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Response of composts and biofertilizers on growth of black soybean (*Glycine max* (L.) Merrill) variety-VL 201(Bhat)

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Abstract
A field experiment was conducted at agriculture field of Himalayan University, Jollang during kharif season of 2023 and 2024 to study the response of composts and bio-fertilizers on growth and yield of black soybean [*Glycine max* (L.) Merr.]. The experiment was laid out in randomized block design with eight treatments and three replications. Results revealed that use of treatment T_4 (Vermicompost at 2.5 kg/ha + *Phosphate solubilizing bacteria* at 2.5 kg/ha) recorded significantly higher plant height (14.7 cm, 25.5cm, 35.3 cm) at 30 DAS,60 DAS, 90 DAS, leave length (5.73,7.7, 9.03) at 30 DAS, 60 DAS, 90 DAS, number of leaves of plant (17.3, 26.6, 38) at 30 DAS, 60 DAS, 90 DAS, However, lowest plant height (9.9 cm, 21.6 cm, 31.6 cm) at 30 DAS, 60 DAS, 90 DAS, lowest leave length (3.96, 4.8, 7.46) at 30 DAS, 60 DAS, 90 DAS, number of leaves (12, 22, 32) at 30 DAS, 60 DAS, 90 DAS was obtained in control treatment T_1. Dual inoculation of vermicompost and phosphate solubilizing bacteria improved the quality of soybean in presence of chemical fertilizers. The use of treatment T_5 (Vermicompost @ 5 kg/ha + Rhizobium @ 2.5 kg/ha) and treatment T_4 (Vermicompost at 2.5 kg/ha + *Phosphate solubilizing bacteria* at 2.5 kg/ha) gave at par results but statistically superior to control. Fresh weight at 30 DAS,60 DAS, 90 DAS (11.5 g, 20.1g, 27.1g) and dry weight at 30 DAS, 60 DAS, 90 DAS (10.3 g, 20.1 g, 30.2 g) were recorded highest with T_4 (Vermicompost at 2.5 kg/ha + *Phosphate solubilizing bacteria* at 2.5 kg/ha).

Keywords: Biofertilizers, treatments, black soybean, growth, yield

Introduction

Soybean (*Glycine max*) is an important legume crop that is widely cultivated globally due to its versatility and nutritional value. Originating from East Asia, soybean has become a major crop in countries such as the United States, Brazil, Argentina, and China. The state with the highest production of soybean in India is Madhya Pradesh. Madhya Pradesh is known as the "Soybean Bowl of India" and contributes significantly to the country's soybean production. Other major soybean-producing states in India include Maharashtra, Rajasthan, Uttar Pradesh, and Gujarat. It is valued for its high protein content, oil production, and wide range of uses in both human and animal consumption (Morya *et al*., 2018) [5].

Compost, known for its ability to improve soil structure, increase water retention, and provide a balanced supply of essential nutrients, serves as a valuable resource for enriching the soil environment in which black soybean plants grow. The organic matter in compost releases nutrients slowly over time, ensuring a steady supply of nitrogen, phosphorus, potassium, and micronutrients essential for plant growth. Additionally, compost enhances soil microbial activity, fostering a healthy rhizosphere environment that supports nutrient cycling and promotes plant root growth. By incorporating compost into the soil, black soybean farmers can potentially improve soil fertility, reduce the reliance on synthetic fertilizers, and enhance the overall productivity of their crops (Yaduwanshi *et al*., 2018) [9].

Biofertilizers, on the other hand, offer a unique approach to enhancing plant growth by harnessing the power of beneficial microorganisms such as nitrogen-fixing bacteria, phosphate solubilizing fungi, and plant growth-promoting rhizobacteria. These biofertilizers play a crucial role in improving nutrient availability and uptake by forming symbiotic relationships with plant roots, facilitating nutrient transfer and enhancing plant resilience to stress. By inoculating black soybean plants with biofertilizers, farmers can potentially increase nitrogen fixation, improve phosphorus and potassium uptake, and stimulate root development, leading to enhanced crop growth and productivity. Furthermore, the use of biofertilizers can contribute to the development of sustainable agricultural practices by reducing the reliance on chemical fertilizers and promoting eco-friendly farming methods (Soverda *et al*., 2009) [6].

The incorporation of composts and biofertilizers in the cultivation of black soybean has emerged as a sustainable practice with significant implications for enhancing crop growth and yield. Additionally, certain biofertilizers contain nitrogen-fixing bacteria that aid in converting atmospheric nitrogen into a form usable by plants, thereby reducing the reliance on synthetic nitrogen fertilizers. Research studies, such as those conducted by Kumar *et al*. (2018) [4] and Singh *et al*. (2013) [7], have demonstrated the effectiveness of composts and biofertilizers in improving the growth and yield of black soybean.

