The Pharma Innovation Journal 2022; 11(12): 4482-4486

www.ThePharmaJournal.com

The Pharma Innovation

**ISSN (E): 2277-7695**
**ISSN (P): 2349-8242**
**NAAS Rating: 5.23**
TPI 2022; 11(12): 4482-4486

www.thepharmajournal.com
Received: 15-09-2022
Accepted: 18-10-2022

**Shivani Shakhtawat**
Faculty of Agriculture Science, Mandsaur University, Mandsaur, Madhya Pradesh, India

**Ashish Dwivedi**
Faculty of Agriculture Science, Mandsaur University, Mandsaur, Madhya Pradesh, India

**Arvind Kumar**
Barkatullah University, Bhopal, Madhya Pradesh, India

**Urwashi Manekar**
Faculty of Agriculture Science, Mandsaur University, Mandsaur, Madhya Pradesh, India

**Vishal Sarsariya**
Faculty of Agriculture Science, Mandsaur University, Mandsaur, Madhya Pradesh, India

**Rajeev Ranjan**
Faculty of Life Science, Mandsaur University, Mandsaur, Madhya Pradesh, India

**Shahnawaz Mansuri**
Faculty of Agriculture Science, Mandsaur University, Mandsaur, Madhya Pradesh, India

**Corresponding Author:**
**Ashish Dwivedi**
Faculty of Agriculture Science, Mandsaur University, Mandsaur, Madhya Pradesh, India

# Response of mungbean varieties and organic manure on performance and chemico-microbiological properties in Malwa region

**Shivani Shakhtawat, Ashish Dwivedi, Arvind Kumar, Urwashi Manekar, Vishal Sarsariya, Rajeev Ranjan and Shahnawaz Mansuri**

## Abstract
The negligence to the conservation and use of organic sources for nutrients has not only exhausted soil nutrient reserves, but also resulted in an imbalance among the available nutrients, leading to soil problems. Keeping this on mind a field experiment was conducted during summer season 2021-22. Result revealed that significantly maximum growth parameters, yield attributes, yields, soil available nutrients, and microbial populations were recorded under variety of PDM-131, except actinomycetes which was least population as against variety Erge-1. Moreover, 50% FYM+ 50% Vermicompost were recorded maximum nitrogen (242.50 kg $ha^{-1}$), Phosphorus (16.00 kg $ha^{-1}$) and Potassium (340.00 kg $ha^{-1}$) in soil at the harvest. It had also recorded the higher microbial population *viz.*, Rhizobium (9.7 x10 $^{7}$ cfu), Azotobacter (13.1 x10 $^{7}$ cfu) and Fungai (9.8 x10 $^{7}$ cfu) in the soil. However, the highest population of Actinomycetes was recorded in control. Similar similar trends were also showed in other parameters like performance and economics. Hence, the above treatment can be suggested as a combination for getting higher benefit as well as soil health with greater quantity on sustainable basis.

**Keywords:** Organic, mungbean varieties, soil available nutrients, microbial population

## Introduction
Currently, mungbean is cultivated on more than 6 million hectares worldwide (about 8.5% of global pulse cultivation area) and global annual production is 3 million tons (5% of global pulse production). India is the largest mungbean producing country followed by China and Myanmar (Nair *et al.* 2014) [11]. In MP, mungbean is grown on an area of about 0.37 million hectares with the production of about 0.29 million tones.

Vermicompost has been advocated as good organic mare used for integrated management practices in the field crops. Use of vermicompost as a biofertilizer and substitute for chemical fertilizer is advised by pioneers of organic farming, Vermicompost is a sustainable bio - fertilizer regenerated from organic wastes using earthworms. It is a rich source of N, PO GO and micronutrients. Besides containing a good proportion of exchangeable Ca, Mg, Na, etc. it adds organic carbon to the soil and helps to release the nutrients slowly and also rich in growth hormones, vitamins and acts as powerful biocide against diseases and nematodes besides improving physical condition of soil. Poor nutrient economy of light textured soils necessitates the need for supplementing fertilizer with organic manures. Since; vermicompost helps in enhancing the activity of microorganism in soils which further enhance solubility of nutrients and their consequent availability. Thus, the plants is known to be altered by microorganism by reducing soil pH at micro sites, chelating action of organic acids produced by them and in traphyl mobility in the fungal filaments (Chhonkar, 2002) [5].

