Effect of different organic nutrition combination on growth and yield of Moong bean (*Vigna radiata* L. Wilczek)

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Abstract— *The present investigation was carried at Organic Research Farm, Department of Agronomy, Institute of Agricultural Sciences, Bundelkhand University, Karguanji, Jhansi, Uttar Pradesh during the Kharif-2023 with a view to identify the effects of different combinations of organic nutrition and its role in growth, yield and economics of moong bean variety Samrat. The experiment was laid in Randomized block design with 8 treatments and 3 replications with different combination of organic nutrition. Under this experiment, overall, 8 treatment was taken T_0 Control (water spray), T_1 (100% Farmyard Manure), T_2 (100% Vermicompost), T_3 (100% Neem cake), T_4 (50% Farmyard + 50% Vermicompost), T_5 (50% Farmyard Manure + 50% Neem cake), T_6 (50% Neem cake + 50% Vermicompost) and T_7 (33.33% Farmyard Manure + 33.33% Neem cake + 33.33% Vermicompost). From the above experimental finding it may be concluded that the treatment T_3 (100% Neem cake) was found to be best in the terms of growth parameters like plant height (61.81cm); number of branches (16.48 branches); number of root nodules (15.41 nodules); fresh shoot weight (195.45 gram) at 60 DAS, earliness in flowering (41.00 days) and maturity (61.67 days). T_3 also performed best in terms of yield like highest number of pods per plant (50.48 pods); number of seeds per pod (11.33 seeds); pod weight (5.86 gram); longest pod (11.48 cm) and seed yield per hectare (13.60 q/ha).*

Keywords— Moong bean, Farmyard Manure, Neem cake, Vermicompost, Benefit cost ratio.

I. INTRODUCTION

Pulse cultivation holds immense importance in the realm of global agriculture, making a substantial contribution to both food security and nutrition. The leading pulse-producing nations across the globe include India, Canada, Myanmar, China, Australia, the United States, Russia, Brazil, Ethiopia, and Turkey. Collectively, these countries are responsible for more than 85% of the total global pulse production. The increasing demand for pulses, driven by their nutritional advantages and their potential to enhance soil quality, has spurred research, development, and investments in this sector. The production of pulses can be influenced by various factors, such as weather conditions, pest infestations, diseases, and market fluctuations. Efforts are currently underway to advance farming practices and promote both the cultivation and consumption of pulses. Notably, India stands as the largest producer and consumer of pulses on a global scale, covering 37% of the world's pulse-growing area and contributing 20% of the total production. In India, pulse cultivation encompassed 26.28 million hectares of land, resulting in a production of 23.01 million metric tonnes in the 2020-21 fiscal year. (*Source:* **DES, Ministry of Agriculture & Farmers Welfare, Government of India, 2021-22**). India produces a wide range of pulses, including chickpeas, pigeon peas, lentils, mung beans, black gram, and kidney beans. Chickpeas and pigeon peas are the most widely cultivated pulses in India, accounting for around 60% of the total pulse production. Mungbean, also known as green gram, is a pulse crop with a short