Materials and Methods

Field experiments were carried out during kharif season of 2023 and 2024 at agriculture field, Himalayan University, Jollang. The experimental soil belongs to the order of Vertisol, slightly acidic (4.25) in nature, high in available N (613.5 kg ha^{-1}), low in available P (4.86 kg ha^{-1}) and medium in available K (218.4 kg ha^{-1}). The organic C content in soil was 1.59 g kg^{-1}. The experiment consisted of eight treatments namely T_1-control, T_2 (Coir compost at 2.5 kg/ha + *Phosphate solubilizing bacteria* at 2.5 kg/ha), T_3 (Coir compost at 5 kg/ha + *Rhizobium* at 2.5 kg/ha), T_4 (Vermicompost at 2.5 kg/ha + *Phosphate solubilizing bacteria* at 2.5 kg/ha), T_5 (Vermicompost at 5 kg/ha + *Rhizobium* at 2.5 kg/ha), T_6 (Biochar at 2.5 kg/ha + Vermicompost at 5 kg/ha + *Rhizobium* at 2.5 kg/ha), T_7 (Biochar at 5 kg/ha + Phosphate solubilizing bacteria at 2.5 kg/ha), T_8 (Coir compost at 2.5 kg/ha + Vermicompost at 2.5 kg/ha + Biochar at 2.5 kg/ha).Treatments were tested in RBD with three replications. The recommended dose of vermicompost and *phosphate solubilizing bacteria* as per treatments was first mixed in clean water to make thick slurry. This slurry was mixed with required quantity of seeds before sowing.

Table 1: Physio-chemical properties of soil in the experimental field.

Sl. No	Particulars	Value
1.	Sand (%)	54.2%
2.	Silt (%)	29.5%
3.	Clay (%)	16.3%
4.	Soil Texture	Sandy Loam
1.	Soil pH	4.25
2.	Organic carbon	1.59%
3.	Electrical conductivity	0.452 dS/m
4.	Available Nitrogen	613.5 Kg/ha
5.	Available Phosphorus	4.86 Kg/ha
6.	Available Potassium	218.4 Kg/ha

The various methods for calculation of growth parameters are given below

Plant height

Plant height was taken in cm from the growth level to the tip of the plant from randomly selected 5 (five) plants in each individual plot and these plants were tagged for subsequent observation. A total of 3 (three) observation 30 DAS, 60 DAS and 90 DAS were recorded from the same plants in each plot and the average height of plant in each treatment was worked out for each observation.

Number of leaves per plant

The total number of leaves per plant was recorded 30DAS, 60DAS and 90 DAS and average number of each leaf per plant was calculated.

Fresh weight

The fresh weight of plants refers to the weight of the plant or plant parts immediately after harvest, including the water content present in the product.

Dry weight

The dry weight of a plant is the weight of the plant after all its water content has been removed. This is typically done by drying the plant material at temperatures higher than ambient temperature until all moisture is evaporated.

Crop growth rate (CGR)

The CGR explains the dry matter accumulated per unit land area per unit time (g m^{-2} day^{-1})

$$CGR = \frac{(W_2 - W_1)}{\rho\ (t_2 - t_1)}$$

Where, W1 and W2 are whole plant dry weight at time $T_1 - T_2$ respectively, ρ is the ground area on which W1 and W2 are recorded. CGR of a species are usually closely related to interception of solar radiation.

Relative growth rate (RGR)

Relative Growth Rate (RGR) expresses the total plant dry weight increase in a time interval in relation to the initial weight or dry matter increment per unit biomass per unit time or grams of dry weight increase per gram of dry weight and expressed as unit dry weight / unit dry weight / unit time (g g^{-1} day^{-1})

$$RGR = \frac{\log_e W_2 - \log_e W_1}{t_2 - t_1}$$

Where, W1 and W2 are whole plant dry weight at T_1 and T_2 respectively and T_1 and T_2 are time interval in days.

