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# Effect of Organic, Inorganic and Biofertilizers on Growth and Yields of Mungbean

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**ABSTRACT: Feeding the ever increasing population of country with balanced nutritional requirements is big challenge. As population increases, the protein requirement of the country is increasing day by day. Another threat for agriculture production is depletion of soil health due to continuously use of only chemicals. To meet the concern demand we have to increase the production of protein rich crops specially pulses with appropriate nutrient management. Mungbean is the one of the major pulse grown in country. Keeping the challenges in mind to boost up the mungbean productivity with sustained soil health a field experiment for two year during *Rabi* season of 2018-19 and 2019-20 at Norman E. Borlaug Crop Research Centre, G. B. Pant University of Agriculture and Technology, Pantnagar, India. The experiment comprised of 18 treatment combinations with three inorganic fertilizers (75% RDF, 100% RDF and 125% RDF) and two organic manure (control and FYM 5 t/ha) and three biofertilizer treatments (*Rhizobium*, LNM-16 and *Rhizobium* + LNM-16) was laid out in Factorial Randomized Block Design with three replications. Application of 125% RDF was found better than 75% and 100% RDF by producing maximum plant population (278 and 271 000/ha), lowest mortality percentage (12.87% and 10.42%), maximum plant height at harvest (90.5 and 90.1 cm), DMA at 30 DAS, 60 DAS and at harvest, grain yield (1022 and 1019 kg ha$^{-1}$) and stover yield (2916 and 2868 ka ha$^{-1}$) during the year 2018-19 and 2019-20, respectively. Application of organic manure gave higher plant population (277 and 267 000/ha), lower mortality percentage (13.34% and 12.18%), maximum plant height at harvest (87.3 and 84.3 cm), grain yield (1052 and 1042 kg ha$^{-1}$) and stover yield (2908 and 2844 ka ha$^{-1}$) during the year 2018-19 and 2019-20, respectively. Inoculation of *Rhizobium* + LNM-16 was found superior to other's by producing maximum plant population (280 and 271 000/ha), lowest mortality percentage (12.51% and 11.21%), maximum plant height at harvest (84.6 and 84.3 cm), grain yield (1059 and 1042 kg ha$^{-1}$) and stover yield (2927 and 2833 ka ha$^{-1}$) during the year 2018-19 and 2019-20, respectively. Results suggested suitable nutrient management practices of organic manures, inorganic fertilizers and biofertilizers would be an effective approach for improving growth and yield of mungbean.**

**Keywords:** Mungbean, Organic, Inorganic, Biofertilizers, Yield.

## INTRODUCTION

India is the largest pulses-growing country in the world. Pulses occupy a key position in the Indian diet and meet more than 30 per cent of the daily protein requirement (Navsare *et al.*, 2018; Jadeja *et al.,* 2019). Mungbean cropping system has a great potential in the northern plains zone of India, comprising Punjab, Haryana, Western Uttar Pradesh, Delhi, parts of Rajasthan, Madhya Pradesh etc. (Neelam and Kumar 2014). Among the pulses, green gram (*Vigna radiata* L.) commonly known as mung bean is one of the most important and extensively cultivated pulse crop (Nair *et al.*, 2013). It has an edge over other pulses because of its high nutritive value, digestibility, and non-flatulent behavior (Anjum *et al.*, 2006). With the huge nutritional content (20-25% protein, 0.5-0.8% fat, 0.8-1.0% fiber and 2.5-4.0% ash), mungbean occupy an important place in nutritional diet. In India, Mung bean is cultivated in about 20.35 lakh ha with production and productivity of 2.01 million tons and 467 kg/ha, respectively and contributing 9.41% to total pulse production.

The productivity of mungbean in India is low as compared to other pulse crops, which is governed by several factors. For this one of the major factors considered is poor nutrient management, which can be managed by the precise and optimum nutrient supply, which not only helps in increasing in crop yield but also reduces the cost of cultivation in ecofriendly manner. A nutrient management practice said to be better when it supplies all the nutrients in suitable proportion through combined source as (1.) Inorganic source- chemical fertilizer, (2.) Organic source- farm yard manure (3.) Biofertilizers, to meet the crop and soil requirement for a profitable and sustainable crop production (Shete *et al.,* 2010).

Pulses are known to improve soil quality through their unique ability of biological nitrogen ($N_2$) fixation, addition of organic carbon and deep root system (Ghosh *et al.*, 2012). The rhizo-deposition of N constitutes a significant pool of the below-ground nitrogen in grain legumes ranges from 47 to 80% and constitutes between 35 and 45% of total residue N (Mayer *et al.,* 2003). The benefits of cultivation of mungbean not only are limited up to existing season but are remain continued to further season (Amarasingha *et al.,* 2017). In addition, the residual effect reduces the fertilizer requirement for succeeding crop by 20-30% which helps in reduction of cost of cultivation for succeeding crop (Xu *et al.*, 2015). The productivity of soils has declined as a result of prolonged cultivation of crops with only inorganic fertilizers, so it's time to supplement these inorganic fertilizers with organics and micronutrients in order to sustain soil fertility and productivity (Behera *et al.*, 2007). Integrated use of inorganic, organic, and biofertilizer sources of nutrients as well as biofertilizers has been found to give soybeans higher yields, which result in increased monetary returns and productivity (Singh and Rai 2004). Unlike inorganic sources, organic sources have a substantial residual effect on the succeeding crops, whereas inorganic sources do not have this impact (Duraisami and Mani 2001). In order to improve food and nutritional security and sustainability, it is proposed in order to introduce a grain legume into cereal-based cropping systems in order to achieve increased productivity and profitability. Keeping these factors in mind, the objective of this study was to figure out suitable nutrient management practices for the mungbean cropping system based on these points in mind and to use these practices in order to increase productivity and profit. The aim of this study to find out the effect of organic, inorganic and biofertilizers on growth and yields of mungbean.

