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Effect of conventional and natural sources of nutrients on growth and yield of soybean

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Abstract

A field experiment was conducted India during *kharif* season of the year 2025 to Study the effect of conventional and natural sources of nutrients on growth and yield of soybean at Agronomy Farm, B. A. College of Agriculture, Anand Agricultural University, Anand, Gujarat. The experiment was laid out with twelve treatments replicated three times in Randomized Complete Block Design (RCBD). The treatment consisted of different nutrient sources viz., (T₁)-100% RDF, (T₂)- Seed treatment of Bio-NP consortium (*Rhizobium* + PSB) + 50% RDF, (T₃)- Seed treatment of *Bijamrut* + 50% RDF, (T₄)- 50% RDF + FYM 1t/ha + *Ghanjivamrut* 1t/ha, (T₅)- FYM 4 t/ha, (T₆)- Seed treatment of Bio-NP consortium (*Rhizobium* + PSB) 5mL/kg + FYM 2 t/ha, (T₇)- Seed treatment of *Bijamrut* seed 300 mL/kg + FYM 2 t/ha, (T₈)- *Ghanjivamrut* 4 t/ha, (T₉)- Seed treatment of Bio-NP consortium (*Rhizobium* + PSB) + *Ghanjivamrut* 2 t/ha, (T₁₀)- Seed treatment of *Bijamrut* + *Ghanjivamrut* 2t/ha, (T₁₁)- Seed treatment of *Bijamrut*+ *Ghanjivamrut* 2 t/ha+ *Jeevamrut*, (T₁₂)- Seed treatment of *Bijamarut* + *Ghanjivamrut* 2 t/ha + *Jeevamrut* + foliar spray of *Jeevamrut*. The growth and yield attribute like plant height, number of nodules per plant, weight of root nodules, seed yield and straw yield were significantly improved by application of *Ghanjeevamrut* 4 t/ha or Bio NP consortium (*Rhizobium* + PSB) + FYM 2 t/ha or 50% RDF+ FYM 1 t/ha + *Ghanjivamrut* 1 t/ha.

Keywords: Organic formulations, growth, yield, soybean

Introduction

Soybean (*Glycine max* (L.) Merrill) is an important oilseed pulse crop of the world and stands out due to its dual role as an oilseed and pulse crop. It is a rich source of high-quality protein (about 40–42%) and cholesterol-free oil (around 20%), and contains essential amino acids, vitamins (A, B-complex, C, D, E, K), and minerals. Known as the “Golden Crop” or “Miracle Crop of the 21st Century,” soybean has become a staple in both the food and industrial sectors. Its adaptability, high yield potential and soil-enriching characteristics make it central to sustainable agriculture in India.

In 2023, global soybean production reached 371.18 million tonnes across 136.91 million hectares. Brazil, USA, Argentina, China, and India are the top five producers. India contributes about 4% to the global output, with major soybean producing states being Madhya Pradesh, Maharashtra, Rajasthan, Karnataka, Gujarat, and Telangana (Agricultural Market Intelligence Centre, PJTSAU, 2025) [7].

One such approach is the effectiveness of conventional mineral fertilizers. The integration of some natural nutrient sources such as *Jeevamrut*, *Bijamrut*, *Ghanjivamrut*, compost, vermicompost, and biofertilizers like the Bio-NP consortium (*Rhizobium* + PSB) has gained significant importance in promoting sustainable crop production.

Jeevamrut improves nutrient solubilization, boosts plant vigour and enhances immunity (Devakumar *et al.*, 2014) [2]. These organic inputs not only contribute to nutrient recycling but also improve soil structure, enhance microbial activity and support long-term soil health key elements of ecological and agronomic sustainability.

