

# Effect of different nutrient management practices on crop growth, yield and yield attributes of soybean (*Glycine max L.*) under Kymore Plateau and Satpura Hills agro-climatic zone

## ABSTRACT

The field trial was conducted at Krishi Nagar Farm, Department of Agronomy, College of Agriculture, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh, India, during the *kharif* season of 2021. The field experiment consisted with 06 treatments and they were tested in randomized block design with 04 replications. The study revealed that maximum plant height (50.35 cm), branches per plant (5.74), effective root nodules (57), Leaf area index (4.90), dry weight plant<sup>-1</sup> (45.16 g), yields attributes parameters like seed per pod (57.74), pods per plant (2.91) as well as seed index (11.88), seed yield (1009 kg ha<sup>-1</sup>), stover yield (2087 kg ha<sup>-1</sup>) and HI (32.59%) of soybean was found higher under 100 % Organic NM followed by 25% Organic + NF inputs BJJ +25% Inorganic NM.

*Keywords:* Soybean; natural farming; Beejamrit; Jeevamrit; Ghanjeevamrit; seed yield; organic; inorganic; nutrient management.

## 1. INTRODUCTION

Soybean (*Glycine max L.*) is the world's most important seed legume; it is a native of North-eastern China belongs to family *Fabaceae*. It can grow well in tropical and subtropical climate and require warm and moist season. A temperature range of 25 to 30°C appears to be the optimum. Soybean is extensively grown in all over India especially in Madhya Pradesh because of its wide adaptability to agro-climatic conditions and better market value. It has great nutritive value and very high protein content (42-43%) and oil (18-20%) with major essential fatty acids and vitamins (A and D). It also having high carbohydrate (30%) and fiber (4%) content. Therefore, it also known as golden bean, wonder crop and man-made meat [1]. According to USDA, world soybean production in 2021-22 is estimated 372.5 million tons from total area of 120.50 million hectare [2]. Area under soybean in India is 11.34 million hectare and production are estimated 11.99 million tons (SOPA) in 2021-22. Madhya Pradesh stood first with 5.51

million hectares area and production of 5.56 million tons in 2021-22 [3]. Being a leguminous crop, it improves soil fertility by fixing atmospheric nitrogen at the rate of 65 to 115 kg per hectare per year with the process of symbiosis through *Rhizobium japonicum*. Nitrogen (N) is the most demanded nutrient by the soybean crop. It is estimated that it takes 80 kg of N to make 1000 kg of seeds. The content of soil reserve-derived nitrogen taken up by the whole soybean plants averaged 61.29 kg N/kg [4]. Chemical fertilizers cannot sustain productivity of land under modern farming system. Similarly, nutrient supply through organic manures and bio-fertilizers can hardly fulfill the need of a crop. Application of organic manure in conjunction with inorganic fertilizers in an integrated manner, proved to be the best alternative [5]. Integrating chemical fertilizer with organic manures has been proven to be highly promising in terms of not only preserving higher output but also increasing crop production stability [6]. When used with lower dosages of

inorganic fertilizers, farmyard manure or vermicompost enhanced soil fertility, crop growth, and yield. Chemical fertilizers, on the other hand, have a negative impact on soil fertility leading to unsustainable yields, while integration of chemical fertilizers with organic manures and bio-fertilizers would be able to maintain soil fertility and sustain crop productivity [7]. Nutrient supply plays an important role in the crop production but under intensive cultivation, use of chemical fertilizers alone for a longer period would result in deterioration of soil fertility and quality of produce [8]. Integrated nutrient management (INM) is an integral part of the sustainable agriculture which requires the management of resources in a way to fulfill the changing human needs without deteriorating the quality of environment and conserving vital natural resources. It comprises of application of organic manures, green manures, blue-green algae, bio-fertilizers and crop rotation with legumes along with minimum use of chemical fertilizers to produce optimum crop yield without deteriorating the soil health [9].

## 2. MATERIAL AND METHODS

### 2.1 Study Area

A field experiment entitled “Studies on the effect of varying nutrient management practices on growth and yield of soybean (*Glycinemax L.*)” was conducted during *kharif* 2021. The district Jabalpur is located in Madhya Pradesh, India, and is located between 23°18' N latitude and 79°98' E longitude, with an average altitude of approximately 411.78 meters (1387.73 ft) above mean sea level with a total area of 5198 km<sup>2</sup>. According to the National Agricultural Research Program's criteria, Jabalpur is located in the "Kymore Plateau and Satpura Hills" agro-climatic zone. In the Jabalpur area, the average annual rainfall is 1350 mm. Though rainfall was less abundant during the crop season (from planting to harvesting), its distribution was not uniform. As a result, it encouraged crop establishment, followed by crop growth, development, and yield. These conditions were also quite congenial at this stage. Entire weather conditions were almost favorable for proper growth, development and yield of crops.