## MATERIALS AND METHODS

*A. Study area and physico-chemical characteristics of soil*

The field experiments were conducted at $D_6$ block of Pulse Agronomy of N. E. Borlaug Crop Research Centre of G.B. Pant University of Agriculture and Technology, Pantnagar, district Udham Singh Nagar (Uttarakhand) during *Kharif* and *Rabi* season of 2018-19 and 2019-20. Geographically, the N. E. Borlaug Crop Research Centre is situated at the southern end of the Shivalik range of the foothills of the Himalayas at 29°North latitudes and 79.5°East longitudes and an altitude of 243.83 m above mean sea level. The experimental site comes under *tarai* region and the order of soil of *tarai* region classified as "Mollisols". It has developed from calcareous and medium to moderately coarse textured parent material under the predominant influence of forest vegetation under moderate to well drained conditions. These soils were originated from alluvial sediments. To determine the various soil properties, soil samples were taken randomly from different spots on the experimental site up to a depth of 0-15 cm before sowing. Then after, samples were mixed thoroughly to obtain a composite soil sample. A representative sample was prepared by the quartering process from composite sample. Then, physico-chemical analysis was carried out by different methods as shown in Table 1 and 2. The results, presented in Table 1 and 2, showed that the texture of soil of experimental site was sandy loam having high organic carbon, low to medium available nitrogen, medium available phosphorus and potassium with slightly acidic to neutral soil reaction.

**Table 1: Physical characteristics of soil.**

| Particulars | Values (%) | Method |
|---|---|---|
| Sand | 46.2 | Hydrometer method (Bouyoucos, 1962) |
| Silt | 26.6 | |
| Clay | 27.2 | |

**Table 2: Chemical characteristics of soil.**

| Particulars | Method | Status 2018-19 | Status 2019-20 |
|---|---|---|---|
| Soil pH | Blackman Glass electrode pH meter (Jackson, 1973) | 7.3 | 7.2 |
| EC (dS/m) | Conductivity meter (Jackson, 1973) | 0.65 | 0.66 |
| Organic carbon (%) | Modified Walkley and Black method (Black, 1965) | 0.81 | 0.82 |
| Available N (kg/ha) | Alkaline potassium permanganate method (Subbiah and Asija, 1956) | 272.6 | 286.4 |
| Available $P_2O_5$ (kg/ha) | Olsen's Method (Olsen *et al.,* 1954) | 23.8 | 24.6 |
| Available $K_2O$ (kg/ha) | Flame emission spectrophotometry (Jackson, 1973) | 221.3 | 226.1 |

*B. Experimental details*

The experiment comprised of three factors inorganic fertilizers, organic manures, and biofertilizers. The details of the experiment were given in Table 3. The experiment was conducted in Factorial Randomized Block Design with three replications. In each replication fresh randomization of treatment was done in purely chance manner. The plan of layout adopted is given as Fig. 1.

The experiment comprised of 18 treatment combinations with three inorganic fertilizers (75% RDF, 100% RDF and 125% RDF) and two organic manure (control and FYM 5 t/ha) and three biofertilizer treatments (*Rhizobium,* LNM-16 *and Rhizobium* + LNM-16) was laid out in Factorial Randomized Block Design with three replications. The details of the treatments are as follows: a) Inorganic Fertilizers: recommended dose of fertilizers (20:40:20) N: $P_2O_5$: $K_2O$- (i) 75% RDF; (ii) 100% RDF and (iii) 125% RDF; (b) Organic Manures (tons/ha)- (i) Control; (ii) FYM 5 t/ha; and (c) Biofertilzers- (i) Rhizobium; (ii) LNM-16; and (iii) Rhizobium + LNM-16.

The crop growth, yield parameters were recorded at physiological maturity and both the crops were harvested manually, threshed and yield was recorded.

**Table 3: Experimental details.**

| Sr. No. | Particulars | Mungbean |
|---|---|---|
| 1. | Experimental Block | D6 Block, N. E. Borlaug Crop Research Centre, GBPUA &T , Pantnagar |
| 2. | Design | Factorial Randomized Block Design (FRBD) |
| 3. | No. of replications | 3 |
| 4. | No. of treatments | 18 |
| 5. | Total no. of plots | 54 |
| 6. | Gross plot size | 5 m x 3.6 m |
| 7. | Net plot size | 4 m x 1.8 m |
| 8. | No. of rows | 12 |
| 9. | Spacing | 30 cm x 10 cm |
| 10. | Season and year | *Kharif* 2018 and 2019 |
| 11. | Variety | Pant Mung-5 |
| 12. | Seed rate | 15 kg ha$^{-1}$ |
| 13. | Recommended dose of fertilizers (RDF) | 20:40:20 ($N:P_2O_5:K_2O$) |

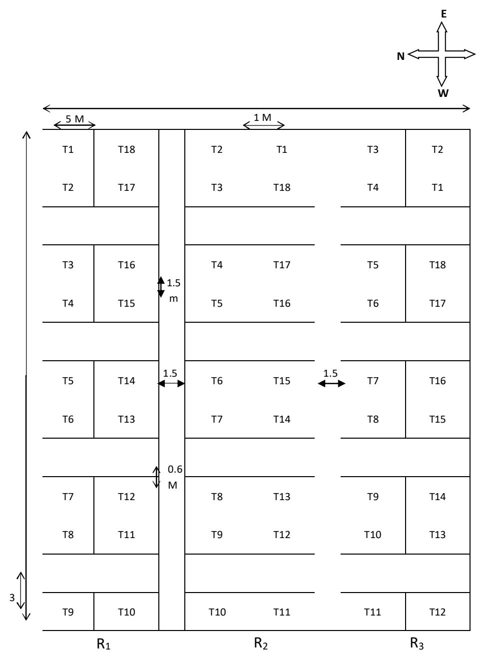


**Fig. 1.** Layout of the experimental field.

## RESULTS AND DISCUSSION

*A. Crop growth studies*

***Plant population and mortality percentage:*** The data pertaining to the plant population and mortality percentage in mungbean as influenced by different inorganic fertilizers, organic manures and biofertilzers are presented in Table 4. The effect of different inorganic fertilizers, organic manures and biofertilizers was non-significant in terms of plant population at initial stage as well as at harvest during both the years of experimentation. Plant population recorded at initial stage was higher than that at harvesting stage in all treatments during both the years. The highest plant population at harvest was recorded in the treatment containing 125% RDF (278 and 271 000/ha) followed by 100% RDF (274 and 262 000/ha) and 75% RDF (273 and 256 000 /ha) during 2018 and 2019, respectively. In case of organic manure, the highest values of plant population at harvest were recorded with the application of FYM 5 t/ha (277 and 267 000/ha) and minimum with treatment containing control (268 and 259 000/ ha) during 2018 and 2019, respectively. Among biofertilizers, highest plant population at harvest was recorded with the combined inoculation of seeds with *Rhizobium* + LNM-16 (280 and 271 000/ha) followed by their alone inoculation with LNM-16 (273 and 261 000/ ha) and *Rhizobium* (269 and 261 000/ha) during 2018 and 2019, respectively.