Application of such beneficial microbes alone or along with fertilizers as providers of nutrients presents an economically and environmentally promising strategy and can aid in replenishing and maintaining long - term soil fertility by providing good soil biological activity by suppressing pathogenic soil organisms ; by stimulating microbial activity in the rhizosphere and to improve plant health (Ouahmane *et al.* 2007) [12] of the various plant nutrients, even though $P_20$ ; is abundant in soil, its availability is limited in plants due to fixation by other soil elements such as insoluble phosphates of iron, aluminum, and calcium (Khan *et al*, 2010) [8].

Nutrient management strategies should be aimed at achieving the twin goals of fertilizer economy and sustainability. The negligence to the conservation and use of organic sources for nutrients has not only exhausted soil nutrient reserves, but also resulted in an imbalance among the available nutrients, leading to soil problems. Integration of inorganic and organic sources such as vermicompost, poultry manure, farm yard manure and their efficient management has shown promise in sustaining the productivity and soil health, besides meeting part of crop nutrient requirement (Chaudhary *et al.* 2014) [3]

## Materials and Methods

### Experimental details and soil description

A field experiment was conducted during the summer season of 2021-2022, The field trial was conducted at the Mandsaur University, Department of Agriculture, Mandsaur (M.P.) The Crop Research Farm is located at latitude 24.0752° N and longitude 75.0312° E, 379 m above mean sea level. The regions located at latitude 24.0752° N and longitude 75.0312° E, 379 m above mean sea level. The soil of the experimental field was black texture in category of soils group, which is low in organic carbon and nitrogen, phosphorus and high in potassium. The experiment consisted of two factors. Two level of Mungbean varieties ; (PDM -131 And ERGE - 1) and factor B : Six levels of Organic Manures fertilizers T1 = Control (no fertilizer or manure), T2 = (PSB+ Rhizobium), T3= Recommended dose of fertilizer (75% FYM+ 25% Vermicompost), T4 = (50% FYM + 50% Vermicompost), T5= (100% FYM), T6 = (100% Vermicompost) and The experiment was laid out in split- plot design with four replications. The growth performance and development attributes of Mungbean varieties were found significant with the combined effect of different organic manures and recommended doses of biofertilizers, with the spacing (rows) 30 cm x 10 cm and seed rate of 20-30 kg/ha for mungbean, respectively and sown on 27 march 2022. Two hand weeding were done manually with the help of khurpi for controlling weeds, first at 25 days after sowing and second at 45 days after sowing, Moreover, 3 irrigation was applied at 57 DAS due to rains commensurate well with crop water requirement at critical stages.

### Data collection

Observation on various growth parameters viz. plant height (cm), number of branches, dry matter accumulation, number of nodules/plant, dry weight of nodules, 50% flowering and maturity, and CGR, RGR were recorded at harvest in mungbean.

Observations on various yield parameters viz. Number of pods per plant, Number of seeds per pod, Length of Pods, 1000 grain weight, Grain yield per plant, Grain yield per hectare and Benefits cost ratio were recorded at harvest in mungbean.

### Soil sampling and analysis

Numbers of soil culturable Rhizobium, Azotobacter, fungi and actinomycetes were counted at the maturity stage. Soil cores near the plant roots were collected with an auger. The top 1 cm soil layer was removed and the remaining soil core (as deep as 0.2 m) was sampled. After air-drying, samples were sieved through a 1-mm sieve. Ten grams of each fresh soil sample was added to 90 ml of sterile distilled water. After homogenization for 30 min, each soil suspension was sequentially diluted and 50 ¼L of the resulting solutions was placed on appropriate isolation culture media. After incubation at 32 °C for 24 hours for Rhizobium and actinomycetes, for Azotobacter 32 °C for 48 hours and 28 °C for 24 hours for fungi, the colony forming units (CFU) were counted. Soil bacteria, fungi and actinomycetes were cultured on Rhizobium medium, CSA medium, Azotobacter agar medium, PDA medium, respectively. The data obtained were subjected to statistical analysis as outlined by Gomez and Gomez (1984) [18]. The treatment differences were tested by using "F" test and critical differences (at 5 per cent probability).

## Results and Discussion

### Growth parameters of mungbean

The data presented in Table 1 disclosed that variety PDM-131 was recorded significantly the lowest mortality percentage (30.48), and highest plant height (29.64 cm), plant branches (19.35), plant weight (21.58), nodules/ plant (14.00), nodules dry weight (0.42), plant flowering (40.99%) and plant maturity (61.17) at harvest respectively, And the variety ERGE-1 shows the highest result of mortality percentage (58.07) and lowest plant height (23.33 cm), plant branches (16.97), plant weight (18.90), nodules/ plant (5.59), nodules dry weight (0.12), plant flowering (40.99%) and plant maturity (61.17). Further, recommended dose of organic manure with variety pdm-131 recorded significantly higher values for growth parameters and the dose of organic manure with variety Erge-1 recorded significantly lowest values for growth parameters. The similar result was recorded by Vikrant *et al.* (2005) [17] and Singh *et al.* (2008) [15].