**Table 1: Physico-chemical properties of soil of experimental field**

Texture	Sandy clay loam (Sand:54%, Silt:24%, and Clay:21.69%)
Soil reaction	7.16
Electrical conductivity (dS/m)	0.28
Soil organic carbon (%)	0.60
Available N kg ha <sup>-1</sup>	216
Available P <sub>2</sub> O <sub>5</sub> kg ha <sup>-1</sup>	12.41
Available K <sub>2</sub> O kg ha <sup>-1</sup>	240

The field experiment consisted with 06 treatments and they were tested in randomized

block design with 04 replications. The details of the treatments are given below:

**Table 2: Treatments details**

Treatments	
T <sub>1</sub>	100% Organic nutrient management
T <sub>2</sub>	50% Organic NM +NF inputsBeejamrit+ Jeevamrit+Ghanjeevamrit
T <sub>3</sub>	50% Organic NM + 50% Inorganic NM

T <sub>4</sub>	25% Organic +NF inputs Beejamrit+Jeevamrit+Ghanjeevamrit 25% Inorganic NM
T <sub>5</sub>	Farmer practices
T <sub>6</sub>	100% Inorganic nutrient management

## 2.2 Statistical analysis of treatment

Data recorded on various observations were tabulated and subjected to their statistical analysis by using techniques of the analysis of variance [10]. The significance of the treatments was tested by using 'F' test and when 'F' best shown the significance, of the difference between the treatments was further tested with critical difference (C. D.) at 5% level of significance.

## 3. RESULTS AND DISCUSSION

### 3.1 Effect of Different Nutrient Management Practices on Crop Growth

#### 3.1.1 Plant Height

The mean data on plant height of soybean crop as influenced by different nutrient management treatments (organic, inorganic and integrated nutrient management) which is given in Table 3. The plant height was recorded at two growth intervals as like at 60 DAS and harvest of crop. The data indicate that the applied organic, inorganic and INM treatments have significant impact on plant height. The maximum plant height at 60 DAS and harvest (46.66 and 50.35 cm respectively) was recorded in case of 100 % Organic NM, followed by 25% Organic + NF inputs BJK +25% Inorganic NM (42.24 and 47.74 cm respectively). Thereafter the height was significantly lowered down (35.91 and 45.52 cm respectively) in case of Farmer Practice treatments. This might be due to the combine application of FYM, vermicompost and neemcake which enhanced the availability of nitrogen being a major constituent of chlorophyll, which facilitated more synthesis of food materials which caused greater cell division and

cell enlargement. This could have contributed towards the increase in plant height with the inclusion of different organic manures sources [11].

#### 3.1.2 Number of branches plant<sup>-1</sup>

The mean data in relation to branches per plant at 60 DAS are presented in Table 3. The mean data on branches per plant of soybean crop as influenced by different nutrient management treatments under different treatments. The results of mean data studies revealed that number of branches plant<sup>-1</sup> was significantly affected under different treatments. The maximum number of branches (5.74 plant<sup>-1</sup>) was recorded under treatment *i.e.*, 100 % Organic NM which is at par with T<sub>4</sub> (5.41 plant<sup>-1</sup>), T<sub>6</sub> (4.99 plant<sup>-1</sup>) and T<sub>2</sub> (4.66 plant<sup>-1</sup>). The minimum number of branches (4.16 plant<sup>-1</sup>) was found under Farmer Practice treatment. This might be due to inclusion of different organic manures *i.e.*, FYM, vermicompost and neemcake under T<sub>1</sub> would have facilitated better growth and development ultimately a greater number of branches per plant [12, 13, 14].

#### 3.1.3 Leaf area index (LAI)

The data related to LAI of soybean at 60 DAS was significantly influenced under different treatments as like (organic, inorganic and integrated nutrient management) as revealed from Table 3. Among all the treatments the highest LAI (4.90) was found under T<sub>1</sub> (100 % Organic NM) which is at par with T<sub>4</sub> (25% Organic + NF inputs BJK +25% Inorganic NM) (4.84) and T<sub>6</sub> (100 % Inorganic NM) (4.81). The

significantly lowest value of LAI (4.59) was recorded under T<sub>5</sub>. This, might be due to maximum number of leaves was found under T<sub>1</sub> and minimum leaves was found under T<sub>5</sub> and LAI is positively correlated with number of leaves per plant [15, 16, 17,].