Results and Discussions

Plant height (cm)

At 30 DAS the maximum increase in plant height was observed and recorded in treatment T_4(Vermicompost at 2.5 kg/ha + *Phosphate solubilizing bacteria* at 2.5 kg/ha),) *i,e*. 14.7 cm and T_5 (Vermicompost at 5 kg/ha + *Rhizobium* at 2.5 kg/ha), *i,e.*, 14.3 cm was found to be statistically at par with T_4 (Vermicompost at 2.5 kg/ha + *Phosphate solubilizing bacteria* at 2.5 kg/ha). Lowest plant height was observed in treatment T_1 (*Control*) *i,e.*,9.9 cm. At 60 DAS the maximum plant height was observed to be statistically significant in treatment T_4 (Vermicompost at 2.5 kg/ha + *Phosphate solubilizing bacteria* at 2.5 kg/ha) *i,e.*, 25.5 cm and T_5 (Vermicompost at 5 kg/ha + *Rhizobium* at 2.5 kg/ha), *i,e.*, 24.9 cm was found to be statistically at par with T_4 (Vermicompost at 2.5 kg/ha + *Phosphate solubilizing bacteria* at 2.5 kg/ha). Lowest plant height was observed in treatment T_1 (control) *i,e.*, 21.6 cm. At 90 DAS the maximum plant height was observed to be statistically significant in treatment T_4 (Vermicompost at 2.5 kg/ha + *Phosphate solubilizing bacteria* at 2.5 kg/ha),) *i,e.*, 35.3 cm and T_5 (Vermicompost at 5 kg/ha + *Rhizobium* at 2.5 kg/ha), *i,e.*, 34.3 cm was found to be statistically at par with T_4 (Vermicompost at 2.5 kg/ha+ *Phosphate solubilizing bacteria* at 2.5 kg/ha). Lowest plant height was observed in treatment T_1 (Control) *i,e.*, 31.6 cm.

The probable reason for higher plant height in the T_4 (Vermicompost at 2.5 kg/ha + *Phosphate solubilizing bacteria* at 2.5 kg/ha), tretament could be the synergistic effects of plant growth promoting bacteria (PSB) and vermicompost on plant growth. *Phosphate solubilizing bacteria* can enhance nutrient availability, while vermicompost provides nutrients and improves soil structure, leading to increased plant growth and height. The combination of these two factors in the T_4 treatment may have resulted in optimal conditions for plant growth, hence the higher plant height compare to other treatments (Sunil *et al*., 2013) [8].

Table 2: Effect of compost and biofertilizer on plant height number of black soybean

Treatments	Plant height (cm)		
	30 DAS	60 DAS	90DAS
T_1- Control	9.9	21.6	31.6
T_2- Coir compost at 2.5 kg/ha + Phosphate solubilizing bacteria at 2.5 kg/ha	10.7	22.7	32.7
T_3 - Coir compost at 5 kg/ha + *Rhizobium* at 2.5 kg/ha	11.6	23.8	32.8
T_4- Vermicompost at 2.5 kg/ha + Phosphate solubilizing bacteria at 2.5 kg/ha	14.7	25.5	35.3
T_5- Vermicompost at 5 kg/ha + *Rhizobium* at 2.5 kg/ha	14.3	24.9	34.3
T_6- Biochar at 2.5 kg/ha + Vermicompost at 5 kg/ha+ *Rhizobium* at 2.5 kg/ha	14.3	24.8	33.6
T_7- Biochar at 5 kg/ha + Phosphate solubilizing bacteria at 2.5 kg/ha	13.9	24.8	33.3
T_8- Coir compost at 2.5 kg/ha +Vermicompost at 2.5 kg/ha + Biochar at 2.5 kg/ha	12.7	24.2	33.0
F Test	NS	S	S
S.Ed (±)	0.632173	0.498251	0.53091
CD (P=0.05)	1.355876	1.068642	1.138688

Leave length

At 30 DAS the maximum increase in leave length was observed and recorded in treatment T_4 (Vermicompost at 2.5 kg/ha+ *Phosphate solubilizing bacteria* at 2.5 kg/ha) i,e. 5.73 cm and T_5 (Vermicompost at 5 kg/ha + *Rhizobium* at 2.5 kg/ha), i,e., 5.43 cm was found to be statistically at par with T_4 (Vermicompost at 2.5 kg/ha + *Phosphate solubilizing bacteria* at 2.5 kg/ha). Lowest leave length was observed in treatment T_1 (Control) i,e., 3.96 cm. At 60 DAS the maximum leave length was observed to be statistically significant in treatment T_4 (Vermicompost at 2.5 kg/ha + *Phosphate solubilizing bacteria* at 2.5 kg/ha), i,e., 7.7 cm and T_5 (Vermicompost at 5 kg/ha + *Rhizobium* at 2.5 kg/ha), i,e., 6.9 cm was found to be statistically at par with T_4 (Vermicompost at 2.5 kg/ha + *Phosphate solubilizing bacteria* at 2.5 kg/ha),). Lowest leave length was observed in treatment T_1 (control) i,e.,4.8 cm. At 90 DAS the maximum plant leave length was observed to be statistically significant in treatment T_4 (Vermicompost at 2.5 kg/ha + *Phosphate solubilizing bacteria* at 2.5 kg/ha), i,e., 9.03 cm and T_5 (Vermicompost at 5 kg/ha + *Rhizobium* at 2.5 kg/ha) i,e., 8.53 cm was found to be statistically at par with T_4 (Vermicompost at 2.5 kg/ha + *Phosphate solubilizing bacteria* at 2.5 kg/ha). Lowest leave length was observed in treatment T_1 (Control) i,e., 7.46 cm.

