dried at 65±50C temperature at until a constant weight was achieved and the average weight was expressed in gram per plant. The yield attributes viz; Pods/plant, Pod length (cm) and Grains/pod were recorded according to standard procedure. After the harvesting of border rows the grain yield, stover yield and biological yield were recorded in kg/plot in each net plot and express as q/ha, protein content in grains was determined by modified- Kjeldahl method by using the formula as,

Protein content (%) = Nitrogen content in grain (%) × 5.85 (correction factor)

 Protein yield of the grain was measured by multiplying the average protein content of grain with grain yield/ha and expressed as kg/ha. This gave the total protein yield/ha and as per given formula:

Protein yield (kg/ha) = $\frac{Protein content in grain (\%) × grain yield (kg/ha)}{100}$

 The mean of data was analyzed through Analysis of Variance (ANOVA) techniques for randomized block design and presented at 5 % level of significance (<P = 0.05).

**Result and Discussion**

**Growth and development of green gram**

The data is presenting table 1. The Impact of different INM practices on various growth parameter *viz*; Plant height, number of branches/plant and dry matter accumulation (g/plant) at 25, 50 days after sowing (DAS) and at harvest stage. The maximum plant height of 29.54, 50.99 and 61.1 cm noted that with the application of FYM @5 t/ha + N: P: K (12:32:16) @100 kg/ha + NPK Consortia @20 ml/kg seed + NPK (18:18:18) @0.5 % foliar spray @40 and 50 DAS + Bio stimulant spray @625 ml/ha @40 and 50 DAS at 25,50 and at harvest stage, respectively. Which being *at par* with T7, T9 and T10 significantly superior with T1, T2, T3, T4, T5 and T6 at 25, 50 DAS and at harvest stage. While, the lowest plant height 19.02, 30.78 and 35.11 was recorded under control at 25, 50 DAS and at harvest stage, respectively. Number of branches/plants was significantly affected by different nutrient management practices. The result presented in table 1 showed that the minimum to maximum branches/plant of 2.01, 2.9 and 3.12 to 2.9, 5.1 and 6.16 under control and FYM @5 t/ha + N: P: K (12:32:16) @100 kg/ha + NPK Consortia @20 ml/kg seed + NPK (18:18:18) @0.5 % foliar spray @40 and 50 DAS + Bio stimulant spray @625 ml/ha @40 and 50 DAS (T8), respectively. Which being statically *at par* with T10 at 25 and at harvest, T10 and T9 at 50 DAS. The result presented in table 1 showed that the minimum to maximum dry matter accumulation (g/plant) varies from 1.72, 5.14 and 7.34 to 4.34, 11.48 and 18.23 (g/plant) was recorded under control (T1) and (T8) which was significantly superior with all the treatment except (T10). This might be due to the combined use of FYM and N: P: K (12:32:16) ensured a balanced and continuous nutrient supply during the early vegetative stages. Application of NPK Consortia promoted nutrient solubilization and microbial activity in the rhizosphere, thereby enhancing root growth and nutrient uptake. The bio stimulant sprays further improved physiological functions and stress tolerance, leading to robust vegetative growth. The foliar application of NPK (18:18:18) during critical stages (40 and 50 DAS) met the crop’s immediate nutrient demand, contributing to healthy canopy development and better biomass accumulation. Similar results also reported by [8], [9], [10].

