

# Effect of different organic liquid formulations on the growth and yield of Soybean: A Case Study

## Abstract:

This case study investigates the influence of the six different organic formulations on the growth and yield parameters of soybean (*Glycine max* L.), which is a popular vegetable oilseed in India. A Randomized Block Design (RBD) with four replications was considered to carry out the field experiment during rabi seasons of year 2022-23. Well-formulated organic liquids, namely Jeevamrut, Panchgavya, Vermiwash, Cowdung wash, Cow urine, and a Control, were applied as part of an integrated nutrient management (INM) approach. Key observations were recorded for various parameters such as plant height, number of branches per plant, number of pods per plant, length of pod, number of seeds per pod, test weight, pod yield, seed yield, and straw yield. The study indicates that Panchgavya (T2) was most effective among the treatments, showing highest seed yield of 1223 kg/ha and a corresponding straw yield of 2144.5 kg/ha. The outcomes of the study would be beneficial for other crops currently facing many challenges related to quality and yield due to the use of chemical-based treatments.

**Keywords:** Soybean, Organic formulations, INM, Crop protection equipment, Vegetable Oilseed, Randomized Block Design, ,

## INTRODUCTION

The consistently rising demand of vegetable oil has encouraged farmers to grow oil seeds crops. Soil health condition and climates of the topography of the farming land is one of the important deciding factors of opting oilseed crops. India has great growth potential in vegetable oilseeds, and soybean is the most preferred oilseed crop for cultivation. Soybean oilseeds, soybean oil, and soybean meal have all gained significant importance for the Indian economy over the past two decades. Soybean cultivation has risen in the central Indian states where the weather is suitable. It has become the crop of choice for the farmers during the kharif season. The soybean productivity in India has fluctuated significantly and has not reached anywhere near 3400 kg/ha achieved by the top producers USA and Brazil. The world edible oil production over last 4 years from 2017-18 to 2020-21 has increased by 4.87% to 199.33 MMT, soybean oil which accounts for 30.32% (60.44 MMT) of the world edible oil production in 2020-21. The consumption of edible oil in India is at 23.46 MMT with a per capita consumption of 16 kg/ person, India's edible oil production stands at 8.97 MMT in 2020-21 and it is assumed that the consumption may touch 30 million ton by 2025. After mustard oil production (2.85 MMT), soybean oil ranks second at 1.69 MMT, with India being dominated by these two oil sources. [Govt of Telangana].

In the past few decades, the use of chemical-based fertilizers has increased significantly to obtain profitable crop yields. This has consequently led to several chronic diseases, such as cancer and gastric issues, while also degrading the natural properties of the soil.

The present study aims to highlight the usefulness of organic treatments amid the global crop nutrition crisis.

Many researchers have highlighted the positive effects of organic treatments on various crops. Jagdale et al. (2019) and Lokhande et al. (2023) reported the usefulness of organic formulations on the yield and

quality of soybean. Swapnil et al. (2024) assessed the effects of different bio stimulants on mustard and muskmelon crops. The subsequent sections describe the materials and methods, present the results and discussion, and conclude with the findings.

## MATERIALS AND METHODS

The field trials were Carried out during the Rabi season on the farming land at ASPEE agricultural research and development foundation (ARDF), located in the north Konkan region of Maharashtra, India. In this agricultural experiment, soybean is the chosen crop. The soil characteristics of experimental field is shown in Table 1.

Table 1: Physical and chemical properties of Test soil

Parameter	Value
Sand (%)	11.0
Silt (%)	17.6
Clay (%)	71.4
pH	7.28
Organic carbon (%)	0.17
Electrical Conductivity (dSm <sup>-1</sup> )	0.84
Nitrogen, N (kg/ha)	85.29
Phosphorus, P (kg/ha)	92.19
Potassium, K (kg/ha)	394.17

The planting configuration involves a spacing of 30 cm X 15 cm between individual soybean plants. The experiment follows a Randomized Block Design (RBD), and each plot has dimensions of 6.0 m X 4.2 m. With careful replication, the experiment includes four repetitions, ensuring a robust and statistically sound evaluation of the soybean cultivation under these specified conditions.

To investigate the effect of organic matters on growth of plants and overall yields, well scheduled treatments with six different kinds of organic formulations was applied during the course of experiment. These treatment formulations are presented in Table 2.