The reduction in plant population (mortality percentage) also remained non-significant in case of inorganic fertilizers, organic manure and biofertilizers. Among the inorganic fertilizers, the lowest mortality percentage *i.e.,* 12.87 % during 2018 and 10.42% during 2019 was recorded with 125% RDF. In case of organic manure, the application of FYM @ 5 t/ha recorded the lowest mortality percentage *i.e.,* 13.34% during 2018 and 12.18% during 2019. Among the biofertilizers, the lowest mortality *i.e.,* 12.51% during 2018 and 11.21% during 2019 was recorded with inoculation of mungbean seeds with *Rhizobium* + LNM-16. The interaction effect between inorganic fertilizers and organic manure, inorganic fertilizers and biofertilizers, organic manure and biofertilizers, inorganic fertilizers, organic manure and biofertilizers remained non-significant in terms of plant population and mortality percentage.

**Table 4: Plant population per hectare and mortality (%) in mungbean as influenced by different inorganic fertilizers, organic manures and biofertilizers during 2018 and 2019.**

| Treatment | 2018 | | | 2019 | | |
|---|---|---|---|---|---|---|
| | Plant population ('000 $ha^{-1}$) | | Mortality (%) | Plant population ('000 $ha^{-1}$) | | Mortality (%) |
| | Initial (30 DAS) | Harvest | | Initial (30 DAS) | harvest | |
| **Inorganic Fertilizers** | | | | | | |
| 75% RDF | 318 | 273 | 14.08 | 299 | 256 | 14.47 |
| 100% RDF | 318 | 274 | 13.31 | 300 | 262 | 12.80 |
| 125% RDF | 319 | 278 | 12.87 | 303 | 271 | 10.42 |
| SEm± | 67 | 66 | 0.99 | 63 | 58 | 1.32 |
| CD at 5% | NS | NS | NS | NS | NS | NS |
| **Organic Manures** | | | | | | |
| Control | 310 | 268 | 13.49 | 296 | 259 | 12.35 |
| FYM 5 t/ha | 319 | 277 | 13.34 | 304 | 267 | 12.18 |
| SEm± | 55 | 54 | 0.81 | 52 | 47 | 1.07 |
| CD at 5% | NS | NS | NS | NS | NS | NS |
| **Biofertilizers** | | | | | | |
| *Rhizobium* | 312 | 269 | 13.65 | 298 | 261 | 12.35 |
| LNM-16 | 313 | 273 | 12.62 | 301 | 261 | 14.14 |
| *Rhizobium* + LNM -16 | 320 | 280 | 12.51 | 305 | 271 | 11.21 |
| SEm± | 67 | 66 | 0.99 | 63 | 58 | 1.32 |
| CD at 5% | NS | NS | NS | NS | NS | NS |

*DAS- Days after sowing.

**Plant height:** The data pertaining to the plant height recorded at various stages of crop growth in mungbean as influenced by different inorganic fertilizers, organic manure and biofertilzers are presented in Table 5 and depicted in Fig. 2 and 3. In general, the plant height increased continuously with advancement of crop age and attained its maximum value at the maturity stage. The plant height influenced significantly with the variation in nutrient applications by different inorganic fertilizers, organic manure and biofertilizers at various crop growth stages. In case of inorganic fertilizers, tallest plants *i.e.,* 36.3, 83.0 and 90.5 cm during 2018 and 36.1, 82.9 and 90.1cm during 2019 at 30 and 60 DAS and harvest stages of crop growth were recorded with the application of 125% RDF. The shortest plants *i.e.,* 29.7, 77.1 and 83.9 cm during 2018 and 29.2, 76.8 and 83.6 cm during 2019 were observed with application of 75% RDF at 30 and 60 DAS and harvest stages of crop growth, respectively. The application of FYM @ 5 t/ha recorded significantly taller plants *i.e.,* 34.6, 80.1 and 87.3 cm during 2018 and 32.9, 80.6 and 84.3 cm during 2019 at 30 and 60 DAS and harvest stages of crop growth, respectively as compared to control. Seed inoculation with *Rhizobium* + LNM-16 was recorded tallest plants *i.e.,* 34.6, 80.7 and 84.6 cm during 2018 and 32.9, 80.6 and 84.3 cm at 30 and 60 DAS and harvest stages of crop growth, respectively. However, the treatment containing alone application of *Rhizobium* and LNM-16 were statistically at par with each other during both the years. The favourable function of nitrogen being a main structural constituent of cell, helps in cell division and cell enlargement, which helps to increase plant height. These results are in conformity with the findings of Singh *et al.* (2011); Achakzai *et al.* (2012); Azadi *et al.* (2013); Patel *et al.* (2017); Saha and Patra (2017).