### **3.1.4 Number of root nodules plant<sup>-1</sup>**

Number of root nodules plant<sup>-1</sup> at 45 DAS was counted treatment wise and data were subjected to statistical analysis. The data presented in Table 3. The study revealed that root nodules per plant showed significant difference under different treatments with highest number of root nodules (57.00 plant<sup>-1</sup>) was found under the treatment with addition of 100 % Organic NM which is at par with T<sub>3</sub> (56.33 plant<sup>-1</sup>) and T<sub>4</sub> (55.91 plant<sup>-1</sup>). However, minimum root nodules count was observed when application of 100 % Inorganic NM i.e., 52.58 root nodules plant<sup>-1</sup>. This might be due to organic sources provide good moisture and aeration in soil which facilitate the vigorous and synchronized root system and enhances the microbial activity in rhizosphere region of plant root [18, 19,].

### **3.1.5 Dry weight plant<sup>-1</sup>**

Data pertaining to dry weight per plant is presented in Table 3. The results revealed that significantly higher plant dry weight (45.16 g) at harvest was found in T<sub>1</sub> (100 % Organic NM) which is at par with T<sub>4</sub> (40.75 g) and T<sub>6</sub> (37.31 g). The significantly lowest plant dry weight (25.83 g) was observed under Farmer Practice treatments. This might be due to increased supply of nutrients sources to the crop as well as indirect effect resulting from reduced loss of nutrients from organic source [20, 21].

## **3.2 Effect of Different Nutrient Management Practices on yield attributes characters**

### **3.2.1 Number of pods per plant**

The number of pods plants<sup>-1</sup> was counted under each treatment and data were subjected to statistical analysis which is presented in Table 4. Among all different treatments significantly higher number of pods plant<sup>-1</sup> (57.24) were found in 100 % Organic NM which is followed by T<sub>4</sub> (51.74) pods plant<sup>-1</sup> (25% Organic + NF inputs BJJG +25% Inorganic NM). However, significantly minimum number of pods per plant (37.66) was recorded under Farmer Practice. This might be due to inclusion of different organic manures which improved agronomic performance of soybean and increased crop yield [22, 23].

### **3.2.2 Number of Seeds per pod**

The data related to number of seeds per pod was recorded treatment wise. The data presented in Table 4. It indicates that no significant difference on seeds per pod was found under all treatments but variation in number of seeds per pod from 2.58 to 2.91.

### **3.2.3 Seed index (g)**

The seed index was recorded in each treatment and the data were statistically calculated and presented in Table 4. Seed index is significantly affected under different treatments. Among different treatments the maximum seed index (11.88 g) was found in T<sub>1</sub> (100 % Organic NM) which is at par with T<sub>4</sub> 11.50g (25% Organic + NF inputs BJJG +25% Inorganic NM) and minimum seed index (10.04 g) was recorded in T<sub>5</sub> (Farmer Practice) [24, 25].

**Table 3: Plant height, branches, LAI, effective root nodules and dry weight plant<sup>-1</sup> as influenced by different nutrient management practices in soybean**

Treatment No.	Plant height (cm)		Branches Plant <sup>-1</sup>	LAI	Root nodules Plant <sup>-1</sup>	Dry weight Plant <sup>-1</sup>
	60 DAS	At harvest				
			60 DAS	60 DAS	45 DAS	At harvest
T <sub>1</sub> 100 % Organic NM	46.66	50.35	5.74	4.90	57.00	45.16
T <sub>2</sub> 50 % Organic NM +NF inputs BJG	40.07	46.27	4.66	4.71	55.25	35.25
T <sub>3</sub> 50% Organic+50% Inorganic NM	38.33	45.85	4.24	4.65	56.33	32..25
T <sub>4</sub> 25% Organic + NF inputs BJG +25% Inorganic NM	42.24	47.74	5.41	4.84	55.91	40.75
T <sub>5</sub> Farmer Practice	35.91	45.52	4.16	4.59	53.50	25.83
T <sub>6</sub> 100 % Inorganic NM	40.66	46.49	4.99	4.81	52.58	37.31
<b>SEm±</b>	<b>1.59</b>	<b>1.16</b>	<b>0.45</b>	<b>0.06</b>	<b>0.39</b>	<b>2.94</b>
<b>CD (p= 0.05%)</b>	<b>4.78</b>	<b>3.51</b>	<b>1.37</b>	<b>0.17</b>	<b>1.16</b>	<b>8.85</b>

