Growth Parameter of Mung bean (*Vigna radiata* L.) under different Integrated Nutrient Management Practices in Western Uttar Pradesh, India

ABSTRACT

The field experiment was conducted during the summer seasons of 2022 and 2023 at the Crop Research Centre (CRC) of Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut (UP). The experiment was laid out in a Randomized Block Design with eleven treatment combinations and three replications to evaluate the effects of different treatments on the growth parameters of mung bean (Vigna radiata L.). Among the different integrated nutrient management strategies, treatment T4 (75% NPK + Vermicompost @ 0.34 t ha-1 + Rhizobium + PSB) resulted in significantly higher plant height (59.7 & 61.5 cm), number of branches per plant (4.65 & 4.75), number of trifoliate leaves per plant at 40 DAS (11.1 & 11.4), dry matter accumulation per plant (15.4 & 15.7 g), leaf area index at 40 DAS (4.9 & 5.2), and number of effective nodules per plant (43.8 & 46.4). In contrast, the lowest values for plant height (44.9 & 46.2 cm), number of branches per plant (3.0 & 3.2), number of trifoliate leaves per plant at 40 DAS (7.9 & 8.3), dry matter accumulation per plant (9.4 & 9.7 g), leaf area index at 40 DAS (2.8 & 3.0), and number of effective nodules per plant (31.3 & 33.2) were recorded in T1 (Absolute control) during both years.

Keyword:Mung Bean, INM, NPK, Vermicompost, Rhizobium, PSB.

INTRODUCTION

Mung bean (*Vigna radiata* L.) belongs to the group of pulses that are commonly produced in India. Mung beans have a high protein content of almost 24%, along with nutritional values of 1.9% fats, 10.9% moisture, and 60.3% carbohydrates (Shroti *et al.*, 2018).

By enhancing the nitrogen condition of the soil, they enhance its health and ensure the agricultural systems remain sustainable. About 85.40 million hectares are planted with pulses worldwide, yielding 87.40 million tons at a productivity of 1023 kg ha-1. The largest producer of pulses, India, has an area of around 29 million hectares, ranks first in terms of production and area (34 and 26%, respectively), and has an average productivity of 835 kg ha-1. (Directorate of Economics & Statistics, Agricultural Statistics Division, 2020). By enhancing the efficiency of applied nutrients, integrated nutrient management or INM contributes significantly to yield and production maintenance (Pandey *et al.*, 2023). In order to enhance soil structure, boost soil penetration and encourage the development and inhabitants of advantageous soil microbes, poultry manure serves as an excellent source of nutrients and water for soil (Kumar et al., 2023) [c.]

By enhancing the physical, chemical, and biological characteristics of soil and providing balanced plant nutrition, poultry manure contributes significantly to increased soil fertility and productivity (Iqbal et al. 2016). When poultry manure is applied to the soil, it increases the amount of organic matter, total nitrogen, available potassium, exchangeable cations (ca, mg, and k), CEC, and percent base saturation. [E.O. Adeleye, 2007]. Significant advancements have been made in the use of vermicompost and seed inoculation with PSB and rhizobium for integrated nutrient management over the past several years (Dhakal et al., 2016). Beneficial organism development in the soil has been effectively aided by vermicompost. It also raises the efficacy of biofertilizers and improves crop growth, yield, and quality (Meena 2013; Mujahid and Gupta, 2010).

Microbe that dissolves phosphate and is applied to soil or seeds. These are organic products made of live cells from various microorganisms that can change an essential nutrient from an inaccessible state to an available one through a biological process. Through their ability to transform insoluble phosphorus from the soil into soluble form, PSB such as Bacillus and Pseudomonas also improve the availability of phosphorus to plants. (Swati kadam *et al.*, 2014).

Soil fertility and production can be maintained by adding organic material to the soil, such as farm yard manure (Kumar*et al.*, 2023) [a.]

In order to achieve agricultural sustainability, it is necessary to incorporate both organic and inorganic sources of nutrients, as no single source can satisfy the growing demands for nutrients in agriculture. (Premanantharajah*et al.*, 2013). Use of bio fertilizer along with vermicompost and poultry manure is necessary to attain good yields (Biswas *et al.* 2009).