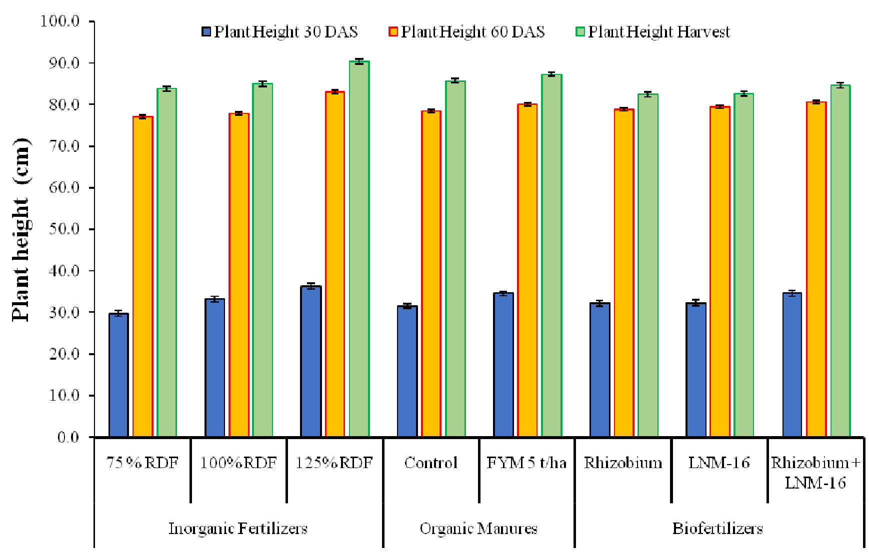


**Fig. 2.** Plant height of mungbean as influenced by different inorganic fertilizers, organic manures and biofertilizers during 2018-19.

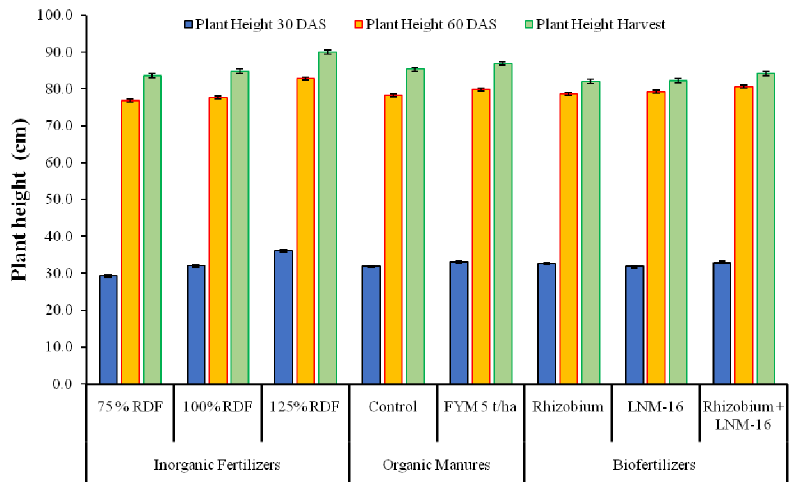


**Fig. 3.** Plant height of mungbean as influenced by different inorganic fertilizers, organic manures and biofertilizers during 2019-20.

**Table 5: Plant height of mungbean as influenced by different inorganic fertilizers, organic manures and biofertilizers during 2018 and 2019.**

| Treatment | Plant height (cm) | | | | | |
|---|---|---|---|---|---|---|
| | 2018 | | | 2019 | | |
| | 30 DAS | 60 DAS | Harvest | 30 DAS | 60 DAS | Harvest |
| **Inorganic Fertilizers** | | | | | | |
| 75% RDF | 29.7 | 77.1 | 83.9 | 29.2 | 76.8 | 83.6 |
| 100% RDF | 33.2 | 77.8 | 85.0 | 32.0 | 77.7 | 84.8 |
| 125% RDF | 36.3 | 83.0 | 90.5 | 36.1 | 82.9 | 90.1 |
| SEm± | 0.7 | 0.4 | 0.6 | 0.3 | 0.4 | 0.6 |
| CD at 5% | 1.9 | 1.2 | 1.7 | 0.9 | 1.3 | 1.7 |
| **Organic Manures** | | | | | | |
| Control | 31.5 | 78.5 | 85.7 | 31.8 | 78.3 | 85.4 |
| FYM 5 t/ha | 34.6 | 80.1 | 87.3 | 33.0 | 79.9 | 86.9 |
| SEm± | 0.5 | 0.4 | 0.5 | 0.2 | 0.4 | 0.5 |
| CD at 5% | 1.5 | 1.0 | 1.4 | 0.7 | 1.0 | 1.4 |
| **Biofertilizers** | | | | | | |
| *Rhizobium* | 32.2 | 78.8 | 82.4 | 32.6 | 78.7 | 82.0 |
| LNM-16 | 32.3 | 79.5 | 82.6 | 31.8 | 79.2 | 82.2 |
| *Rhizobium* + LNM-16 | 34.6 | 80.7 | 84.6 | 32.9 | 80.6 | 84.3 |
| SEm± | 0.7 | 0.4 | 0.6 | 0.3 | 0.4 | 0.6 |
| CD at 5% | 1.9 | 1.2 | 1.7 | 0.9 | 1.3 | 1.7 |

**Dry matter accumulation:** The data related to the dry matter accumulation per plant of mungbean as influenced by different inorganic fertilizers, organic manure and biofertilizers at various stages of crop growth are presented in Table 6 and depicted in Fig. 4 and 5. The result shows that the dry matter accumulation by individual plant was increased continuously with the advancement of crop age and reached to the maximum at maturity. The crop sown during 2018 recorded higher dry matter accumulation per plant than in crop sown during 2019 at all the stages of crop growth. The dry matter accumulation per plant in mungbean was significantly affected due to application of various inorganic fertilizers, organic manure and biofertilizers at all stages of crop growth. Among the inorganic fertilizers, application of 125% RDF accumulated the highest dry matter *i.e.,* 14.63 and 15.02g per plant during 2018 and 14.35 and 14.72 g per plant during 2019 at 60 DAS and harvest stages of crop growth, respectively. However, at 30 DAS this treatment accumulated almost similar plant dry matter as in case of 100% and 75% RDF. During both the years, at all stages of crop growth except 30 DAS, the lowest dry matter was recorded with application of 75%RDF. In case of organic manures, application of FYM @ 5 t/ha accumulated significantly higher dry matter *i.e.,* 4.96, 14.29 and 14.82 g per plant during 2018 and 4.72, 13.92 and 14.48 g per plant during 2019 at 30 and 60 DAS and harvest stages, respectively as compared to control. During 2018, seed inoculated with *Rhizobium*+LNM-16 accumulated the highest dry matter *i.e.* 4.99, 14.16 and 14.69 g per plant at 30 DAS, 60 DAS and harvest stages, respectively which was significantly superior to that of *Rhizobium* and LNM-16. Similar trend was observed during 2019 in terms of plant dry matter accumulation at all the stages of crop growth. This increase might be owing to improved metabolism, higher chlorophyll formation and better vegetative growth thereby, enhanced photosynthetic efficiency and thus more accumulation of photosynthates and larger translocation and partitioning of photosynthates Sipai *et al.* (2016); Choudhry *et al.* (2017).