growth duration that is cultivated throughout India. It holds the position of being the third most significant pulse crop, following chickpeas and pigeon peas, and accounts for approximately 12-13% of the total pulse acreage in the country. From a botanical perspective, Mungbean is scientifically referred to as *Vigna radiata* L. Wilczek, and it belongs to the Leguminosae family, specifically the sub-family Papillionaceae. It is a diploid, self-pollinating species with a chromosome count of 2n=22, as determined by **Karpechenko** in **1925**. The origins of Mungbean are believed to be in India, as suggested by **De Candole** in **1986**. This crop is predominantly grown in regions such as China, India, Burma, and other parts of Southeast Asia. The wild progenitor of Mungbean is *Vigna radiata* sub; *Sublobata*. In the year 2020-21, Mungbean production in India covered an area of 38.32 lakhs hectares, yielding a total production of 17.84 lakhs tonnes, according to data from the Department of Economics and Statistics (**DES**), Ministry of Agriculture & Farmers Welfare, Government of India. Rajasthan emerged as the leading state in both the area and production of Mungbean in the year 2021-22, followed by Maharashtra and Karnataka. In Uttar Pradesh, the Mungbean production area amounted to 0.54 lakhs hectares, resulting in a production of 0.29 lakhs tonnes for the same year. Mungbean is highly regarded for its quality as a pulse due to its outstanding digestibility and high protein content, ranging from 25% to 28%. The application of FYM enriches the soil with nutrients, contributing to improved soil fertility. On average, well-decomposed farmyard manure contains approximately 0.5% Nitrogen (N), 0.2% Phosphate (P_2O_5), and 0.5% Potassium (K_2O). Additionally, FYM enhances the availability of soil phosphorus. Furthermore, when FYM is used in conjunction with fertilizer phosphorus, it can impact the solubility and potential availability of applied phosphorus. It's essential to recognize that neither the sole use of organic manure nor chemical fertilizers in isolation can ensure sustainable and productive yields in modern intensive farming. A balanced approach that combines both organic and chemical inputs is often necessary to achieve long-term agricultural sustainability (**Singh, 2019**). Vermicompost is the result of a decomposition process that employs various types of earthworms, including red worms, white worms, and other earthworm species. This process, known as worm composting, involves breaking down a mixture of vegetable or food waste, bedding materials, and vermicast (worm castings). Raising earthworms for the purpose of creating this nutrient-rich mixture is often referred to as worm farming, and the final product is known as Vermicompost. Vermicompost boasts significant mineral content, including nitrogen (2-3%), potassium (1.85-2.25%), and phosphorus (1.55-2.25%). In addition to these primary nutrients, it also contains micronutrients, beneficial soil microbes, and is rich in 'plant growth hormones and enzymes.' Scientifically, Vermicompost has been proven to act as a remarkable growth promoter for plants and serves as a protective agent against pests and diseases. This makes it a valuable and multifaceted resource for improving soil health and supporting plant growth in agricultural and horticultural practices. Neemcake, a by-product of neem seed oil extraction, is a nutrient-rich organic fertilizer. Packed with nitrogen, potassium, phosphorus, and micronutrients, it enhances soil health, improves water retention, and boosts plant growth. Its high nitrogen content fosters robust plant development, while potassium aids in flowering and fruiting. Phosphorus promotes root growth. Additionally, Neemcake acts as a natural pest repellent due to its azadirachtin content. Environmentally friendly and beneficial, it serves as a valuable resource in sustainable agriculture practices. On average, Neemcake has a nutrient composition of about 5.03 percent nitrogen (N), 3.63 percent phosphate (P_2O_5), and 1.03 percent potassium (K_2O). Numerous studies have demonstrated that the application of neem cake can enhance production efficiency with protective features. A sufficient supply of nitrogen is particularly critical for achieving robust vegetative growth in crops. This highlights the importance of neem cake, which provides an enriched source of essential nutrients, including nitrogen, that can promote the vigorous growth of millet and, by extension, other crops. (**Ayub *et al.*, 2009**). Mung bean holds a significant position in agriculture due to its economic importance. Organic substances like Farmyard Manure (FYM), Vermicompost, and Neem cake not only enhance crop yields and quality but also unlock the genetic potential of plants. The presence of these nutrients contributes to root development, fruit formation, and overall plant vigour and health. Furthermore, they improve soil quality and its biological diversity. Nutrients are essential for a well-rounded plant diet and serve as valuable tools for farmers seeking to boost both quantity and quality in their yields. This study aimed to investigate the impact of various organic fertilizers on the growth and yield attributes of mung bean. The combined use of organic materials has the potential to increase mung bean productivity in terms of both quantity and quality, making the plants more resilient to stress conditions, be they biotic or abiotic. This, in turn, can enhance market prices and profitability. Therefore, the objective of this research is to assess the growth and yield parameters of mung

bean. Keeping these above point the present investigation was carried out with objective to determine effect of organic manures on growth and yield of Moongbean *cv.* Samrat.

II. MATERIALS AND METHODS

The current investigation was carried out in *Kharif*-2023 at the Karguan ji Organic Research Farm, Jhansi Department of Agronomy, Institute of Agricultural Sciences, Bundelkhand University, Jhansi, U.P. The experimental design employed was a Randomized Block Design (RBD) with three replications and nine treatments. The **Fisher and Yates, 1963** method was used to statistically analyse the data. The software used for analysis was INDOSTAT. The Moong bean variety used was Samrat. In the study, the height of randomly chosen plants from each plot was assessed in centimetres using a meter scale. Stem diameter was measured at last harvest stage using meter tape in random selected five plants. Additionally, the number of branches and leaves per plant, emerging from the main shoot, was counted, and the values were averaged. TSS was measured using refractometer. The details of treatments comprised of T_0 Control (water spray), T_1 (100% Farmyard Manure), T_2 (100% Vermicompost), T_3 (100% Neem cake), T_4 (50% Farmyard + 50% Vermicompost), T_5 (50% Farmyard Manure + 50% Neem cake), T_6 (50% Neem cake + 50% Vermicompost) and T_7 (33.33% Farmyard Manure + 33.33% Neem cake + 33.33% Vermicompost).