To achieve productivity requirements, soil fertility must be maintained and plant nutrient delivery must be optimized by utilizing all available plant nutrition sources in concert. (Kumar *et al*., 2023)[b].

MATERIALS AND METHODS

The experiment was conducted at Crop Research Centre of Sardar Vallabh Bhai Patel University of Agriculture and Technology, Meerut (U.P.) in *summer* season of 2022 and 2023. Meerut is situated on Delhi-Dehradun road. Geographically it is located at 29°05′ N latitude and 77°41′ E longitude at an altitude of 230 meters above the mean sea level. The climate of this region is sub-tropical and semi-arid climate characterized with hot summers and extremely cold winters. The treatment consists of vermicompost, poultry manure, *Rhizobium* and *PSB culture*. T_1 [Control], T2 [100%NPK], T_3 [100%NPK+*Rhizobium*+*PSB*], T_4 [75%NPK+Vermicompost@0.34tha^{-1}+*Rhizobium* +*PSB*], T_5 [75%NPK+ Poultrymanure@0.17tha^{-1}+ *Rhizobium* +*PSB*], T_6 [50%NPK+Vermicompost @0.34tha^{-1}+Poultrymanure @0.17 t ha^{-1} + *Rhizobium* + *PSB*], T_7 [50%NPK+Vermicompost@0.66t ha^{-1}], T_8 [50%NPK+Poultrymanure@0.34tha^{-1}], T_9 [50%NPK+Vermicompost@0.66tha^{-1}+*Rhizobium*+*PSB*], T_{10} [50%NPK+ Poultrymanure@0.34tha^{-1}+ *Rhizobium* +*PSB*] and T_{11} [125%NPK]. The experiment was laid out in Randomized Block Design with eleven treatment combination and three replications in plot size 5.0 × 3.9 = 19.5 m^2. The recommended dose of NPK (20:40:20), vermicompost and poultry manure are applied as basal dose according to treatments and *Rhizobium & PSB culture* are applied as seed treatment. The growth parameters data was recorded as 20, 40 and 60 days after sowing.

RESULTS AND DISCUSSION

Integrated nutrition management treatments showed a significant impact on a number of growth parameters in the current investigation. *viz.* plant height (cm), number of branches, number of trifoliate leaves, number of effective nodules, leaf area index and dry matter accumulation plant^{-1} recorded at different time periods of crop growth. Enhancement of growth parameters through integrated nutrient management treatments: these treatments stimulate the growth of new cells, plant vigor, and accelerate leaf development. This, in turn, aids in the harvesting of more solar energy and improves the utilization of nutrients, particularly nitrogen, which contributes to higher growth attributes by supplying hormones and other growth factors. Plant height was significantly influenced by the different treatments at all growth stages. The highest plant height 29.8& 31.6 cm, 47.7& 50.6 cm and 59.7 & 61.5 cm was recorded in T_4 (75%NPK+Vermicompost@0.34tha^{-1}+*Rhizobium* +*PSB*) at 20, 40 and 60 DAS stage of crop growth, respectively (Table 1) while, shortest plant height in T_1 (Control) during 2022 and 2023. A notable rise in plant height was seen, which may have resulted from the plant's ability to maintain an appropriate ratio between the nutrients it receives and needs for optimal growth. It facilitates the growth of a larger root system, allowing the plant to draw more water and nutrients from the soil at a deeper level and leading to better development. The investigation's outcomes are consistent with the conclusions made by Ahmad et al (2013). The highest number of branches (3.45 & 3.65 and 4.80 & 4.95 plant^{-1}) were recorded in T_4 (75%NPK+Vermicompost@0.34tha^{-1}+*Rhizobium* +*PSB*) at 40 and 60 DAS stage, respectively (Table 1). However, lowest numbers of branches (2.35 & 2.45 and 3.0 & 3.20 plant^{-1}) were recorded in control (T_1). Increase in number of branches might be due to integrated nutrient management, elongation and chlorophyll biosynthesis, which in turn, improve the branches plant^{-1}. These results are in agreement with those of Tahir *et al.* (2020). The highest dry matter accumulation 6.5 & 6.8, 11.0 & 11.3 and 15.4 & 15.7 g plant^{-1} at 20, 40 and 60 DAS stage of mung bean during 2022 and 2023, respectively (Table 2) was found in T_4 (75%NPK+Vermicompost@0.34tha^{-1}+*Rhizobium* +*PSB*). However, the lowest values were recorded in control (T_1). These results are in close conformity with the findings of Gokila*et al.* (2015). The highest leaf area index 3.8 & 4.0, 4.9 & 5.1 and 4.0 & 4.3 at 20, 40 and 60 DAS stage of mung bean during 2022 and 2023, respectively (Table 2) was found in T_4 (75%NPK+Vermicompost@0.34tha^{-1}+*Rhizobium* +*PSB*). However, the lowest values were recorded in control (T_1). The number of effective nodules plant^{-1} in moong bean was significantly influenced by integrated nutrient management treatments (Table 2). The highest number ofeffective nodules 43.8 & 46.4 plant^{-1}, respectively were recorded in T_4 (75%NPK+Vermicompost@0.34tha^{-1}+*Rhizobium* +*PSB*) during 2022 and 2023. However, lowest number of effective nodules 31.3 & 33.2 plant^{-1} respectively were recorded in control (T_1). It may have happened as a result of bacteria' increased capacity for competition close to roots, which are the sites of microbial infections. A well-developed root system increases the evidence of infection, leading to a higher number of functional nodules. These results are believed to be pertinent to Gowthami and Rama (2014).