Table 2: Treatment Details

Treatment (T)	Organic formulation
T1	Jeevamrut
T2	Panchgavya
T3	Vermiwash
T4	Cowdung wash
T5	Cow Urine
T6	Control

Table 3: Observations of Growth and Yield Parameters

Treatment	Plant height (cm)	No. of branches per plant	No. of pods per plant	No. of seeds per pod	Test weight (g)	Seed Yield (kg/ha)	Straw Yield (kg/ha)
<b>T 1</b>	36.31	9	24.6	4.95	13.57	1101	1924.6
<b>T 2</b>	38.34	9.6	29	5.35	14.07	1223	2144.5
<b>T 3</b>	35.22	8.85	19	4.7	12.93	1029	1805.3
<b>T 4</b>	33.82	8.4	18	4.45	12.36	962	1684.9
<b>T 5</b>	30.84	7.6	17.2	4.2	11.84	923	1615.4
<b>T 6</b>	27.58	6.6	13.6	3.9	9.4	804	1406.3
<b>S.Em.±</b>	1.01	0.42	1.58	0.07	0.12	20.91	41.23
<b>CD</b>	3.04	1.27	4.76	0.2	0.36	63.02	124.27

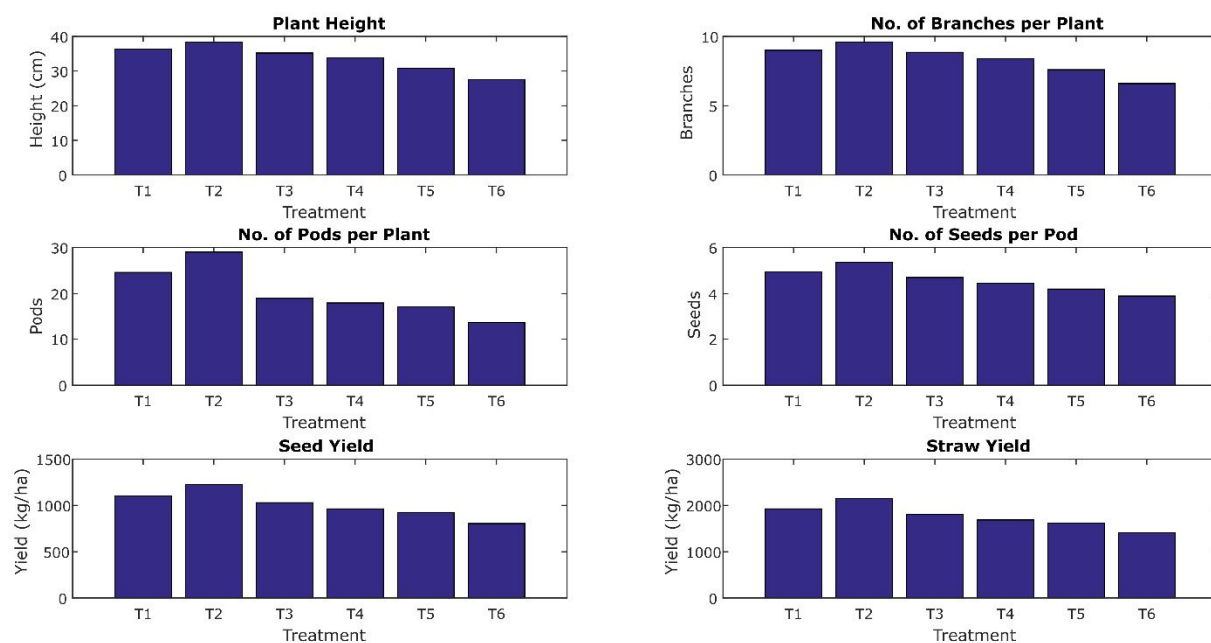


Figure 1: Effect of treatments on various parameters

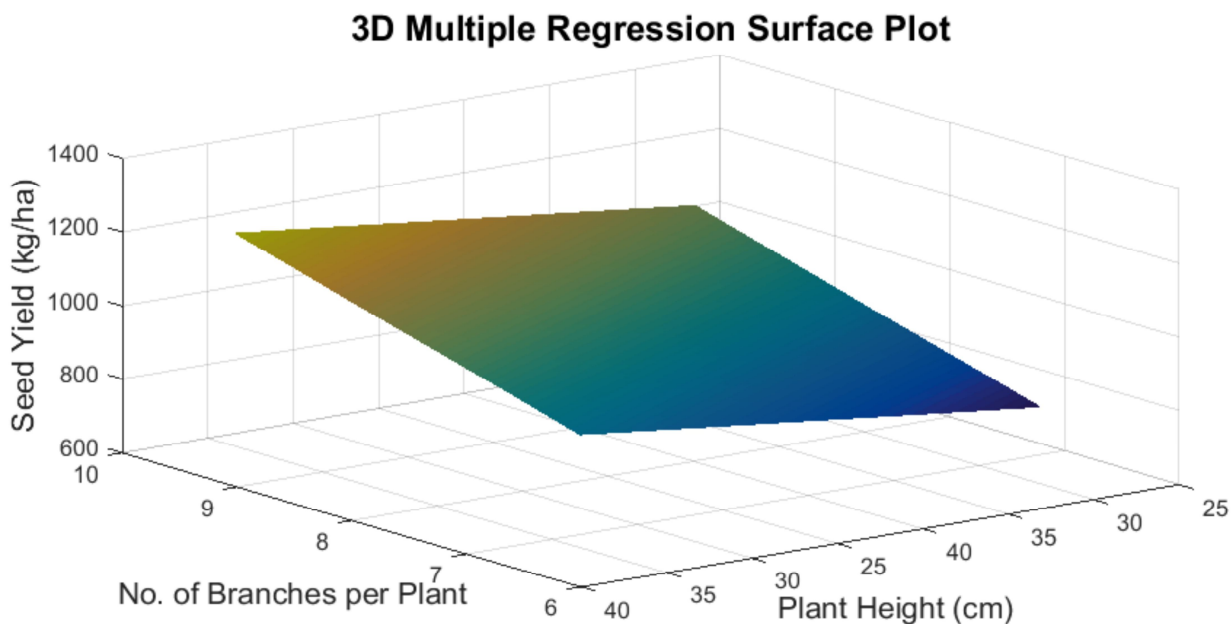


Figure 2: Response of influencing variables on seed yield

## RESULTS:

The present field study evaluated the influence of six different organic treatments on the certain plant parameters for growth and yield of soybean (*Glycine max L.*) during the Rabi season of 2022-23. The well-formulated combination of organic treatments includes Jeevamrut, Panchgavya, Vermiwash, Cowdung wash, Cow Urine, and a Control. The observations were recorded during course of time for various parameters. These are presented in Table 2. The obtained data were statistically analysed using Multivariate variance (ANOVA) to get the stabilized results. The graphical representation of the effects of these treatments on various parameters are illustrated in Figures 1 & 2. They also show a general trend of increasing values for these parameters from T6 (Control) to T2 (Panchgavya), indicating the positive impact of the organic formulations on soybean growth and yield. Notably, the control group (T6) had the lowest values for all parameters, highlighting the potential benefits of using organic formulations in soybean cultivation.

## DISCUSSION:

### Plant height

The obtained results show that the highest plant height 38.34 cm was recorded with treatment Panchgavya (T2). The micro-organic matters in Panchgavya probably improves different soil characteristics helps in supplying required nutrients to growing plants. Navin et al. (1996); Ayoola and Maknide, (2009); Mahmoud and Ibrahim, (2012); Khaim et al. (2013). Similar observations have also been reported by Ghaly et al. (2020).

### Branches/plant

The maximum average number of branches per plant noticed 9.6 with treatment T2. The larger plant spacing, at 6 m x 4.2 m between plants, provides sufficient sunlight, soil moisture, and nutrients, leading to increased photosynthesis, metabolic activities, and overall growth and development, which results in a higher number of branches Gadade et al. (2018).

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

Different organic treatments showed a significant effect on the number of pods per plant. It was ranged from 13.6 to 29. The highest number of filled pod was recorded in with T2 where as lowestwith T6. Similar observations was Chaubey et al. (2000) and Khaim et al (2013).