The higher leaf length observed in the T_4 (Vermicompost at 2.5 kg/ha + *Phosphate solubilizing bacteria* at 2.5 kg/ha), can be attributed to the combined effects of enhanced nutrient availability, improved soil structure, and beneficial microbial interactions. The presence of vermicompost in the T_4 treatment may have contributed to improved soil structure, moisture retention, and nutrient availability, which are beneficial for leaf growth and development. The combination of *Phosphate solubilizing bacteria* and vermicompost in the T_4 treatment likely created a synergistic effect, enhancing the plant's ability to uptake nutrients and support optimal leaf growth. The presence of beneficial microorganisms and a nutrient-rich environment may have stimulated leaf elongation and expansion, leading to the observed higher leaf length in the plants Dusane *et al*. (2018) [2].

Table 3: Effect of compost and biofertilizer on leave length of black soybean

Treatments	Leaves Length (cm)		
	30 DAS	60 DAS	90DAS
T_1- Control	3.96	4.8	7.46
T_2- Coir compost at 2.5 kg/ha + Phosphate solubilizing bacteria at 2.5 kg/ha	4.26	5.63	7.9
T_3 - Coir compost at 5 kg/ha + *Rhizobium* at 2.5 kg/ha	5.36	6.46	8.26
T_4- Vermicompost at 2.5 kg/ha + Phosphate solubilizing bacteria at 2.5 kg/ha	5.73	7.7	9.03
T_5- Vermicompost at 5 kg/ha + *Rhizobium* at 2.5 kg/ha	5.43	6.93	8.53
T_6- Biochar at 2.5 kg/ha + Vermicompost at 5 kg/ha + *Rhizobium* at 2.5 kg/ha	5.4	6.8	8.4
T_7- Biochar at 5 kg/ha + Phosphate solubilizing bacteria at 2.5 kg/ha	5.3	6.7	8.36
T_8- Coir compost at 2.5 kg/ha +Vermicompost at 2.5 kg/ha + Biochar at 2.5 kg/ha	5.2	6.6	8.3
F Test	NS	S	S
S.Ed (±)	0.294392	0.276816	0.257275
CD (P=0.05)	0.631408	0.593711	0.5518

Number of leaves of plant

At 30 DAS the maximum increase in number of leaves was observed and recorded in treatment T_4 (Vermicompost at 2.5 kg/ha+ *Phosphate solubilizing bacteria* at 2.5 kg/ha) i,e. 17.3 and T_5 (Vermicompost at 5 kg/ha + *Rhizobium* at 2.5 kg/ha), i,e., 15.6 was found to be statistically at par with T_4 (Vermicompost at 2.5 kg/ha+ *Phosphate solubilizing bacteria* at 2.5 kg/ha). Lowest number of leaves was observed in treatment T_1 (Control) i,e., 12 .At 60 DAS the maximum number of leaves was observed to be statistically significant in treatment T_4 (Vermicompost at 2.5 kg/ha + *Phosphate solubilizing bacteria* at 2.5 kg/ha), i,e., 26.6 and T_5 (Vermicompost at 5 kg/ha + *Rhizobium* at 2.5 kg/ha) i,e., 25.6 was found to be statistically at par with T_4 (Vermicompost at 2.5 kg/ha + *Phosphate solubilizing bacteria* at 2.5 kg/ha). Lowest number of leaves was observed in treatment T_1 (control) i,e., 22 . At 90 DAS the maximum number of leaves was observed to be statistically significant in treatment T_4 (Vermicompost at 2.5 kg/ha + *Phosphate solubilizing bacteria* at 2.5 kg/ha) i,e., 38 and T_5 (Vermicompost at 5 kg/ha + *Rhizobium* at 2.5 kg/ha) i,e., 36.6 was found to be statistically at par with T_4 (Vermicompost at 2.5 kg/ha + *Phosphate solubilizing bacteria* at 2.5 kg/ha). Lowest number of leaves was observed in treatment T_1 (Control) i,e., 32. The higher number of leaves observed in the T_4 treatment combination of (Vermicompost at 2.5 kg/ha + *Phosphate solubilizing bacteria* at 2.5 kg/ha) can be attributed to the synergistic effects of improved nutrient availability, enhanced soil health, and beneficial microbial interactions.