Table : 1. Effects of different integrated nutrient management practices on plant height, number of branches and number of trifoliate leafs of mung bean crop

Treatments	Plant height (cm)						Number of branches plant^{-1}				Number of trifoliate leaf plant^{-1}					
	20 DAS		40 DAS		60 DAS		40 DAS		60 DAS		20 DAS		40 DAS		60 DAS	
	2022	2023	2022	2023	2022	2023	2022	2023	2022	2023	2022	2023	2022	2023	2022	2023
T_1	20.5	21.7	33.5	35.5	44.9	46.2	2.35	2.45	3.0	3.2	1.9	2.2	7.9	8.3	5.4	5.6
T_2	25.9	27.5	37.6	39.9	48.6	50.1	2.9	3.1	3.9	4.05	2.5	2.7	8.8	9.2	7.0	7.3
T_3	27.3	28.9	45.0	47.7	56.4	58.1	3.2	3.4	4.4	4.55	3.1	3.5	10.5	10.8	8.3	8.5
T_4	29.8	31.6	47.7	50.6	59.7	61.5	3.45	3.65	4.8	4.95	3.9	4.2	11.1	11.4	8.9	9.2
T_5	28.9	30.6	47.1	49.9	58.4	60.2	3.4	3.6	4.65	4.75	3.6	3.8	10.9	11.2	8.8	9.1
T_6	27.1	28.7	44.5	47.2	55.5	57.2	3.2	3.35	4.3	4.45	3.0	3.4	10.0	10.2	7.9	8.2
T_7	26.3	27.9	42.3	44.8	53.9	55.5	3.1	3.25	4.0	4.15	2.9	3.2	10.1	10.3	8.0	8.3
T_8	26.1	27.7	39.2	41.6	50.3	51.8	2.95	3.15	3.95	4.15	2.7	2.9	9.8	10.1	7.6	7.9
T_9	27.0	28.6	43.8	46.4	55.1	56.8	3.15	3.3	4.2	4.35	3.0	3.3	9.2	9.6	7.3	7.6
T_{10}	26.2	27.8	42.0	44.5	53.4	55.0	3.05	3.2	4.05	4.2	2.8	3.1	9.8	10.1	7.8	8.0
T_{11}	27.4	29.0	45.4	48.1	56.8	58.5	3.25	3.4	4.45	4.6	3.3	3.5	10.6	10.9	8.4	8.7
SEm (±)	0.92	0.97	1.48	1.56	1.86	1.92	0.11	0.11	0.14	0.15	0.1	0.11	0.32	0.33	0.27	0.28
C.D. (P=0.05)	2.65	2.81	4.25	4.5	5.37	5.53	0.31	0.33	0.42	0.43	0.3	0.32	0.92	0.95	0.78	0.8

Table :2. Effects of different integrated nutrient management practices on dry matter accumulation, leaf area index and effective nodules of mung bean crop.