**Table 6: Plant dry matter accumulation of mungbean as influenced by different inorganic fertilizers, organic manures and biofertilizers during 2018 and 2019.**

| Treatment | Plant dry matter accumulation (g/plant) | | | | | |
|---|---|---|---|---|---|---|
| | 2018 | | | 2019 | | |
| | 30 DAS | 60 DAS | Harvest | 30 DAS | 60 DAS | Harvest |
| **Inorganic Fertilizers** | | | | | | |
| 75% RDF | 4.70 | 13.55 | 13.96 | 4.34 | 13.28 | 13.71 |
| 100% RDF | 4.83 | 13.87 | 14.66 | 4.50 | 13.54 | 14.34 |
| 125% RDF | 4.94 | 14.63 | 15.02 | 4.67 | 14.35 | 14.72 |
| SEm± | 0.05 | 0.07 | 0.07 | 0.06 | 0.09 | 0.09 |
| CD at 5% | 0.13 | 0.21 | 0.20 | 0.17 | 0.25 | 0.25 |
| **Organic Manures** | | | | | | |
| Control | 4.69 | 13.75 | 14.26 | 4.29 | 13.53 | 14.03 |
| FYM 5 t/ha | 4.96 | 14.29 | 14.82 | 4.72 | 13.92 | 14.48 |
| SEm± | 0.04 | 0.06 | 0.06 | 0.05 | 0.07 | 0.07 |
| CD at 5% | 0.11 | 0.17 | 0.16 | 0.14 | 0.20 | 0.21 |
| **Biofertilizers** | | | | | | |
| *Rhizobium* | 4.75 | 14.01 | 14.48 | 4.46 | 13.74 | 14.19 |
| LNM-16 | 4.73 | 13.88 | 14.46 | 4.35 | 13.56 | 14.12 |
| *Rhizobium* + LNM-16 | 4.99 | 14.16 | 14.69 | 4.70 | 13.87 | 14.47 |
| SEm± | 0.05 | 0.07 | 0.07 | 0.06 | 0.09 | 0.09 |
| CD at 5% | 0.13 | 0.21 | 0.20 | 0.17 | 0.25 | 0.25 |

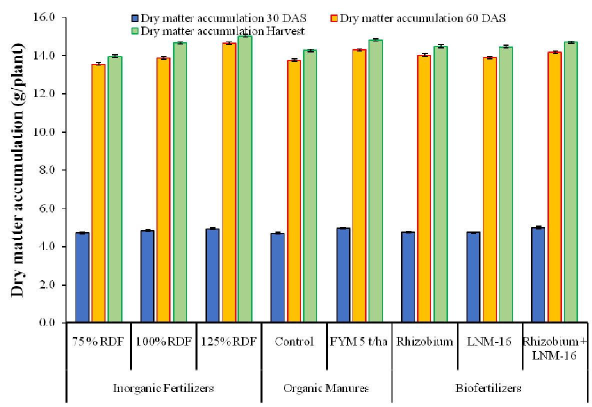


**Fig. 4.** Plant dry matter accumulation of mungbean as influenced by different inorganic fertilizers, organic manures and biofertilizers during 2018-19.

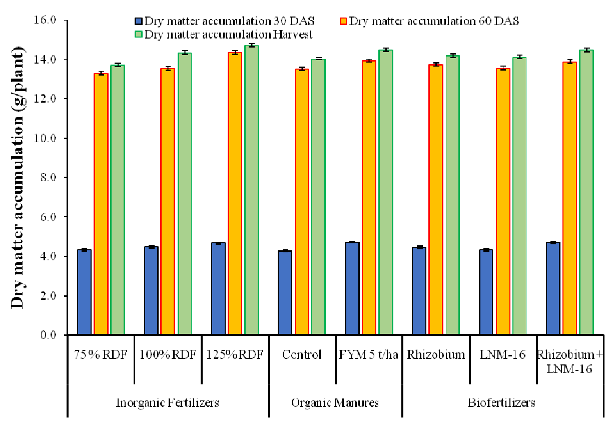


**Fig. 5.** Plant dry matter accumulation of mungbean as influenced by different inorganic fertilizers, organic manures and biofertilizers during 2019-20.

*B. Yield of mungbean*

The data pertaining to grain yield of mungbean as influenced by different inorganic fertilizers, organic manure and biofertilizers are presented in Table 7 and depicted in Fig. 6. It was noticed that the crop sown during 2018 yielded more grain as compared to crop sown in 2019. The grain yield was influenced significantly due to different inorganic fertilizers, organic manure and biofertilizers application during both the years. Among the inorganic fertilizers, application of 125% RDF produced the highest grain yield *i.e.*, 1022 kg/ha during 2018 and 1019 kg/ha during 2019 however, it remained at par with 100% RDF during 2018. During both the years, application of 100% RDF in mungbean noted significantly more grain yield than 75% RDF. Higher grain yield per hectare may be due to increased number of pods per plant, number of grains per pod and higher grain weight per plant. The higher stover yield in 125% RDF may be due to higher biomass production. Varying responses due to application of inorganic fertilizers also have been reported by Patel *et al.* (2013); Gajera *et al.* (2014); Nayekha *et al.* (2015). In case of organic manure, the significantly higher grain yield per hectare *i.e.*, 1052 kg/ha during 2018 and 1042 kg/ha during 2019 was recorded with the application of FYM @ 5 t/ha as compared to control during both the years. In case of biofertilizer, result on grain yield revealed that significantly higher yield *i.e.,* 1059 kg/ha during 2018 and 1042 kg/ha during 2019 was produced in seed inoculation with *Rhizobium*+LNM-16 as compared to their alone inoculation either with *Rhizobium* or LNM-16 during both the years. The grain yield per hectare produced in *Rhizobium* alone treatment was statistically at par with LNM-16 treatment during both the years.