III. RESULTS AND DISCUSSION

There was significant difference present for plant height at 60 DAS among different treatment combinations. The tallest plant (61.81 cm) at 60 DAS was observed with treatment T_3 (100% Neem cake) followed by T_6 (50% Vermicompost + 50% Neem cake) with 57.31 cm. Plant with minimum height (49.78 cm) was observed in T_0 (control), while the remaining treatments were moderate in their growth habit. The highest number of branches (16.48 branches) at 60 DAS was observed with treatment T_3 (100% Neem cake) followed by T_6 (50% Vermicompost + 50% Neem cake) with 12.82 branches. Plant with minimum number of branches (8.67 branches) was observed in T_0 (control). The improved performance of the treatment combining 100% neem cake followed by a combination of 50% vermicompost and 50% neem cake, in contrast to other treatments for moong bean's plant height and number of branches per plant, likely arises from the rich nutrient composition of neem cake. Its organic richness aids in stimulating lateral branching and foliage growth. Additionally, the combined treatment offers a balanced nutrient amalgamation, fostering robust branch development and plant height. This harmonious blend of neem cake's nutritional benefits and the balanced composition likely promotes increased branching in moong bean plants. Similar findings were reported by **Armin *et al.*, (2016); Patel *et al.*, (2019)** in Moong bean.

The highest number of root nodules (15.41 nodules) at 60 DAS was observed with treatment T_3 (100% Neem cake) followed by T_6 (50% Vermicompost + 50% Neem cake) with 14.79 nodules. Plant with minimum number of root nodules (9.11 nodules) was observed in T_0 (control). The enhanced performance of the treatment sequence utilizing 100% neem cake followed by a combination of 50% vermicompost and 50% neem cake, over other treatments in moong beans concerning the number of root nodules per plant, likely arises from neem cake's bioactive compounds. Neem cake fosters rhizobial activity, aiding nitrogen fixation and nodule formation. The combined treatment's balanced nutrient mix supports symbiotic interactions, encouraging increased nodulation. This synergistic effect between neem cake's properties and the balanced nutrient blend likely augments root nodule formation in moong bean plants. Similar findings were reported by **Raj and Mehera (2022)** in Moong bean.

The highest fresh shoot weight (195.45 gram) at 60 DAS was observed with treatment T_3 (100% Neem cake) followed by T_6 (50% Vermicompost + 50% Neem cake) with 188.68 gram. Plant with lowest fresh shoot weight (142.93 gram) was observed in T_0 (control). The highest dry shoot weight (59.62 gram) at 60 DAS was observed with treatment T_3 (100% Neem cake) followed by T_6 (50% Vermicompost + 50% Neem cake) with 57.56 gram. Plant with lowest dry shoot weight (37.29 gram) was observed in T_0 (control). The superior performance of the treatment sequence, starting with 100% neem cake and followed by a mixture of 50% vermicompost and 50% neem cake, in comparison to other treatments for dry shoot weight in moong beans, likely stems from neem cake's nutrient richness. Neem cake provides slow-release nutrients, fostering robust shoot growth. The combined treatment offers a balanced nutrient amalgamation, promoting vigorous foliage. This synergy between

neem cake's nutrient profile and the balanced blend likely supports enhanced shoot growth in moong bean plants. Similar findings were reported by **Kumar *et al.*, (2021); Tadewos *et al.*, (2021)** in Moong bean.