Growth characters: The data related to different growth characters shows significant variation among the different treatments under investigation. The treatment $T_4$ (50% Fym+ 50% Vermicompost) having Shows the lowest mortality percentage (38.05) and the highest plant height (31.39 cm), plant branches (19.60), dry matter accumulation (21.49 g), nodules plant$^{-1}$(15.75), nodules dry weight (0.41 mg), plant flowering (41.11%) and plant maturity (63.25%) at harvest respectively, And the control ($T_1$) shows the the highest mortality percentage (52.35) and lowest result of plant height (23.27cm), plant branches (16.98), dry matter accumulation (19.38g), nodules plant$^{-1}$(6.51), nodules dry weight (0.14 mg mg), plant flowering (29.28%)) and plant maturity (58.15%) at harvest. It might be due to better availability of nutrients and moisture to the crop and less competition for natural resources as evident from the beneficial effects on the crop growth. These results were in the conformity with the findings of Kumar *et al.* (2015) [10]

**Table 1:** Effects of varieties and organic sources on maturity percentage, growth attributes at harvest, nodulation, days taken to flowering and maturity

| Treatments | Mortality percentage | Plant height | Number of branches per plant | Dry matter accumulation | Number of nodules/ plant | Dry weight of nodules | Days to 50% flowering | Days to maturity | Crop growth Rate 50 – at harvest | Relative growth rate 50 – at harvest |
|---|---|---|---|---|---|---|---|---|---|---|
| PDM-131 | 30.48 | 29.64 | 19.35 | 21.58 | 14.00 | 0.42 | 40.99 | 61.17 | 0.26 | 0.066 |
| ERGE-1 | 58.07 | 23.33 | 16.97 | 18.90 | 5.59 | 0.12 | 28.38 | 58.03 | 0.21 | 0.013 |
| SEm± | 0.08 | 0.09 | 0.05 | 0.05 | 0.12 | 0.00 | 0.11 | 26.72 | 0.01 | 0.000 |
| CD (p= 0.05) | 0.41 | 0.43 | 0.23 | 0.27 | 0.58 | 0.02 | 0.51 | NS | 0.01 | 0.001 |
| **Organic manure** | | | | | | | | | | |
| Control | 52.35 | 23.27 | 16.98 | 19.38 | 6.51 | 0.14 | 29.28 | 58.15 | 0.22 | 0.022 |
| PSB + Rhizobium | 48.63 | 24.61 | 17.15 | 19.55 | 7.01 | 0.15 | 31.98 | 59.33 | 0.22 | 0.028 |
| 75% FYM + 25% Vermicompost | 39.95 | 28.04 | 19.08 | 20.73 | 11.75 | 0.36 | 36.88 | 62.79 | 0.24 | 0.050 |
| 50% FYM + 50% Vermicompost | 38.05 | 31.39 | 19.60 | 21.49 | 15.75 | 0.41 | 41.11 | 63.25 | 0.26 | 0.061 |
| 100% FYM | 45.18 | 25.15 | 18.05 | 19.93 | 8.01 | 0.27 | 33.21 | 60.05 | 0.23 | 0.034 |
| 100% Vermicompost | 41.49 | 26.46 | 18.11 | 20.38 | 9.75 | 0.30 | 35.65 | 58.03 | 0.23 | 0.040 |
| SEm± | 0.58 | 0.50 | 0.33 | 0.37 | 0.23 | 0.01 | 0.65 | 25.15 | 0.01 | 0.001 |
| CD (p= 0.05) | 1.70 | 1.46 | 0.98 | 1.08 | 0.67 | 0.035 | 1.91 | NS | 0.07 | 0.001 |

**Growth analysis (CGR and RGR)**

The data related to different growth analysis shows significant variation among the different treatments under investigation (Table 1). The Variety PDM-131 was recorded significantly the maximum CGR (0.26), RGR (0.066) and the variety ERGE-1 shows the lowest CGR (0.21) and RGR (0.013). The recommended dose of organic manure with variety pdm-131 recorded significantly higher values for CGR and RGR,. And the dose of organic manure with variety Erge-1 recorded significantly lowest values for CGR and RGR. The similar result was recorded by Barik *et al.* (2011) [1].