Phosphate solubilizing bacteria (PSB) play a vital role in solubilizing phosphorus in the soil, making it more accessible to plants for uptake. The presence of vermicompost in the T_4 treatment may have improved soil fertility, promoted root development, and supported overall plant growth, resulting in the production of a greater number of leaves.The synergistic relationship between phosphate solubilizing bacteria and vermicompost in the T_4 treatment likely created an optimal environment for plant growth, facilitating nutrient uptake and utilization. The combined benefits of improved nutrient availability, enhanced soil structure, and microbial interactions may have stimulated leaf production and increased the number of leaves in the plants (Alizadeh *et al*., 2019) [1].

Table 4: Effect of compost and biofertilizer on number of leaves of black soybean

Treatments	No of leaves		
	30 DAS	**60 DAS**	**90DAS**
T_1- Control	12	22	32
T_2- Coir compost at 2.5 kg/ha + Phosphate solubilizing bacteria at 2.5 kg/ha	14	24	33.6
T_3 - Coir compost at 5 kg/ha + *Rhizobium* at 2.5 kg/ha	15.3	24.3	34.3
T_4- Vermicompost at 2.5 kg/ha + Phosphate solubilizing bacteria at 2.5 kg/ha	17.3	26.6	38
T_5- Vermicompost at 5 kg/ha + *Rhizobium* at 2.5 kg/ha	15.6	25.6	36.6
T_6- Biochar at 2.5 kg/ha + Vermicompost at 5 kg/ha + *Rhizobium* at 2.5 kg/ha	16.6	25.6	36.3
T_7- Biochar at 5 kg/ha + Phosphate solubilizing bacteria at 2.5 kg/ha	16.3	25	35
T_8- Coir compost at 2.5 kg/ha +Vermicompost at 2.5 kg/ha + Biochar at 2.5 kg/ha	15.6	24.6	34.6
f-test	NS	S	S
S.Ed (±)	1.481366	0.657677	0.906327
CD (P=0.05)	3.177214	1.410578	1.943878

Fresh Weight (g)

At 30 DAS the maximum increase in fresh weight was observed and recorded in treatment T_4 (Vermicompost at 2.5 kg/ha + *Phosphate solubilizing bacteria* at 2.5 kg/ha), *i,e.* 11.5 g and T_5 (Vermicompost at 5 kg/ha + *Rhizobium* at 2.5 kg/ha), *i,e.,* 11.2 g was found to be statistically at par with T_4 (Vermicompost at 2.5 kg/ha + *Phosphate solubilizing bacteria* at 2.5 kg/ha). Lowest fresh weight was observed in treatment T_1 (*Control*) *i,e.,*7.8 g. At 60 DAS the maximum fresh weight was observed to be statistically significant in treatment T_4 (Vermicompost at 2.5 kg/ha + *Phosphate solubilizing bacteria* at 2.5 kg/ha), *i,e.,* 20.1 g and T_5 (Vermicompost at 5 kg/ha + *Rhizobium* at 2.5 kg/ha) *i,e.,* 19.7 g was found to be statistically at par with T_4 (Vermicompost at 2.5 kg/ha + *Phosphate solubilizing bacteria* at 2.5 kg/ha). Lowest fresh weight was observed in treatment T_1 (control) *i,e.,* 12 g.At 90 DAS the maximum fresh weight was observed to be statistically significant in treatment T_4 (Vermicompost at 2.5 kg/ha + *Phosphate solubilizing bacteria* at 2.5 kg/ha),)*i,e.,* 27.1 g and T_5 (Vermicompost at 5 kg/ha + *Rhizobium* at 2.5 kg/ha), *i,e.,* 24.3 g was found to be statistically at par with T_4 (Vermicompost at 2.5 kg/ha + *Phosphate solubilizing bacteria* at 2.5 kg/ha). Lowest fresh weight was observed in treatment T_1 (Control) *i,e.,* 19.2 g.

The probable reason for the higher fresh weight in the T_4 treatment combination of (Vermicompost at 2.5 kg/ha + *Phosphate solubilizing bacteria* at 2.5 kg/ha), can be linked to the synergistic effects of improved nutrient availability, enhanced soil fertility, and beneficial microbial interactions. *Phosphate solubilizing bacteria* can enhance nutrient availability to plants by solubilizing phosphorus, which is essential for plant growth. Vermicompost, on the other hand, is a natural fertilizer that provides a wide range of nutrients and beneficial microorganisms that support plant growth. The synergistic action of *phosphate solubilizing bacteria* and vermicompost in the T_4 treatment may have resulted in better nutrient uptake, improved growth, and ultimately higher fresh weight in the plants (Jaga *et al*., 2015) [3].