Treatments	Dry matter accumulation (g plant^{-1})						Leaf Area Index						Effective nodules (plant^{-1})	
	20 DAS		40 DAS		60 DAS		20 DAS		40 DAS		60 DAS			
	2022	2023	2022	2023	2022	2023	2022	2023	2022	2023	2022	2023	2022	2023
T1	2.1	2.3	6.4	6.6	9.4	9.7	2.0	2.2	2.8	3.0	2.0	2.2	31.3	33.2
T2	4.1	4.3	7.5	7.8	11.8	12.0	2.6	2.7	3.2	3.4	2.6	2.8	36.4	38.6
T3	5.2	5.5	9.9	10.2	14.2	14.5	3.2	3.5	4.3	4.6	3.5	3.8	41.1	43.6
T4	6.5	6.8	11.0	11.3	15.4	15.7	3.8	4.0	4.9	5.2	4.0	4.3	43.8	46.4
T5	6.0	6.3	10.8	11.1	15.0	15.3	3.7	3.9	4.7	5.0	3.9	4.2	42.8	45.4
T6	5.0	5.3	9.8	10.1	14.0	14.3	3.1	3.4	4.2	4.4	3.4	3.6	40.7	43.1
T7	4.7	5.0	9.2	9.4	13.3	13.5	3.0	3.2	3.8	4.1	3.2	3.5	38.7	41.0
T8	4.3	4.7	8.4	8.6	12.4	12.6	2.8	3.0	3.4	3.6	2.9	3.2	38.2	40.5
T9	4.8	5.1	9.5	9.8	13.7	14.0	3.1	3.3	4.0	4.2	3.3	3.5	39.1	41.4
T10	4.4	4.6	8.7	9.0	12.7	13.0	2.9	3.3	3.6	3.8	3.1	3.3	38.5	40.8
T11	5.4	5.7	10.2	10.5	14.5	14.7	3.3	3.5	4.4	4.6	3.7	4.0	41.4	43.9
SEm (±)	0.17	0.18	0.32	0.33	0.46	0.47	0.11	0.12	0.14	0.15	0.11	0.12	1.36	1.44
C.D. (P=0.05)	0.48	0.51	0.93	0.95	1.33	1.36	0.31	0.33	0.39	0.43	0.33	0.35	3.91	4.14

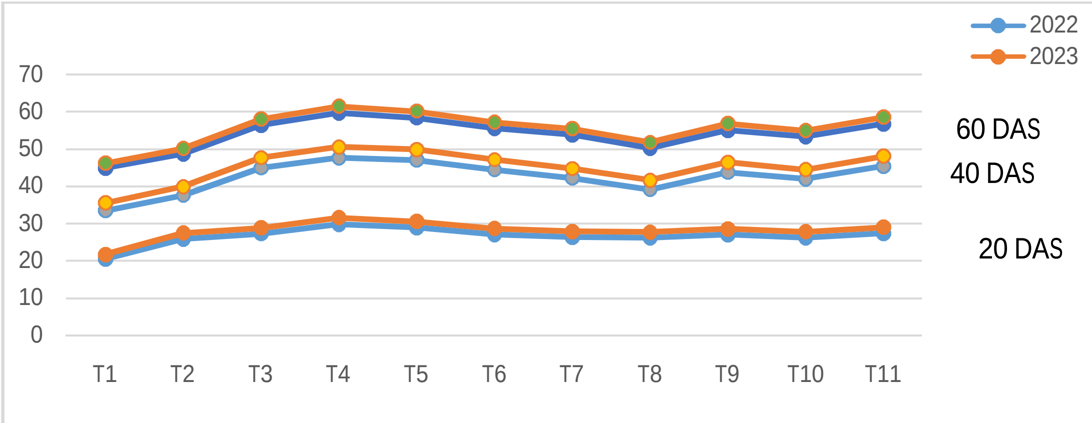

Fig: 1. Effects of different integrated nutrient management practices on plant height of mung bean crop.