Different organic treatment level shows singnificant effect on crop growth rate and relative growth rate. The maximum CGR (0.260), and RGR (0.061) were recorded from treatment $T_4$ (50% Fym + 50% Vermicompost), and the lowest CGR (0.220), and RGR (0.022) were recorded from treatment $T_1$ (Control). These results were in the conformity with the findings of Kumar *et al.* (2015) [10]

**Yield and yield attributes**

The data presented in Table 2 revealed that PDM-131 was recorded significantly the highest number of pods plant$^{-1}$ (8.50), seed pods (9.55), pod length (8.73), 1000 grain weight (36.19g), Grain yield per plant (2.93g), Grain yield per hectare (13.35q/ha$^{-1}$) respectively, And the variety ERGE-1 shows the lowest result of number of pods plant$^{-1}$ (4.68), seed pods (6.21), pod length (6.58), 1000 grain weight (33.11g), Grain yield per plant (1.40g), Grain yield per hectare (5.57q/ha$^{-1}$). The highest seed yield was mainly due to higher yield attributes (pods/plant, seed/pod and test weight) associated PDM-131 variety of Mungbean. Similar results were also reported by Kumar *et al.* (2016) [9]

Among various treatment combinations recorded highest number of pods plant$^{-1}$ (8.51), seed pods (9.83), pod length (8.30cm), 1000 grain weight (35.78g), Grain yield per plant (2.80g), Grain yield per hectare (11.17 q/ha$^{-1}$) followed by $T_4$ (50% Fym + 50% Vermicompost) and lowest number of pods plant$^{-1}$ (5.00), seeds pod (6.66), pod lengths (6.89 cm), 1000 grain weight (33.43g), Grain yield per plant (1.60g), Grain yield per hectare (7.67 t/ha$^{-1}$) were recorded in $T_1$ (Control). Similar results were also reported by Kumar *et al.* (2016) [9]

**Table 2:** Effects of varieties and organic sources on yield and yield attributes characters at harvest

| Treatments | Number of pods per plant | Number of seeds per pod | Pod length | 1000 grain weight (g) | Grain yield/ plant(g) | Grain yield (q/ha$^{-1}$) | BC: ratio |
|---|---|---|---|---|---|---|---|
| PDM-131 | 8.50 | 9.55 | 8.73 | 36.19 | 2.93 | 13.35 | 2.728 |
| ERGE-1 | 4.68 | 6.21 | 6.58 | 33.11 | 1.40 | 5.57 | 1.171 |
| SEm± | 0.07 | 0.09 | 0.01 | 0.09 | 0.01 | 0.01 | 0.007 |
| CD (p= 0.05) | 0.35 | 0.45 | 0.09 | 0.43 | 0.04 | 0.08 | 0.035 |
| Organic manure | | | | | | | |
| Control | 5.00 | 6.66 | 6.89 | 33.43 | 1.60 | 7.67 | 2.034 |
| PSB + Rhizobium | 5.00 | 7.15 | 7.01 | 34.16 | 1.75 | 8.42 | 2.115 |
| 75% FYM + 25% Vermicompost | 7.51 | 8.66 | 8.08 | 35.30 | 2.55 | 10.46 | 1.933 |
| 50% FYM + 50% Vermicompost | 8.51 | 9.83 | 8.30 | 35.78 | 2.80 | 11.17 | 2.048 |
| 100% FYM | 6.51 | 7.15 | 7.66 | 34.36 | 2.05 | 8.95 | 1.715 |
| 100% Vermicompost | 7.00 | 7.83 | 7.98 | 34.88 | 2.25 | 10.09 | 1.855 |
| SEm± | 0.14 | 0.15 | 0.14 | 0.64 | 0.04 | 0.09 | 0.037 |
| CD (p= 0.05) | 0.41 | 0.45 | 0.43 | N/S | 0.12 | 0.27 | 0.107 |

**B: C Ratio**

Variety PDM-131 was recorded significantly (Table 2) the highest benefit cost ratio (2.728), while the variety ERGE-1 shows the lowest result of benefit cost ratio (1.171). This might be due to higher economic yield under this treatment. Similar results have been reported by Shashikumar *et al*. (2013) [14]. Moreover, maximum benefit cost ratio (2.048) of mungbean was achieved in the application of $T_4$ (50% Fym+ 50% Vermicompost) and minimum B; C; ratio (2.034) was obtained in $F_1$ (Control). Similar results were also reported by Kumar *et al*. (2016) [9]

### Soil Nutrient (NPK)

Variety PDM-131 was recorded significantly the highest nitrogen (250), phosphorus (16.00) and potassium (345.83), respectively, (Table 3). However, variety ERGE-1 shows the lowest result of nitrogen (157.50), phosphorus (10.33) and potassium (275.83) in soil of mungbean. Variety PDM-131was recorded significantly the highest NPK content as compared to variety ERGE-1. (157.50). The similar result was recorded by Chaturvedi and Chandel (2005) [2], Chesti *et al*. (2012) [4] and Kumar *et al*. (2016) [9].