Materials and Methods

A field experiment was conducted India during *kharif* season of the year 2025 to Study the effect of conventional and natural sources of nutrients on growth and yield of soybean at Agronomy

Farm (22°35' N, 72°55' E), B. A. College of Agriculture, Anand Agricultural University, Anand, Gujarat situated at an elevation of 45.1 m above sea level. The initial soil pH was 8.13, EC-0.16 dSm⁻¹, Organic Carbon- 0.37%, available nitrogen - 216 kg/ha, available Phosphorus -39.41 kg/ha and available Potassium-223 kg/ha. The soil was loamy sand in texture, moderately alkaline in reaction, low in available nitrogen, medium phosphorus and sufficient in available potassium. The field experiment was carried out on soybean crop (Variety NRC - 37) in *kharif* season during year 2025. After completion of preparatory tillage

operations, the experiment was laid out in randomized complete block design comprising (12) treatments and replicated (3) times.

Treatments details

Twelve treatments were formulated to evaluate the effect of conventional and natural sources of nutrients on growth and yield of soybean. The details of treatment are as follows

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Treatment	Treatments detail
T ₁	100% RDF
T ₂	Seed treatment of Bio-NP consortium (<i>Rhizobium</i> + PSB) + 50% RDF
T ₃	Seed treatment of <i>Bijamrut</i> + 50% RDF
T ₄	50% RDF + FYM 1t/ha + <i>Ghanjivamrut</i> 1t/ha
T ₅	FYM 4 t/ha
T ₆	Seed treatment of Bio-NP consortium (<i>Rhizobium</i> + PSB) 5mL/kg + FYM 2 t/ha
T ₇	Seed treatment of <i>Bijamrut</i> seed 300 mL/kg + FYM 2 t/ha
T ₈	<i>Ghanjivamrut</i> 4 t/ha
T ₉	Seed treatment of Bio-NP consortium (<i>Rhizobium</i> + PSB) + <i>Ghanjivamrut</i> 2 t/ha
T ₁₀	Seed treatment of <i>Bijamrut</i> + <i>Ghanjivamrut</i> 2t/ha
T ₁₁	Seed treatment of <i>Bijamrut</i> + <i>Ghanjivamrut</i> 2 t/ha+ <i>Jeevamrut</i>
T ₁₂	Seed treatment of <i>Bijamrut</i> + <i>Ghanjivamrut</i> 2 t/ha + <i>Jeevamrut</i> + foliar spray of <i>Jeevamrut</i>

Note

- For seed treatment: *Bijamrut* 300 mL/ kg seed (treatment T₃, T₇, T₁₀ and T₁₁), Bio - NP consortium (*Rhizobium* + PSB) 5m L/kg seed (treatment T₂, T₆ and T₉)
- Jeevamrut* 1250 L/ha applied each at sowing and 1st, 2nd and 3rd irrigation with irrigation water in treatment T₁₁, T₁₂
- Foliar spray of *Jeevamrut* 20% at 20 and 40 DAS applied in treatment T₁₂

Results and Discussion

Effect of different source of nutrients on growth of soybean Plant height

The data regarding plant height (cm) recorded at periodical intervals to assess the changes in growth of soybean as influenced by different treatments is furnished in Table 1. The data revealed that plant height exhibited variation across all periodical growth stages in response to the various treatments. At 30 DAS, plant height showed variation among the treatments, ranging from 29.02 to 32.66 cm. However, the differences were found to be statistically non-significant, indicating a similar effect of all treatments on early plant growth.

Significantly higher plant height was recorded at 60 DAS (70.52 cm) under treatment T₁₁ (Seed treatment of *Bijamrut* + *Ghanjivamrut* 2 t/ha + *Jeevamrut*) which was remained at par with T₈ (*Ghanjivamrut* 4 t/ha) with plant height of 64.75 cm. While, minimum plant height of 57.62 cm was recorded under treatment T₉ (Seed treatment of Bio-NP consortium (*Rhizobium* + PSB) + *Ghanjivamrut* 2 t/ha).

Among different treatments, significantly higher plant height of 79.70 cm was recorded at the time of 90 DAS under treatment T₁₁ (Seed treatment of *Bijamrut* + *Ghanjivamrut* 2t/ha + *Jeevamrut*) which was remained at par with T₄, T₈, T₁₂, T₁₀, T₇, T₆, T₁ and T₅. Treatment T₉ (Seed treatment of Bio-NP consortium (*Rhizobium* + PSB) + *Ghanjivamrut* 2 t/ha) was recorded

minimum plant height (66.35cm) at 90 DAS.