The data pertaining to stover yield are presented in Table 7 and depicted in Fig. 7. It was noticed that the stover yield was more in crop sown during 2018 as compared to crop sown in 2019. The stover yield per hectare was affected significantly due to different inorganic fertilizers, organic manure and biofertilizers during both the years. Among the inorganic fertilizers, application of 125% RDF produced the highest stover yield *i.e.* 2916 kg/ha during 2018 and 2868 kg/ha during 2019 which was significantly more to 100% and 75% RDF during both the years. The lowest stover yield *i.e.,* 2588 kg/ha during 2018 and 2560 kg/ha during 2019 was obtained with application of 75% RDF however, it remained at par with application of 100% RDF during both the years. In case of organic manure, similar to grain yield, significantly higher stover yield *i.e*., 2908 kg/ha during 2018 and 2844 kg/ha during 2019 was recorded with the application of FYM @ 5 t/ha as compared to control during both the years. In case of biofertilizer, the significantly higher stover yield *i.e.,* 2927 kg/ha during 2018 and 2833 kg/ha during 2019 was noted under seed inoculation with *Rhizobium*+LNM-16 as compared to their alone inoculation either with *Rhizobium* or LNM-16 during both the years. The stover yield produced in *Rhizobium* alone treatment was statistically at par with LNM-16 treatment during both the years.

The data pertaining to biological yield are presented in Table 7 and depicted in Fig. 8. Among the inorganic fertilizers, application of 125% RDF produced the highest biological yield of 3758 kg/ha during 2018 and 3688 kg/ha during 2019 which was significantly higher than 100% and 75%RDF. The lowest biological yield of 3321 kg/ha during 2018 and 3288 kg/ha during 2019 was produced with application of 75% RDF. Although, biological yield obtained under this treatment was almost similar to that of 100% RDF during both the years. Application of FYM @ 5 t/ha in mungbean crop recorded significantly higher biological yield per hectare *i.e.*, 3760 kg/ha during 2018 and 3685 kg/ha during 2019 as compared to control during both the years. A well-established fact is that organic manures (FYM + vermi compost + green manure) are not only a great source of macro- and micronutrients, but also have a significant impact on soil's physical, chemical, and biological properties (Yadav *et al.,* 2009). Similar observation of the same kind result was reported (Patel and Upadhyay 1993). Among the biofertilizers, the significantly higher biological yield *i.e.,* 3786 kg/ha during 2018 and 3675 kg/ha during 2019 was produced with seed inoculation with *Rhizobium*+LNM-16 treatment as compared to their alone inoculation either with *Rhizobium* or LNM-16 during both the years. The biological yield per hectare produced in *Rhizobium* alone treatment was statistically at par with LNM-16 treatment during both the years.

Increasing grain yields may be attributed to root growth and development, resulting in greater nutrient uptake and higher dry matter accumulation, which is then translocated to growing spikes. The same results were reported by Awasthi and Bhan (1993). The increase in grain yield and straw yield in lentil due to inoculation of *Rhizobium* and PGPR was also reported by Serawat *et al.* (2022). In view of the fact that biological yield is a function of seed and straw yield, which represent the vegetative and reproductive growth of the plant, balanced nutrition plays a profound role in realizing a higher biological yield. Gangaiah *et al.* (2012) reported similar findings.

**Table 7: Yields, grain-stover ratio and harvest index as influenced by different inorganic fertilizers, organic manures and biofertilizers during 2018 and 2019.**

| Treatment | Grain Yield (kg/ha) | | Stover Yield (kg/ha) | | Biological Yield (kg/ha) | | Grain- stover ratio | | Harvest index | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2018 | 2019 | 2018 | 2019 | 2018 | 2019 | 2018 | 2019 | 2018 | 2019 |
| 75% RDF | 932 | 928 | 2,588 | 2,560 | 3,321 | 3,288 | 0.38 | 0.38 | 0.28 | 0.28 |
| 100% RDF | 999 | 985 | 2,695 | 2,624 | 3,494 | 3,409 | 0.40 | 0.41 | 0.29 | 0.29 |
| 125% RDF | 1022 | 1019 | 2,916 | 2,868 | 3,758 | 3,688 | 0.37 | 0.37 | 0.27 | 0.28 |
| SEm ± | 21 | 10 | 69 | 39 | 89 | 47 | 0.005 | 0.005 | 0.002 | 0.002 |
| CD at 5 % | 60 | 28 | 199 | 113 | 255 | 136 | 0.01 | 0.01 | 0.01 | 0.01 |
| Control | 917 | 913 | 2,558 | 2,525 | 3,275 | 3,238 | 0.38 | 0.38 | 0.27 | 0.27 |
| FYM 5 t/ha | 1052 | 1042 | 2,908 | 2,844 | 3,760 | 3,685 | 0.39 | 0.39 | 0.28 | 0.28 |
| SEm ± | 17 | 8 | 56 | 32 | 72 | 39 | 0.004 | 0.004 | 0.002 | 0.002 |
| CD at 5 % | 49 | 23 | 162 | 92 | 208 | 111 | 0.01 | 0.01 | 0.01 | 0.01 |
| *Rhizobium* | 960 | 956 | 2,643 | 2,605 | 3,404 | 3,360 | 0.38 | 0.38 | 0.28 | 0.28 |
| LNM -16 | 935 | 933 | 2,630 | 2,615 | 3,363 | 3,350 | 0.38 | 0.39 | 0.28 | 0.28 |
| *Rhizobium*+ LNM-16 | 1059 | 1042 | 2,927 | 2,833 | 3,786 | 3,675 | 0.37 | 0.39 | 0.28 | 0.28 |
| SEm ± | 21 | 10 | 69 | 39 | 89 | 47 | 0.005 | 0.005 | 0.002 | 0.002 |
| CD at 5 % | 60 | 28 | 199 | 113 | 255 | 136 | NS | NS | NS | NS |