Table 5: Effect of compost and biofertilizer on fresh weight of black soybean

Treatments	Fresh Weight		
	30 DAS	60 DAS	90DAS
T_1- Control	7.8	12	19.2
T_2- Coir compost at 2.5 kg/ha + Phosphate solubilizing bacteria at 2.5 kg/ha	10.4	13.1	19.3
T_3 - Coir compost at 5 kg/ha + *Rhizobium* at 2.5 kg/ha	10.4	14.9	19.8
T_4- Vermicompost at 2.5 kg/ha + Phosphate solubilizing bacteria at 2.5 kg/ha	11.5	20.1	27.1
T_5- Vermicompost at 5 kg/ha + *Rhizobium* at 2.5 kg/ha	11.2	19..7	24.3
T_6- Biochar at 2.5 kg/ha + Vermicompost at 5 kg/ha + *Rhizobium* at 2.5 kg/ha	10.5	16.5	23.9
T_7- Biochar at 5 kg/ha + Phosphate solubilizing bacteria at 2.5 kg/ha	10.3	15.3	23
T_8- Coir compost at 2.5 kg/ha +Vermicompost at 2.5 kg/ha + Biochar at 2.5 kg/ha	10.4	15.2	22.3
F Test	S	S	S
S.Ed (±)	0.749894	0.48616	0.608178
CD (P=0.05)	1.608363	1.0427	1.304413

Dry weight

At 30 DAS the maximum increase in dry weight was observed and recorded in treatment T_4 (Vermicompost at 2.5 kg/ha + *Phosphate solubilizing bacteria* at 2.5 kg/ha), *i,e.* 10.3 g and T_5 (Vermicompost at 5 kg/ha + *Rhizobium* at 2.5 kg/ha), *i,e.,* 10.0 g was found to be statistically at par with T_4 (Vermicompost at 2.5 kg/ha + *Phosphate solubilizing bacteria* at 2.5 kg/ha). Lowest dry weight was observed in treatment T_1 (*Control*) *i,e.,*6.8 g. At 60 DAS the maximum fresh weight was observed to be statistically significant in treatment T_4 (Vermicompost at 2.5 kg/ha + *Phosphate solubilizing bacteria* at 2.5 kg/ha), *i,e.,* 20.1 g and T_5 (Vermicompost at 5 kg/ha + *Rhizobium* at 2.5 kg/ha) *i,e.,* 19.6 g was found to be statistically at par with T_4 (Vermicompost at 2.5 kg/ha + *Phosphate solubilizing bacteria* at 2.5 kg/ha). Lowest dry weight was observed in treatment T_1 (control) *i,e.,* 9.5 g. At 90 DAS the maximum dry weight was observed to be statistically significant in treatment T_4 (Vermicompost at 2.5 kg/ha + *Phosphate solubilizing bacteria* at 2.5 kg/ha) *i,e.,* 27.1 g and T_5 (Vermicompost at 5 kg/ha + *Rhizobium* at 2.5 kg/ha), *i,e.,* 24.3 g was found to be statistically at par with T_4 (Vermicompost at 2.5 kg/ha + *Phosphate solubilizing bacteria* at 2.5 kg/ha). Lowest dry weight was observed in treatment T_1 (Control) *i,e.,* 19.2 g.

The probable reason for the higher dry weight in the T_4 treatment (Vermicompost at 2.5 kg/ha + *Phosphate solubilizing bacteria* at 2.5 kg/ha) can be linked to the synergistic effects of improved nutrient availability, enhanced soil fertility, and beneficial microbial interactions. *phosphate solubilizing bacteria* (PSB) play a crucial role in making phosphorus more accessible to plants by solubilizing phosphate compounds in the soil. This increased availability of phosphorus, a key nutrient essential for plant growth and development, can positively impact the accumulation of dry weight in plants. Vermicompost, being rich in organic matter and nutrients, provides a continuous and balanced supply of essential elements to the plants. The presence of vermicompost in the T_4 treatment may have enhanced soil fertility, improved nutrient uptake by the plant roots, and supported optimal growth, leading to increased dry weight accumulation in the plants (Sunil *et al*., 2013) [8].