**Table4: Number of Pods plant<sup>-1</sup>, Seeds pod<sup>-1</sup> and Seed index as influenced by different nutrient management practices in soybean**

Treatment No.	Pods plant <sup>-1</sup>	Seeds pod <sup>-1</sup>	Seed index (g)
T <sub>1</sub> 100 % Organic NM	57.24	2.91	11.88
T <sub>2</sub> 50 % Organic NM +NF inputs BJG	50.41	2.74	10.87
T <sub>3</sub> 50% Organic+50% Inorganic NM	48.24	2.66	10.62
T <sub>4</sub> 25% Organic + NF inputs BJG +25% Inorganic NM	51.74	2.91	11.50
T <sub>5</sub> Farmer Practice	37.66	2.58	10.04
T <sub>6</sub> 100 % Inorganic NM	50.58	2.75	10.15
<b>SEm±</b>	<b>1.74</b>	<b>0.20</b>	<b>0.20</b>
<b>CD (p= 0.05%)</b>	<b>5.25</b>	<b>NS</b>	<b>0.61</b>

### 3.3 Effect of Different Nutrient Management Practices on soybean yields

#### 3.3.1 Seed and stover yield (kg ha<sup>-1</sup>)

The data related to seed as well as stover yield of soybean presented in Table 5. The data pertaining to seed and stover yield ha<sup>-1</sup> showed significant difference under all treatments. Among different treatment the maximum seed yield and stover yield (1009 and 2087 kg ha<sup>-1</sup> respectively) was recorded under the treatment of 100 % Organic NM in terms of percentage it is (35%) higher as compared to farmer practice, followed by T<sub>4</sub> (25% Organic + NF inputs BJJ +25% Inorganic NM) which is (20%) higher than farmer practice than T<sub>2</sub> (50 % Organic NM +NF inputs BJJ) which is (16%) higher as compare to farmer practice. However, significantly lower seed yield

and stover yield (746 and 1736 kg ha<sup>-1</sup> respectively) was observed under the treatment of Farmer Practice [26, 27, 28].

#### 3.3.2 Harvest index (%)

The harvest index was calculated as per given formula under each treatment. The data presented in Table 5 were statistically computed and study revealed that harvest index is significantly influenced under different treatments. Among all the treatments highest harvest index 32.59% was found in T<sub>1</sub> (100 % Organic NM) which is at par with T<sub>4</sub> (32.57%). However, the lowest harvest index was observed in Farmer Practice i.e., 30.06%. This might be due to excellent growth and development of soybean plant under higher nutrient content [29, 30].

**Table 5: Seed yield and stover yield (kg ha<sup>-1</sup>) as influenced by different nutrient management practices in soybean**

Treatment No.	Seed yield	Stover yield	Harvest index (%)
T <sub>1</sub> 100 % Organic NM	1009	2087	32.59
T <sub>2</sub> 50 % Organic NM +NF inputs BJJ	871	1931	31.08
T <sub>3</sub> 50% Organic+50% Inorganic NM	861	1914	31.02
T <sub>4</sub> 25% Organic + NF inputs BJJ +25% Inorganic NM	899	1861	32.57
T <sub>5</sub> Farmer Practice	746	1736	30.06
T <sub>6</sub> 100 % Inorganic NM	808	1846	30.44
<b>SEm±</b>	<b>31.56</b>	<b>69.00</b>	<b>0.46</b>
<b>CD (p= 0.05%)</b>	<b>95.12</b>	<b>208.00</b>	<b>1.39</b>

## 4. CONCLUSION

Based on the foregoing results and discussion above it can be concluded that maximum plant height, branches per plant, effective root nodules, LAI, dry weight plant<sup>-1</sup>, yields attributes parameters like seed per pod, pods per plant as well as seed index, yields and HI of soybean was found higher under 100 % Organic NM followed by 25% Organic + NF inputs BJJ +25% Inorganic NM. Since the

conclusions are drawn based on the results of only one year experimentation, this study should be repeated at least for 2-3 years without changing the layout, crop, and crop variety to confirm the consistency of results. The cost of beejamrit, jeevamrit and ghanjeevamrit may be worked out for consideration to reduce the cost of cultivation.

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