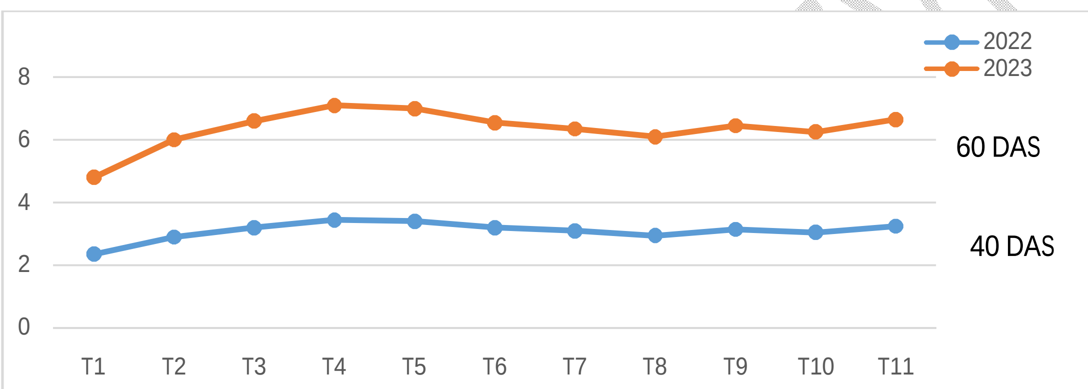

Fig: 2. Effects of different integrated nutrient management practices on number of branches plant^{-1} of mung bean crop.

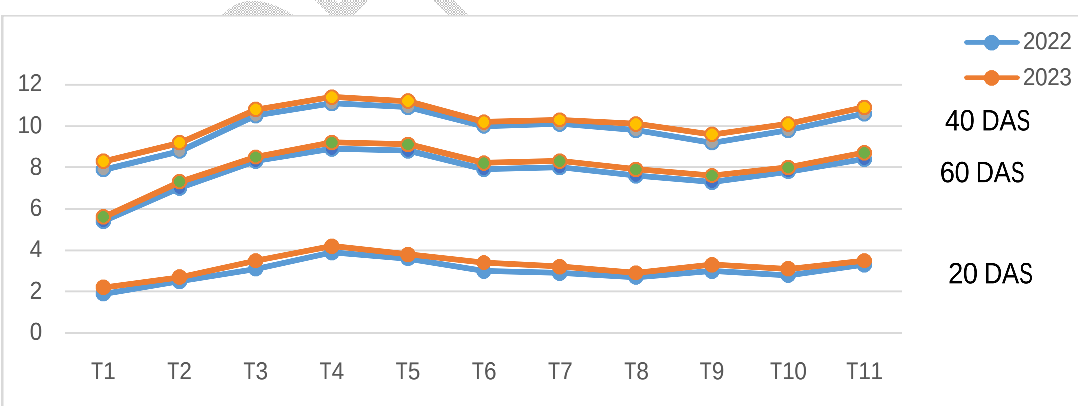

Fig: 3. Effects of different integrated nutrient management practices on number of trifoliate leaf plant^{-1} of mung bean crop.

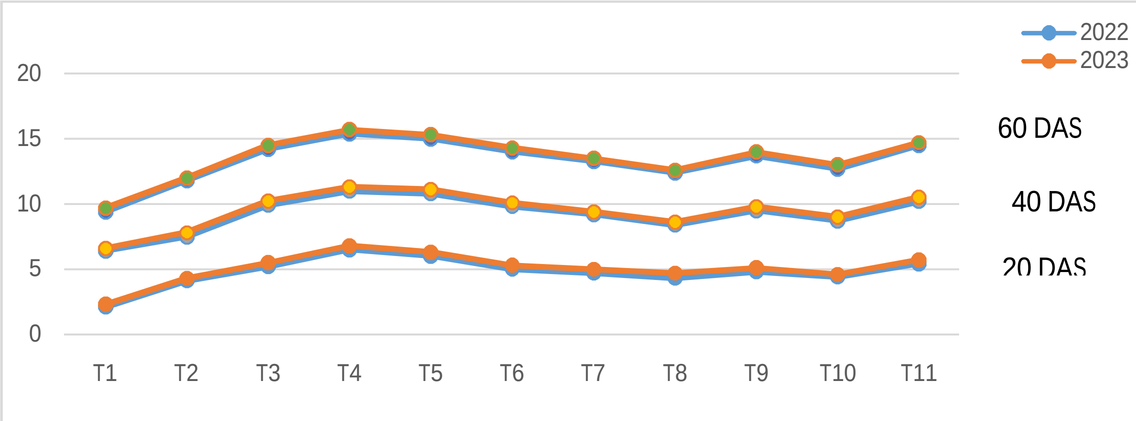

Fig: 4. Effects of different integrated nutrient management practices on dry matter accumulation (g plant^{-1}) of mung bean crop.