Table 6: Effect of compost and biofertilizer on dry weight of black soybean

Treatments	Dry Weight(g)		
	30 DAS	60 DAS	90DAS
T_1- Control	6.8	9.5	12
T_2- Coir compost at 2.5 kg/ha + Phosphate solubilizing bacteria at 2.5 kg/ha	9.2	13.3	18.1
T_3 - Coir compost at 5 kg/ha + *Rhizobium* at 2.5 kg/ha	9.1	14.6	20.1
T_4- Vermicompost at 2.5 kg/ha + Phosphate solubilizing bacteria at 2.5 kg/ha	10.3	20.1	30.2
T_5- Vermicompost at 5 kg/ha + *Rhizobium* at 2.5 kg/ha	10.0	19.6	27.9
T_6- Biochar at 2.5 kg/ha + Vermicompost at 5 kg/ha + *Rhizobium* @ 2.5 kg/ha	9.43	17.7	25.6
T_7- Biochar at 5 kg/ha + Phosphate solubilizing bacteria at 2.5 kg/ha	9.36	16.9	24.1
T_8- Coir compost at 2.5 kg/ha +Vermicompost at 2.5 kg/ha + Biochar at 2.5 kg/ha	9.33	16.5	23.1
F Test	S	S	S
S.Ed (±)	0.673035	0.754458	1.145782
CD (P=0.05)	1.443517	1.618151	2.457459