The minimum days to 50% flowering (41.00 days) was observed with treatment T_3 (100% Neem cake) followed by T_6 (50% Vermicompost + 50% Neem cake) with 44.67 days much earlier compared to T_0 (control) with 51.00 days. The minimum days to maturity (61.67 days) was observed with treatment T_3 (100% Neem cake) at par with T_6 (50% Vermicompost + 50% Neem cake) with 63.67 days much earlier compared to T_0 (control) with 72.00 days. The earlier maturity of moong bean in the treatments with 100% neem cake and a combination of 50% Vermicompost and 50% neem cake, compared to other treatments, can be attributed to the multifaceted benefits of these components. Neem cake's natural pest-repelling properties protected the plants, preventing potential damage and stress, which often delays maturity. Simultaneously, the Vermicompost supplied essential nutrients and organic matter, ensuring optimal plant development. This combined approach enhanced the plant's overall health and vigour, enabling it to reach maturity more swiftly. The synergy of pest resistance and nutrient provision in these treatments expedited the maturation process, potentially resulting in earlier, more efficient seed and grain production. Similar conclusions were drawn by **Patel *et al.*, (2019); Gurjar *et al.*, (2022)** in Moong bean.

Number of pods per plant varied significantly among different treatment combinations. The highest number of pods per plant (50.48 pods) was observed with treatment T_3 (100% Neem cake) at par with T_6 (50% Vermicompost + 50% Neem cake) with 49.62 pods making better over T_0 (control) with 36.48 pods. The highest number of seeds per pod (11.33 seeds) was observed with treatment T_3 (100% Neem cake) followed by T_6 (50% Vermicompost + 50% Neem cake) with 9.57 seeds better over T_0 (control) with 6.43 seeds. The maximum pod weight (5.86 gram) was observed with treatment T_3 (100% Neem cake) followed by T_6 (50% Vermicompost + 50% Neem cake) with 4.75 gram better over T_0 (control) with 3.25 gram. The longest pod (11.48 cm) was observed with treatment T_3 (100% Neem cake) followed by T_6 (50% Vermicompost + 50% Neem cake) with 9.29 cm better over T_0 (control) with 6.65 cm. The highest seed yield per plant (10.88 g/plant) was observed with treatment T_3 (100% Neem cake) at par with T_6 (50% Vermicompost + 50% Neem cake) with 10.05 g/plant which was better than T_0 (control) with 7.49 g/plant. The highest seed yield per hectare (13.60 q/ha) was observed with treatment T_3 (100% Neem cake) at par with T_6 (50% Vermicompost + 50% Neem cake) with 12.56 q/ha. Lowest seed yield per hectare was observed in T_0 (control) with 9.36 q/ha. The enhanced seed yield in the treatment combination of 100% neem cake followed by a 50% vermicompost and 50% neem cake blend, in contrast to other treatments in moong beans, likely stems from the combined impact of neem cake's nutrient richness and vermicompost's organic composition. Neem cake's essential nutrients fortify plant health, fostering robust growth and reproductive vigour. The balanced nutrient synergy in the combined treatment sustains optimal conditions for seed development, promoting larger and more numerous pods. This collaborative effect between neem cake's nutrients and the organic richness of vermicompost likely contributes to an increased seed yield in moong bean cultivation compared to alternative treatments. Similar findings were reported by **Shariff *et al.*, (2015); Patel *et al.*, (2019); Raj and Mehera (2022) and Kumar *et al.*, (2023)** in Moong bean.

The highest biological yield per hectare (29.09 q/ha) was observed with treatment T_1 (100% Farmyard manure) at par with T_3 (100% Neem cake) with 29.06 q/ha which was better than T_5 (50% Farmyard manure + 50% Neemcake) with 25.00 q/ha. The highest harvest index (46.85 %) was observed with treatment T_3 (100% Neem cake) at par with T_6 (50% Vermicompost + 50% Neem cake) with 46.35 % which was better than T_0 (control) with 35.09 %. The highest harvest index in the treatment combination of 100% neem cake followed by a 50% vermicompost and 50% neem cake blend, compared to other treatments in moong beans, likely stems from an optimized resource allocation strategy. Neem cake's nutrient richness, coupled with the balanced nutrient blend in the combined treatment, promotes robust reproductive structures—more pods and seeds—relative to vegetative biomass like straw. This efficient utilization of resources directs more energy towards yield-producing parts, increasing the ratio of edible or harvestable parts to total biomass. The synergistic effect of these treatments likely enhances the harvest index, resulting in a more efficient utilization of resources for yield in moong bean cultivation. Similar findings were reported by **Shariff *et al.*, (2015); Patel *et al.*, (2019); Raj and Mehera (2022) and Kumar *et al.*, (2023)** in Moong bean.