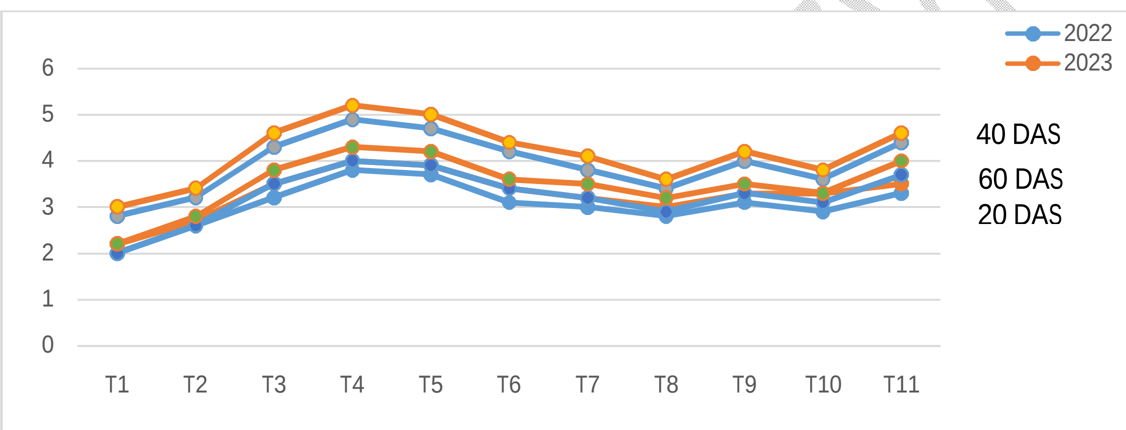

Fig: 5. Effects of different integrated nutrient management practices on leaf area index of mung bean crop.

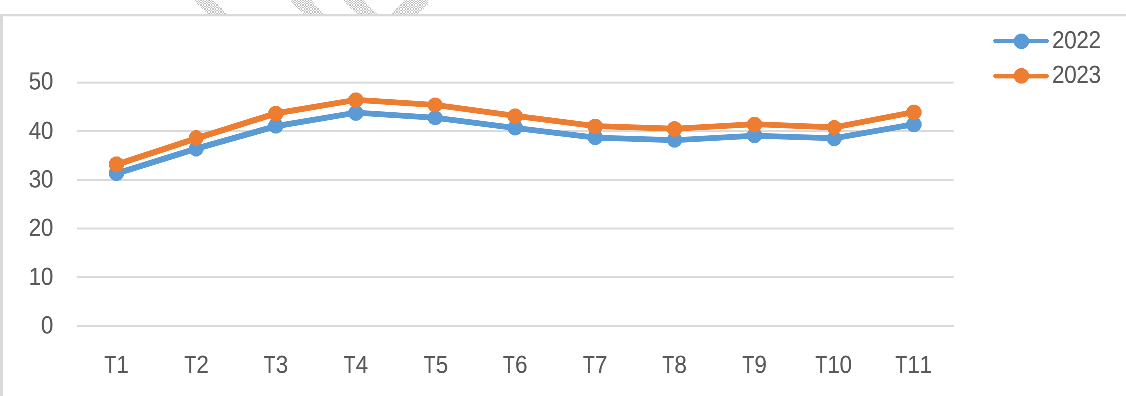

Fig: 6. Effects of different integrated nutrient management practices on number of effective nodules plant^{-1} of mung bean crop.

CONCLUSION

The integrated nutrient management treatments demonstrated a significant impact on various growth parameters of mung bean, including plant height, number of branches, trifoliate leaves, effective nodules, leaf area index, and dry matter accumulation at different stages of crop growth. The T4 treatment (75% NPK + Vermicompost @ 0.34 t ha-1 + Rhizobium + PSB) consistently showed the highest values across these parameters, indicating enhanced plant vigor, better nutrient uptake, and improved growth. These results emphasize the effectiveness of integrated nutrient management in optimizing crop performance and are consistent with previous findings.

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