**Yield attributes, yield and quality**

The data is presenting in table 2. The Impact of different INM practices on various yield attributes *viz*., pods/plant, pod length, grains/pod, test weight (g), grain yield (q/ha), straw yield (q/ha), biological yield (q/ha), protein content (%) and protein yield (kg/ha) have significant different. The significantly maximum pods/plant (14.5) and pod length (8.3cm) were noted under T8, which being statically *at par* with T10. While, the minimum pods/plant (10.6) and Pod length (4.3 cm) recorded under control. The maximum grains/pod (11.1) recorded under T8 was statically *at par* with T3, T6, T9 and T10. The minimum grains/pod (8.9) noted under control. The maximum test weight (33.4 g) noted with the application of FYM @5 t/ha + DAP @100 Kg/ha + Rhizobium culture @625 ml/kg seed + 2 % foliar spray of nano urea @40 and 50 DAS (T4) which was significantly superior with T1, T3 and T6. The minimum test weight (27.7 g) noted under control. The significantly maximum grain yield of 15.9 q/ha, straw yield of 29.3 q/ha and biological yield of 44.8 q/ha were recorded under T8 except straw yield noted under T10. Grain and biological yield at par with T10. While, straw yield significantly superior with all other treatment except T8. The minimum grain yield (7.8 q/ha), straw yield (14.2 q/ha) and biological yield (22.0 q/ha) received under control. The increase in yield attributes cumulative positive effects on growth and nutrient availability. The organic input (FYM) improved soil structure and moisture retention, which facilitated better crop stand and reduced nutrient leaching losses. The NPK (12:32:16) supplied sufficient macronutrients at early stages, boosting flowering and branches. Seed treatment with NPK Consortia enhanced the availability and uptake of phosphorus and potassium, crucial for flowering and grain development. Foliar feeding of NPK ensured a quick nutrient supply during the reproductive phase, improving grain filling and test weight. The use of bio stimulants likely increased enzymatic activity and photosynthetic efficiency, which ultimately resulted in higher yield compared to other treatments. The maximum protein content (24.94 %) was received under T8, which being statically *at par* with T5, T6, T7, T9 and T10. While, the lowest protein content (19.69 %) noted under control. The minimum to maximum protein yield varies from 122.04 to 336.71 kg/ha under T1 and T10, which being significantly superior with all other treatment except T10. Similar results also reported by [11], [12], [13].

 The protein content in grain and protein yield increased significantly with the enhanced availability of balanced nutrients throughout the crop growth stages facilitated better metabolite synthesis, especially proteins. The combination of FYM and biofertilizers supported microbial activity and improved nitrogen metabolism, resulting in higher protein content in grains. The bio stimulant applications may have influenced enzymatic and hormonal activities, leading to enhanced grain quality and nutritional value. Moreover, foliar application of NPK helped maintain nutrient levels during grain filling, reducing the chances of nutrient deficiencies that often degrade grain quality. Similar results also reported by [14], [15], [16].

**Conclusion**

On the basis of experiment, it may be concluded that with the application of FYM @5 t/ha + N:P:K (12:32:16) @100 kg/ha + NPK Consortia @20 ml/kg seed + NPK (18:18:18) @0.5 % foliar spray @40 and 50 DAS + Bio stimulant spray @625 ml/ha @40 and 50 DAS in mung bean seems to be best as they improved the growth, yield attributes, yield and quality of green gram andprovides a reliable, short- term and sustainable approach for increasing the yield in green gram.

**COMPETING INTERESTS DISCLAIMER:**

Authors have declared that they have no known competing financial interests OR non-financial interests OR personal relationships that could have appeared to influence the work reported in this paper.

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**Table 1:** Impact of different nutrient management practices on plant height (cm), number of branches/plant and dry matter accumulation (g/plant) of *kharif* mung bean at successive stage of crop growth.