TABLE 1

EFFECT OF ORGANIC NUTRITION ON GROWTH AND EARLINESS PARAMETERS OF MOONG BEAN

Treatment Details		Plant height (cm) [60 DAS]	No of branches per plant [60 DAS]	No of root nodules per plant [60 DAS]	Fresh shoot weight of plant (g) [60 DAS]	Dry shoot weight of plant (g) [60 DAS]	Days to 50% flowering	Days to Maturity
T_0	Control	49.78	8.67	9.11	142.93	37.29	51	72
T_1	100% Farmyard Manure	51.06	10.65	11.45	180.22	47.1	46.33	69
T_2	100% Vermicompost	52.92	12.55	11.76	176.7	46.03	47	68
T_3	100% Neem cake	61.81	16.48	15.41	195.45	59.62	41	61.67
T_4	50% Farmyard Manure + 50% Vermicompost	52.48	12.19	11.88	175.51	46.03	48	71.33
T_5	50% Farmyard Manure + 50% Neem cake	54.58	11.05	11.87	175.49	46.22	50.67	70.33
T_6	50% Vermicompost + 50% Neem cake	57.31	12.82	14.79	188.68	57.56	44.67	63.67
T_7	33.33% Farmyard Manure + 33.33% Vermicompost + 33.33% Neem cake	54.54	12.24	12.42	183.37	47.99	45	65.17
'F' test		**S**	**S**	**S**	**S**	**S**	**S**	**S**
CV.		**1.45**	**10.21**	**8.25**	**8.36**	**9.25**	**2.7**	**2.86**
SE. m (±)		**0.45**	**0.71**	**0.59**	**8.93**	**2.59**	**0.73**	**1.12**
CD. at 5%		**1.36**	**2.14**	**1.76**	**26.79**	**7.76**	**2.18**	**3.35**

TABLE 2

EFFECT OF ORGANIC NUTRITION ON YIELD PARAMETERS OF MOONG BEAN

Treatment Details		No of pods per plant	No of seeds per pod	Average pod weight (g)	Average pod length (cm)	Seed yield per plant (g/plant)	Seed yield per hectare (q/ha)
T_0	Control	36.48	6.43	3.25	6.65	7.49	9.36
T_1	100% Farmyard Manure	34.5	8.03	3.45	7.76	8.81	11.01
T_2	100% Vermicompost	39.83	9.34	4.75	8.61	8.98	11.24
T_3	100% Neem cake	50.48	11.33	5.86	11.48	10.88	13.6
T_4	50% Farmyard Manure + 50% Vermicompost	39.83	6.77	3.45	7.19	8.41	10.52
T_5	50% Farmyard Manure + 50% Neem cake	28.24	7.39	4.05	8.76	8.69	10.85
T_6	50% Vermicompost + 50% Neem cake	49.62	9.57	4.75	9.29	10.05	12.56
T_7	33.33% Farmyard Manure + 33.33% Vermicompost + 33.33% Neem cake	48.36	9.13	4.55	8.96	9.95	12.44
'F' test		**S**	**S**	**S**	**S**	**S**	**S**
CV.		**8.05**	**6.19**	**5.27**	**8.15**	**8.82**	**8.81**
SE. m (±)		**1.9**	**0.3**	**0.13**	**0.4**	**0.47**	**0.58**
CD. at 5%		**5.71**	**0.91**	**0.39**	**1.21**	**1.4**	**1.75**

TABLE 3
EFFECT OF ORGANIC NUTRITION ON YIELD PARAMETERS OF MOONG BEAN

Treatment Details		Biological yield per hectare (q/ha)	Harvest Index (%)
T_0	Control	26.76	35.09
T_1	100% Farmyard Manure	29.09	37.89
T_2	100% Vermicompost	28.55	39.36
T_3	100% Neem cake	29.06	46.85
T_4	50% Farmyard Manure + 50% Vermicompost	25.84	40.86
T_5	50% Farmyard Manure + 50% Neem cake	25	43.44
T_6	50% Vermicompost + 50% Neem cake	27.14	46.35
T_7	33.33% Farmyard Manure + 33.33% Vermicompost + 33.33% Neem cake	27.88	44.56
'F' test		**S**	**S**
CV.		**9.36**	**2.26**
SE. m (±)		**1.48**	**0.55**
CD. at 5%		**4.44**	**1.64**

IV. CONCLUSION

From the above experimental finding it is concluded that the treatment T_3 (100% Neem cake) was found to be best in the terms of growth, and yield of Moong bean.

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