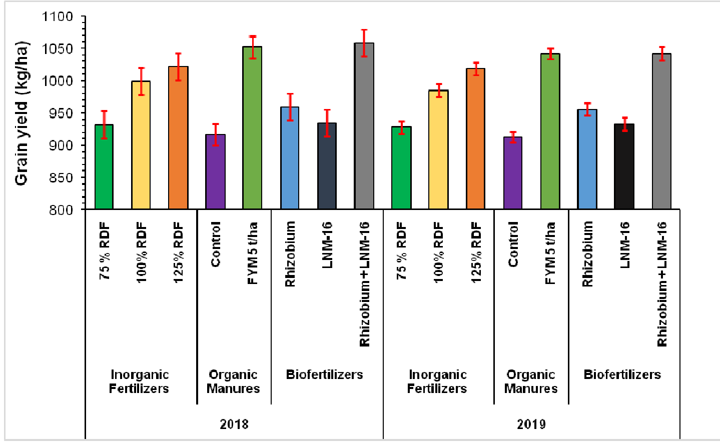


**Fig. 6.** Grain yield of mungbean as influenced by different inorganic fertilizers, organic manures and biofertilizers during 2018 and 2019.

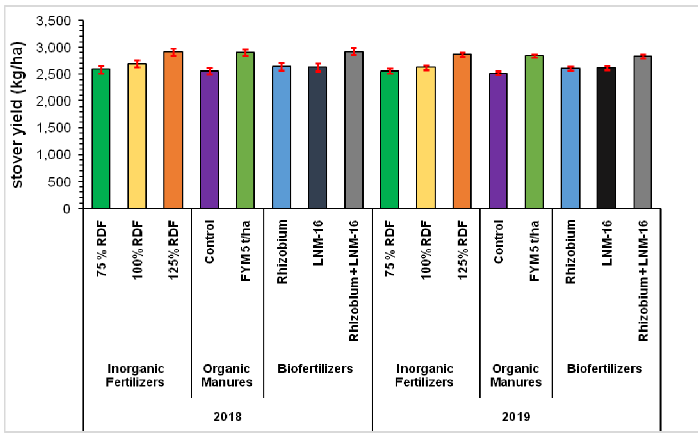


**Fig. 7.** Stover yield of mungbean as influenced by different inorganic fertilizers, organic manures and biofertilizers during 2018 and 2019.

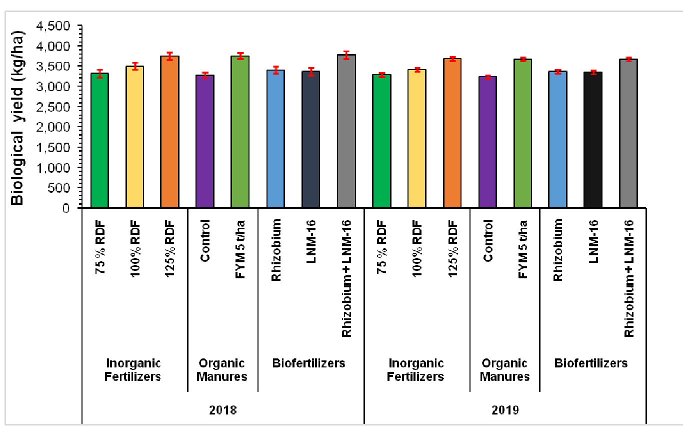


**Fig. 8.** Biological yield of mungbean as influenced by different inorganic fertilizers, organic manures and biofertilizers during 2018 and 2019.

## CONCLUSIONS

As per results of experiment, we can conclude the application of 125% RDF, FYM @ 5t/ha and seed inoculation with combination of Rhizobium and LNM-16 provide the higher growth and yield of mungbean as compared to lower doses of RDF, NO FYM and seed inoculation with sole biofertilizers.

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**Conflict of Interest.** None.

## REFERENCES

Achakzai, A. K. K., Shah, B. H. and Wahi, M. A. (2012). Effect of nitrogen fertilizer on the growth of mungbean [*Vigna radiata* (L.) Wilczek] grown in Quetta. *Pak. J. Bot., 44,* 981- 987.

Amarasingha, R. P. R. K., Suriyagoda, L. D. B., Marambe, B., Rathnayake, W. M. U. K., Gaydon, D. S., Galagedara, L. W., Punyawardena, R., Silva, G. L. L. P., Nidumolu, U. and Howden, M. (2017). Improving water productivity in moisture-limited rice-based cropping systems through