### **Number of seeds per pod**

Variation in number of seed per pod was marginally varying 3.9 to 5.35. The highest was seen with T2 and lowest with control (T6). It was supported by Sharma et al.(2002).

### **Seed Yield:**

Treatment T2 exhibited the significant variation in seed yield. The highest seed yield was 1223kg/ha with T2 whereas lowest yield was 804 kg/ha with Control (T6) found similar outcomes was Mahesbabu et al. (2008).

The above discussion revealed that Panchgavya, on soybean growth and yield can be attributed to the rich nutrient content and beneficial microorganisms present in these formulations. Panchgavya, which is a combination of cow dung, urine, milk, curd, and ghee, is known to enhance soil fertility and provide essential nutrients to plants. The presence of beneficial microorganisms in organic formulations may have contributed to improved soil health, leading to better plant growth and productivity. Further research can explore additional factors and provide recommendations for promoting soybean farming.

### **CONCLUSION:**

The findings of this study indicate that the application of a well formulated organic treatments has a positive impact on the growth and yield of soybean. Among the tested formulations, Panchgavya emerged as the most effective treatment in enhancing various parameters, highlighting its potential as an organic input for soybean cultivation.

The results also support the adoption of appropriate organic farming practices, emphasizing the importance of these liquids in promoting sustainable and environmentally friendly agriculture. Further research and field trials can explore optimal application rates and combinations of organic formulations for maximizing other similar crops productivity under varying soil and climatic conditions.

### **COMPETING INTERESTS DISCLAIMER:**

Authors have declared that they have no known competing financial interests OR non-financial interests OR personal relationships that could have appeared to influence the work reported in this paper.

### **CREDIT AUTHORSHIP CONTRIBUTION STATEMENT**

**Dr. Swapnil:** Conceived the project, Conceptualization, Investigation, performed the experiments, analyzed the data and supervised the work.

**Dr. Narendra Kumar :** Contributed to analysing, drafting and editing of the manuscript.

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### **Disclaimer (Artificial intelligence)**

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Author(s) hereby declare that generative AI technologies such as Large Language Models, etc. have been used during the writing or editing of manuscripts. This explanation will include the name, version, model, and source of the generative AI technology and as well as all input prompts provided to the generative AI technology

Details of the AI usage are given below:

#### **1. ChatGPT (Open source)**

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