|  |  |  |  |
| --- | --- | --- | --- |
| **Treatment** | **Plant Height (cm) at** | **Number of branches/plant at** | **Dry matter accumulation (g/plant) at** |
| **25 DAS** | **50 DAS** | **Harvest** | **25 DAS** | **50 DAS** | **Harvest** | **25 DAS** | **50 DAS** | **Harvest** |
| **T1** | 19.02  | 30.78  | 35.11  | 2.01  | 2.90  | 3.12  | 1.72  | 5.14  | 7.34  |
| **T2** | 21.57  | 39.67  | 46.55  | 2.22  | 3.60  | 4.42  | 2.80  | 6.22  | 9.67  |
| **T3** | 22.11  | 40.85  | 48.50  | 2.30  | 3.90  | 4.77  | 3.20  | 6.45  | 10.49  |
| **T4** | 23.32  | 42.27  | 50.49  | 2.41  | 4.21  | 5.10  | 3.31  | 7.38  | 12.89  |
| **T5** | 625.60  | 44.95  | 53.96  | 2.41  | 4.10  | 5.07  | 3.45  | 8.21  | 15.38  |
| **T6** | 24.87  | 43.88  | 52.63  | 2.60  | 4.50  | 5.44  | 3.84  | 6.95  | 13.44  |
| **T7** | 27.71  | 47.96  | 57.85  | 2.63  | 4.63  | 5.63  | 3.49  | 10.68  | 17.26  |
| **T8** | 29.54  | 50.99  | 61.10  | 2.90  | 5.10  | 6.16  | 4.34  | 11.48  | 18.23  |
| **T9** | 27.33  | 47.18  | 56.79  | 2.68  | 4.74  | 5.75  | 3.16  | 10.78  | 16.57  |
| **T10** | 28.72  | 49.17  | 59.18  | 2.77  | 4.92  | 5.96  | 4.18  | 11.13  | 17.83  |
| **SEm±** | 0.78  | 1.70  | 2.625  | 0.076  | 0.12  | 0.12  | 0.12  | 0.23  | 0.52  |
| **CD(P=0.05)** | 2.34  | 5.1  | 6.72  | 0.20  | 0.37  | 0.35  | 0.35  | 0.69  | 1.56  |

**Table 2**: Impact of different nutrient management practices on yield attributes, yield and quality of *kharif* mung bean

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Treatments** | **Pods/plant** | **Pod length (cm)** | **Grains/pod** | **Test weight (g)** | **Grain yield (q/ha)** | **Straw yield (q/ha)** | **Biological yield (q/ha)** | **Protein content (%)** | **Protein yield (kg/ha)** |
| **T1** | 10.6  | 4.3  | 8.9  | 27.7  | 7.8  | 14.2  | 22.0  | 19.69 | 122.04 |
| **T2** | 11.6  | 4.8  | 9.3  | 31.0  | 10.3  | 18.9  | 29.2  | 21.50 | 189.81 |
| **T3** | 11.4  | 5.3  | 10.3  | 29.7  | 10.8  | 20.1  | 30.9  | 22.06 | 203.43 |
| **T4** | 11.1  | 5.8  | 9.7  | 33.4  | 11.1  | 20.8  | 31.9  | 22.75 | 213.48 |
| **T5** | 12.4  | 6.3  | 9.7  | 32.1  | 12.1  | 22.8  | 34.9  | 23.63 | 243.62 |
| **T6** | 13.1  | 5.7  | 10.4  | 27.2  | 11.5  | 21.4  | 32.9  | 23.31 | 228.46 |
| **T7** | 12.8  | 7.5  | 9.9  | 31.9  | 12.8  | 24.1  | 36.9  | 23.94 | 261.37 |
| **T8** | 14.5  | 8.3  | 11.1  | 31.0  | 15.9  | 28.9  | 44.8  | 24.94 | 336.71 |
| **T9** | 13.1  | 7.4  | 10.5  | 31.2  | 13.6  | 625.8  | 39.4  | 24.23 | 281.17 |
| **T10** | 13.9  | 7.9  | 10.8  | 32.2  | 15.4  | 29.3  | 44.7  | 24.56 | 321.66 |
| **SEm±** | 0.4  | 0.2  | 0.4  | 1.03  | 0.45  | 0.7  | 1.03  |  0.61 |  8.76 |
| **CD(P=0.05)** | 1.3  | 0.5  | 1.1  | 3.1  | 1.36  | 2.1  | 3.09  |  1.84 |  26.23 |