incorporation of maize and mungbean: A modelling approach. *Agricultural Water Management*, *189*, pp.111-122.
Anjum, M. S., Ahmed, Z. I. and Rauf, C. A. (2006). Effect of Rhizobium inoculation and nitrogen nitrogen fertilizer on yield and yield components of mungbean. *International Journal of Agriculture and Biology (Pakistan)*.
Awasthi, U. D. and Bhan, S. (1993). Performance of Wheat (*Triticum aestivum*) varieties with different levels of Nitrogen in moisture-scarce condition. *Indian Journal of Agronomy*, *38*(2), 200-203.
Azadi, E., Rafiee, M. and Hadis, N. (2013). The effect of different nitrogen levels on seed yield and morphological characteristic of mungbean in the climate condition of Khorramabad. *Ann. Biol. Res., 4*, 51-55.
Behera, U. K., Sharma, A. R. and Pandey, H. N. (2007). Sustaining productivity of wheat–soybean cropping system through integrated nutrient management practices on the Vertisols of central India. *Plant and soil*, *297*, 185-199.
Black, I.A. 1965. An examination of the Degtjareff method for determining soil organic matter and a proposed modification of the chromic acid titration. *Soil Sci., 37,* 29-38.
Choudhary, M., Patel, B. A., Meena, V. S., Yadav, R. P. and Ghasal, P. C. (2017). Seed Bio Priming of Green gram With *Rhizobium* and Levels of Nitrogen and Sulphur Fertilization under Sustainable Agriculture. *Legume Res., 3837*, 1-6.
Duraisami, V. P. and Mani, A. K. (2001). Residual effect of inorganic nitrogen, composted coirpith and biofertilizer on yield and uptake of soybean in an Inceptisol. *Madras Agricultural Journal*, *88*(4/6), 277-280.
Gajera, R. J., Khafi, H. R., Raj, A. D., Yadav V. and Lad A. N. (2014). Effect of phosphorus and Bio-fertilizers on Growth yield and economics of Summer Green gram [*Vigna radiata* (L.) Wilczek]. *Agriculture Update, 9*(1), 98-102.
Gangaiah, B., Ahlawat, I. P. S. and Shivakumar, B. G. (2012). Crop rotation and residue recycling effects of legumes on wheat as influenced by nitrogen fertilization. *Agric. Sci. Res. J*, *2*(4), 167-176.
Ghosh, P. K., Venkatesh, M. S., Hazra, K. K. and Kumar, N. (2012). Long-term effect of pulses and nutrient management on soil organic carbon dynamics and sustainability on an inceptisol of indo-gangetic plains of India. *Experimental Agriculture*, *48*(4), 473-487.
Jackson, M.L. 1973. Soil chemical analysis. Prentice hall of India Pvt. Ltd. New Delhi. pp. 263-293
Jadeja, A. S., Rajani, A. V., Kaneriya, S. C. and Hirpara, D. V. (2019). Nutrient content, uptake, quality of chickpea (Cicer arietinum L.) and fertility status of soil as influenced by fertilization of potassium and sulphur. *Int. J. Curr. Microbiol. App. Sci*, *8*(6), 2351-2355.
Mayer, J., Buegger, F., Jensen, E. S., Schloter, M. and Heß, J. (2003). Residual nitrogen contribution from grain legumes to succeeding wheat and rape and related microbial process. *Plant and Soil*, *255*, 541-554.
Nair, R. M., Yang, R. Y., Easdown, W. J., Thavarajah, D., Thavarajah, P., Hughes, J. D. A. and Keatinge, J. D. H. (2013). Biofortification of mungbean (*Vigna radiata*) as a whole food to enhance human health. *Journal of the Science of Food and Agriculture*, *93*(8), 1805-1813.
Navsare, R. I., Mane, S. S. and Supekar, S. J. (2018). Effect of potassium and zinc solubilizing microorganism on growth, yield and quality of mungbean. *International Journal of Chemical Studies*, *6*(1), 1996-2000.
Nayekha, N., Sharma, Y.K., Sharma, S.K. and Gupta, R.C. (2015). Influence of Phosphorus and Phosphorus Solublising Bacteria on performance of Green Gram and Soil Properties. *Ann. plant soil res., 17*(3), 323-325.
Neelam, R. K. and Kumar, P. (2014). Effect of organic and inorganic sources of nutrients on productivity and profitability of mungbean-wheat cropping system.
Olsen, S.R., Cole, C.V., Watanable, F.S. and Dean, L.A. 1954. Estimation of available phosphorus in soils by extraction with sodium bicarbonate. USDA Circ., pp. 939.
Patel, H. B., Shah, K. A., Barvaliya, M. M. and Patel, S. A. (2017). Response of Greengram (*Vigna radiata* L.) to Different Levels of Phosphorus and Organic Liquid Fertilizer. *Int. J. Curr. Microbiol. App. Sci., 6*(10), 3443-3451.
Patel, H. R., Patel, H. F., Maheriya, V. D. and Dodiya, I. N. (2013). Response of Kharif Geengram (*Vigna radita* L. Wilczek) to Sulphur and Phosphorus Fertilization with and Without Biofertilizer Application. *Bioscan, 8*(1): 149-152.
Patel, R. M. and Upadhyay, P. N. (1993). Response of wheat (*Triticum aestivum*) to irrigation under varying levels of nitrogen and phosphorus. *Indian Journal of Agronomy*, *38*, 113-113.
Saha, R. and Patra, P. S. (2017). Energetics and Economics of Greengram [*Vigna radiata* (L.) Wliczek] as Influence by Varying Levels of Nitrogen. *Adv. Res. J. Crop Improv., 8*(2), 145-149.
Sipai, A. H., Jat, J. R. and Rathore, B. S. (2016). Effect of phosphorus, sulphur and biofertilizer on growth, yield and nodulation in mungbean on loamy sand soils of Kutch. *Crop Res., 51,* 1-10.
Serawat, M., Pareek, N., Chandra, R., Raverkar, K. P., Singh, A. V. and Singh, V. K. (2022) Synergistic effect of *Rhizobium* and plant growth promoting rhizobacteria (PGPR) consortia on growth, nodulation and yield of Lentil (*Lens culinaris* M.) AMA-AGR MECH ASIA AF 53:9509-9521
Shete, P. G., Thanki, J. D., Adhav, S. L. and Kushare, Y. M. (2010). Response of R*abi* greengram (*Vigna radiata* L.) to land configuration and inorganic fertilizer with and without FYM. *Crop Res., 39,* 43-46.
Singh, R. and Rai, R. K. (2004). Yield attributes, yield and quality of soybean (Glycine max) as influenced by integrated nutrient management. *Indian Journal of Agronomy*, *49*(4), 271-274.
Subbhiah, B.V. and Asija, C.L. 1956. A rapid procedure for determination of available nitrogen in soils. *Curr. Sci., 25,* 259-262.
Xu, H., Zhong, G., Lin, J., Ding, Y., Li, G., Wang, S., Liu, Z., Tang, S. and Ding, C. (2015). Effect of nitrogen management during the panicle stage in rice on the nitrogen utilization of rice and succeeding wheat crops. *European Journal of Agronomy*, *70*, 41-47.
Yadav, D. S., Kumar, V. and Yadav, V. (2009). Effect of organic farming on productivity, soil health and economics of rice (*Oryza sativa*)–wheat (*Triticum aestivum*) system. *Indian Journal of Agronomy*, *54*(3), 267-271.

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