At harvest, treatment T₁₁ (Seed treatment of *Bijamrut* + *Ghanjivamrut* 2 t/ha + *Jeevamrut*) recorded significantly higher plant height of 80.64 cm, which was found statistically comparable with T₈ (*Ghanjivamrut* 4 t/ha), T₄, T₁₂, T₆, T₁, T₇ and T₁₀. The minimum plant height at harvest (69.40 cm) was recorded under T₉.

The increase in plant height under treatment T₁₁ (Seed treatment of *Bijamrut* + *Ghanjivamrut* 2 t/ha + *Jeevamrut*) might be due to *Jeevamrut* and *Ghanjivamrut* enhance microbial population and biological activity in the soil, which improves nutrient mineralization and thereby the continuous supply of readily available nutrients and growth-promoting substances throughout the crop growth period, particularly nitrogen. The presence of beneficial microorganisms, vitamins, enzymes and plant growth regulators such as auxins and gibberellins promotes rapid cell division and cell elongation. In addition, *Jeevamrut* improves photosynthetic efficiency and metabolic activities, leading to vigorous vegetative growth and consequently higher plant height in soybean. Similar result has been reported by Jagdale *et al.* (2020) [3].

Higher plant height observed under the application of *Jivamrut* and *Ghanjivamrut* might be attributed to improved hormonal and enzymatic activities, which enhanced cell division and cell elongation in plants also reported by Devakumar *et al.* (2018) [1].

Table 1: Effect of various sources of nutrients on plant height at various growth stages of soybean

Tr. No.	Treatments	Plant height (cm)			
		30 DAS	60 DAS	90 DAS	At Harvest
T ₁	100% RDF	30.53	59.16	72.38	74.90
T ₂	Seed treatment of Bio-NP consortium (<i>Rhizobium</i> + PSB) + 50% RDF	32.13	58.87	71.70	73.52
T ₃	Seed treatment of <i>Bijamrut</i> + 50% RDF	32.38	58.66	70.79	72.12
T ₄	50% RDF+ FYM 1t/ha + <i>Ghanjivamrut</i> 1t/ha	29.11	64.00	79.39	79.68
T ₅	FYM 4 t/ha	30.30	58.88	71.91	73.09
T ₆	Seed treatment of Bio-NP consortium (<i>Rhizobium</i> + PSB) + FYM 2 t/ha	31.44	61.63	72.59	75.62
T ₇	Seed treatment of <i>Bijamrut</i> seed + FYM 2 t/ha	29.23	61.03	75.49	74.66
T ₈	<i>Ghanjivamrut</i> 4 t/ha	31.11	64.75	78.75	79.89
T ₉	Seed treatment of Bio-NP consortium (<i>Rhizobium</i> + PSB) + <i>Ghanjivamrut</i> 2t/ha	32.26	57.62	66.35	69.40
T ₁₀	Seed treatment of <i>Bijamrut</i> + <i>Ghanjivamrut</i> 2t/ha	30.08	60.61	75.49	74.23
T ₁₁	Seed treatment of <i>Bijamrut</i> + <i>Ghanjivamrut</i> 2 t/ha + <i>Jeevamrut</i>	29.02	70.52	79.70	80.64
T ₁₂	Seed treatment of <i>Bijamrut</i> + <i>Ghanjivamrut</i> 2 t/ha + <i>Jeevamrut</i> + foliar spray of <i>Jeevamrut</i>	32.66	61.12	78.63	79.30
	S.E.m.±	1.73	2.06	2.66	2.21`
	CD (P=0.05)	NS	6.05	7.80	6.49
	CV (%)	9.72	5.81	6.19	5.07

Effect of different source of nutrients on number of root nodules and dry weight of root nodules per plant

The data on number of nodules per plant and dry weight of nodules per plant at 38 DAS as influenced by different sources of nutrients are presented in Table 2. Nodulation in soybean was significantly influenced by application of various sources of nutrients along with RDF. The data narrated in Table 2 shows that the number of nodules per plant and nodules dry weight were

increased significantly due to combination of natural sources of nutrients with RDF over RDF and alone application of natural sources of nutrients. Significantly higher value of number of nodules and dry weight of nodules per plant (20.10 and 165mg/plant) was recorded in *Ghanjivamrut* 4 t/ha (T₈) treatment while lowest was recorded in T₁ treatment. Similar findings are in conformity with those of Jagdale *et al.* (2020) [3], Singh and Uppal (2025) [6].