The organic manure treatments levels of two mungbean varieties significantly influenced the NPK contain in soil of mungbean. Application of 50% FYM + 50% Vermicompost was recorded highest nitrogen (242.50), phosphorus (16.00) and potassium (340) in soil of mungbean. However the lowest nitrogen (165), phosphorus (10.51) and potassium (280) contain found in Control.

**Table 3:** Effects of varieties and organic sources on Soil Nutrient (NPK) and Soil Microbes

| Treatment | Nitrogen kg ha $^{-1}$ | Phosphorus kg ha $^{-1}$ | Potassium kg ha $^{-1}$ | Rhizobium (x10 $^{7}$) cfu | Azotobacter (x10 $^{7}$) cfu | Actinomycete s (x10 $^{7}$) cfu | Fungai (x10 $^{7}$) cfu |
|---|---|---|---|---|---|---|---|
| Variety | | | | | | | |
| PDM-131 | 250 | 16.17 | 345.83 | 10.1 | 13.1 | 7.2 | 10.1 |
| ERGE-1 | 157.50 | 10.33 | 275.83 | 6.9 | 7.0 | 10.5 | 6.6 |
| SEm± | 0.64 | 0.03 | 0.89 | 0.2 | 0.03 | 0.2 | 0.2 |
| CD (p=0.05) | 3.00 | 0.18 | 4.14 | 0.1 | 0.1 | 1.3 | 1.3 |
| Organic manure | | | | | | | |
| Control | 165 | 10.51 | 280 | 7.5 | 7.8 | 11.6 | 8.1 |
| PSB + Rhizobium | 180 | 11.50 | 292.50 | 7.8 | 8.3 | 9.6 | 7.4 |
| 75% FYM + 25% Vermicompost | 225.01 | 15.00 | 330 | 9.1 | 11.2 | 7.6 | 9.0 |
| (50% FYM + 50% Vermicompost | 242.50 | 16.00 | 340 | 9.7 | 13.1 | 7.0 | 9.8 |
| 100% FYM | 200 | 12.51 | 307.50 | 8.3 | 9.5 | 9.0 | 7.7 |
| 100% Vermicompost | 210.00 | 14.00 | 315 | 8.7 | 10.6 | 8.4 | 8.3 |
| SEm± | 3.89 | 0.25 | 5.80 | 0.1 | 0.2 | 0.5 | 0.5 |
| CD (p= 0.05) | 11.29 | 0.73 | 16.84 | 0.4 | 0.5 | 1.5 | 1.5 |

### Soil microbial population

The data presented in Table 3 disclosed that variety PDM-131 was recorded significantly the highest maximum rhizobium (10.1 x$10^7$ CFU), azotobacter (13.1 x$10^7$ CFU) and fungi (10.1 x$10^7$ CFU) and minimum actinomycetes (7.2 x$10^7$ CFU), and the variety ERGE-1 show lowest minimum rhizobium (6.9 x$10^7$ CFU), azotobacter (7.0x$10^7$ CFU) and fungi (6.6x$10^7$ CFU) and maximum actinomycetes (10.5x$10^7$ CFU). The similar result was recorded by Brown and Rovira (1991) [19].

Microbial population varied significantly due to organic manure system, except actinomycetes which remained not significant in all level. The higher maximum rhizobium (9.7 x$10^7$ CFU), azotobacter (13.1x$10^7$ CFU) and fungi (9.8x$10^7$ CFU) and minimum actinomycetes (7.0 x$10^7$ CFU) were under the treatment of 50% FYM= 50% VERMICOMPOST. This may be due to availability of more organic matter or plant biomass for their food and energy in organic or combine use of biofertilizers treated plots Kaur *et al*. However, the lowest minimum rhizobium (7.5x$10^7$ CFU), azotobacter (7.8x$10^7$ CFU) and fungi (8.1x$10^7$ CFU) and maximum actinomycetes (11.6 x$10^7$ CFU) were under the treatment of control. This may be due to poor availability of lignin like compound for the food and energy for actinomycetes. The results were in consonance with the findings of Tilak (2004) [16].

### Conclusion

Based on above studied, it can be concluded that PDM-131 along with 50% FYM+ 50% Vermicompost performed better in respect of yield, quality alongwith soil health. It had also fetched maximum benefit in terms of economics.

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