Table 2: Effect of various sources of nutrients on number of root nodules and dry weight of root nodules per plant at 38 DAS of soybean

Treatments	No. of root nodules	Dry weight of root nodules (mg/plant)
100% RDF	17.24	132
Seed treatment of Bio-NP consortium (<i>Rhizobium</i> + PSB) + 50% RDF	19.89	144
Seed treatment of <i>Bijamrut</i> + 50% RDF	18.16	145
50% RDF+ FYM 1t/ha + <i>Ghanjivamrut</i> 1t/ha	19.75	154
FYM 4 t/ha	18.55	140
Seed treatment of Bio-NP consortium (<i>Rhizobium</i> + PSB) + FYM 2 t/ha	21.01	152
Seed treatment of <i>Bijamrut</i> seed + FYM 2 t/ha	18.24	150
<i>Ghanjivamrut</i> 4 t/ha	20.10	165
Seed treatment of Bio-NP consortium (<i>Rhizobium</i> + PSB) + <i>Ghanjivamrut</i> 2t/ha	17.55	135
Seed treatment of <i>Bijamrut</i> + <i>Ghanjivamrut</i> 2t/ha	18.45	145
Seed treatment of <i>Bijamrut</i> + <i>Ghanjivamrut</i> 2 t/ha + <i>Jeevamrut</i>	18.56	152
Seed treatment of <i>Bijamrut</i> + <i>Ghanjivamrut</i> 2 t/ha + <i>Jeevamrut</i> + foliar spray of <i>Jeevamrut</i>	19.52	144
S.E.m.±	0.75	6.08
CD (P=0.05)	2.21	NS
CV (%)	6.89	7.16

Effect of different source of nutrients on yield of soybean

Seed yield

The data pertaining to seed yield of soybean (kg/ha) as influenced by different treatments are presented in Table 3. The results revealed that various nutrient management treatments exerted a significant effect on seed yield of soybean. Among different treatments, treatment T₈ (*Ghanjivamrut* 4 t/ha) recorded significantly higher seed yield of 1971 kg/ha. However, it did not differ significantly from treatment T₄ (50% RDF + FYM 1 t/ha + *Ghanjivamrut* 1 t/ha), T₆ (Seed treatment of Bio -NP consortium (*Rhizobium* + PSB) + FYM 2 t/ha), T₁₁ (Seed treatment of *Bijamrut* + *Ghanjivamrut* 2t/ha + *Jeevamrut*), T₇ (Seed treatment of *Bijamrut* + FYM 2 t/ha), T₁₂ (Seed treatment of *Bijamrut* + *Ghanjivamrut* 2t/ha + *Jeevamrut* + foliar spray of *Jeevamrut*),

and T₁ (100% RDF) and recorded 1910, 1908, 1883, 1840, 1789, 1759 kg/ha seed yield, respectively. Significantly lower seed yield of 1476 kg/ha was recorded under treatment T₉ (Seed treatment of Bio-NP consortium (*Rhizobium* + PSB) + *Ghanjivamrut* 2 t/ha), which was followed by T₃ (Seed treatment of *Bijamrut* + 50% RDF) (1609 kg/ha) and T₅ (FYM 4 t/ha) (1625 kg/ha).

Higher seed yield under these treatments might be due to better nutrient availability throughout crop growth period, improved soil physical and biological properties and enhanced microbial activity which resulted in better growth attributes and yield components such as number of pods per plant and seed development. These results are in compliance with the finding of Jagdale *et al.* (2020) [3] and Patil and Udmale (2016) [5].

Table 4: Effect of various sources of nutrients on seed yield and stover yield of soybean

Treatments	Seed yield (kg/ha)	Stover yield (kg/ha)
100% RDF	1759	2619
Seed treatment of Bio-NP consortium (<i>Rhizobium</i> + PSB) + 50% RDF	1633	2403
Seed treatment of <i>Bijamrut</i> + 50% RDF	1609	2330
50% RDF+ FYM 1t/ha + <i>Ghanjivamrut</i> 1t/ha	1910	2849
FYM 4 t/ha	1625	2392
Seed treatment of Bio-NP consortium (<i>Rhizobium</i> + PSB) + FYM 2 t/ha	1875	2807
Seed treatment of <i>Bijamrut</i> seed + FYM 2 t/ha	1840	2643
<i>Ghanjivamrut</i> 4 t/ha	1971	2849
Seed treatment of Bio-NP consortium (<i>Rhizobium</i> + PSB) + <i>Ghanjivamrut</i> 2t/ha	1476	2323
Seed treatment of <i>Bijamrut</i> + <i>Ghanjivamrut</i> 2t/ha	1727	2638
Seed treatment of <i>Bijamrut</i> + <i>Ghanjivamrut</i> 2 t/ha + <i>Jeevamarut</i>	1883	2685
Seed treatment of <i>Bijamrut</i> + <i>Ghanjivamrut</i> 2 t/ha + <i>Jeevamarut</i> + foliar spray of <i>Jeevamarut</i>	1789	2591
S.Em.±	84	128
CD (P=0.05)	247	375
CV (%)	8.30	8.53

Stover yield

The data presented in Table 3 demonstrated that different nutrient management treatments exerted a significant effect on the stover yield of soybean. Among different treatments, treatment T₈ (*Ghanjivamrut* 4 t/ha) recorded significantly the highest stover yield (2849 kg/ha), which remained at par with treatment T₄ (50% RDF + FYM 1 t/ha + *Ghanjivamrut* 1 t/ha) (2849 kg/ha), T₆ (Seed treatment of Bio-NP consortium (*Rhizobium* + PSB) + FYM 2 t/ha) (2807 kg/ha), T₁₁ (Seed treatment of *Bijamrut* + *Ghanjivamrut* 2t/ha + *Jeevamarut*) (2685 kg/ha), T₇ (Seed treatment of *Bijamrut* seed + FYM 2 t/ha) (2643 kg/ha), T₁₀ (Seed treatment of *Bijamrut* + *Ghanjivamrut* 2t/ha) (2638 kg/ha), T₁ (100% RDF) (2619 kg/ha) and T₁₂ (Seed treatment of *Bijamrut* + *Ghanjivamrut* 2t/ha + *Jeevamarut* + foliar spray of *Jeevamarut*) (2591kg/ha).

Higher stover yield under these treatments might be attributed to better vegetative growth, higher dry matter accumulation and improved nutrient availability throughout the crop growth period due to integrated use of organic and inorganic nutrient sources. Treatment T₉ (Seed treatment of Bio-NP consortium (*Rhizobium* + PSB) + *Ghanjivamrut* 2 t/ha) recorded significantly lower stover yield of 2323 kg/ha followed by treatment T₃ (Seed treatment of *Bijamrut* + 50% RDF) (2330 kg/ha) and T₅ (FYM 4 t/ha) (2392 kg/ha). The increase in stover yield of soybean might be due to better growth parameters such as plant height and number of branches per plant. These favourable growth conditions enhanced the utilization of available resources and increased photosynthesis and dry matter production, resulting in higher stover yield. These results are in compliance with the finding of Jagdale *et al.* (2020) [3] and Patil and Udmale (2016) [5].

Conclusion

Application of *Ghanjivamrut* (4 t/ha) enhanced growth, higher yield attributes, seed yield and stover yield of soybean followed by 50% RDF+ FYM 1t/ha + *Ghanjivamrut* 1 t/ha and seed treatment of Bio-NP consortium (*Rhizobium* + PSB) + FYM 2 t/ha.

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