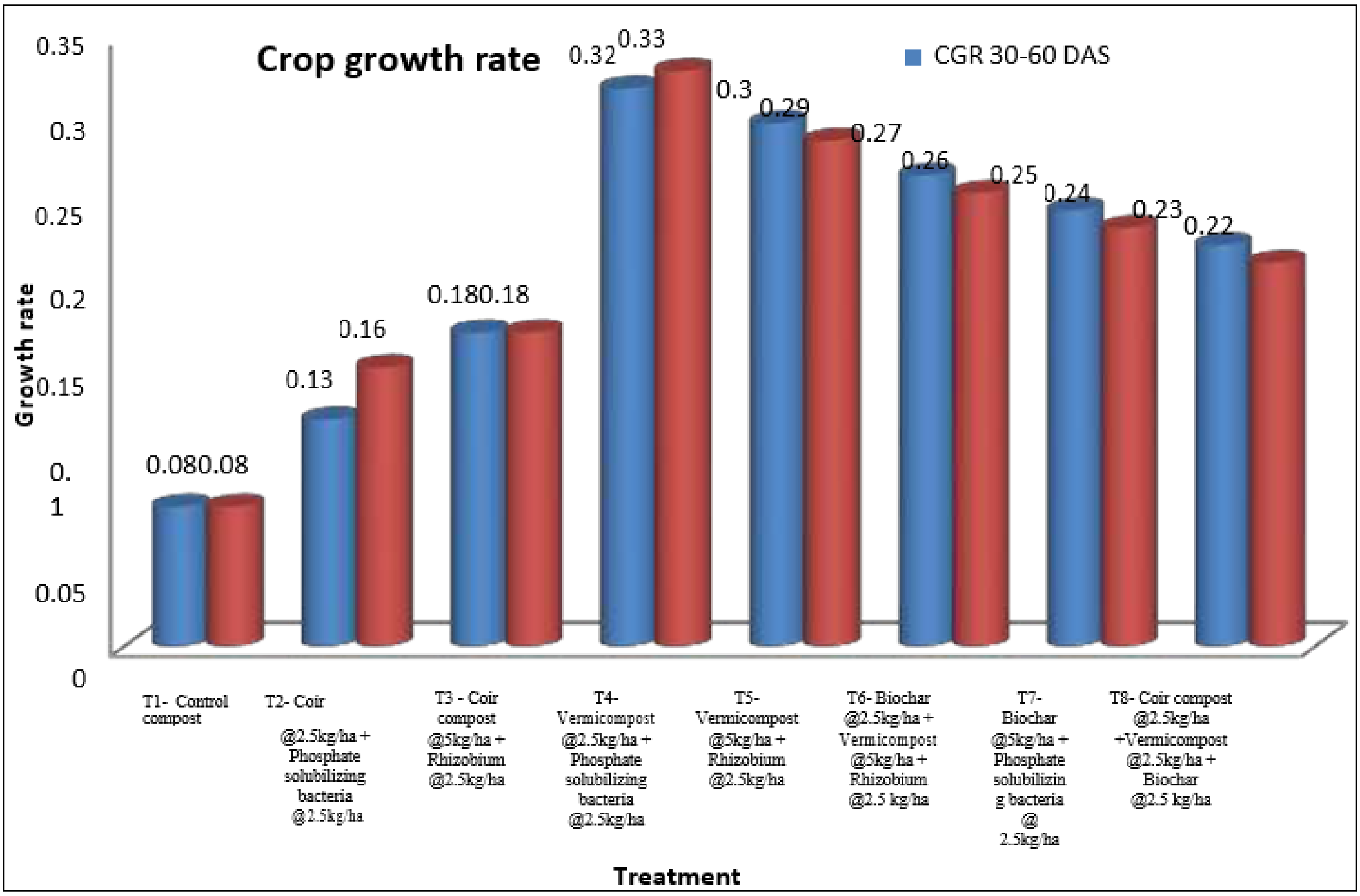

Fig 1: Effect of compost and biofertilizer on CGR of black soybean

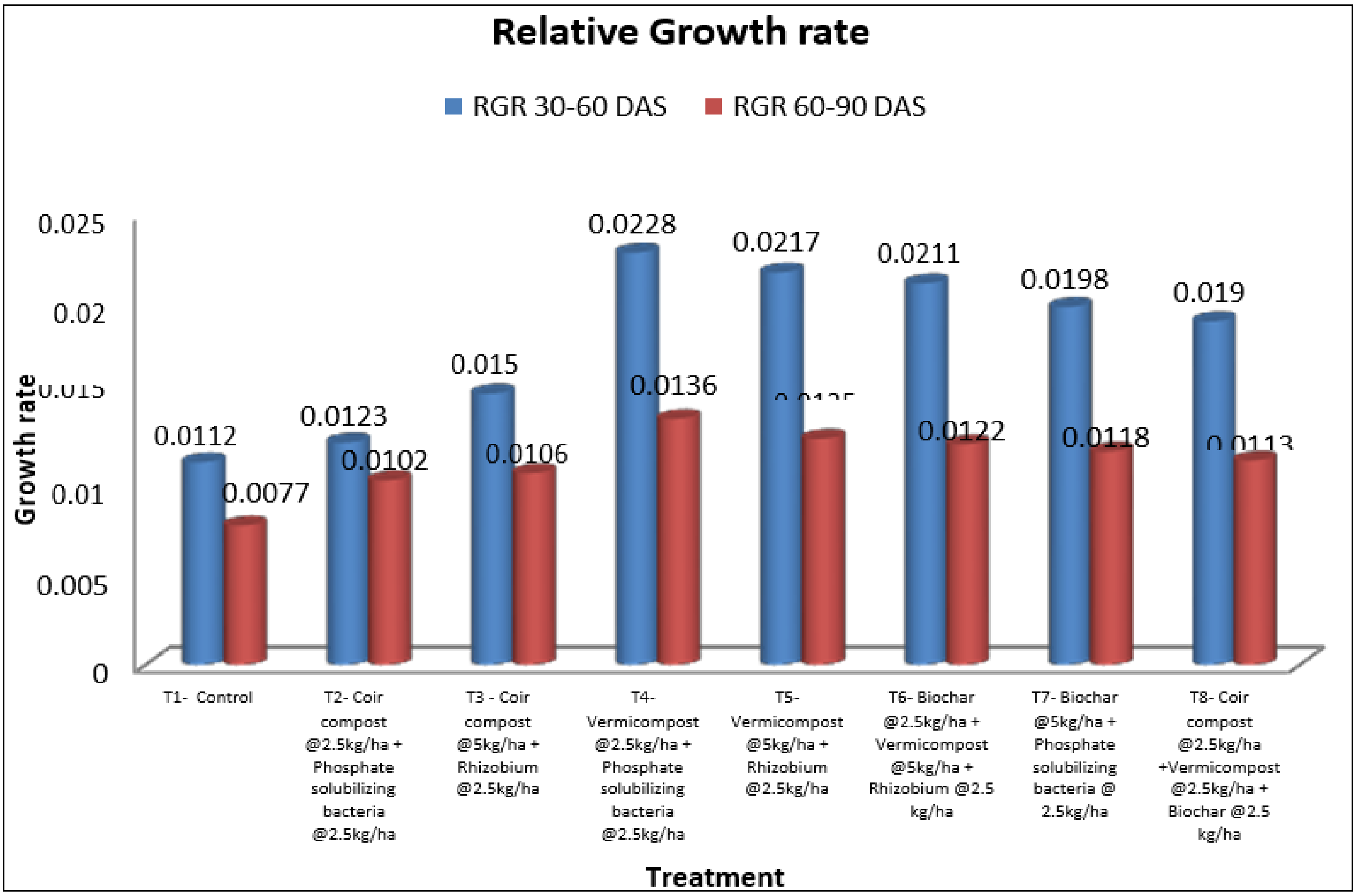

Fig 2: Effect of compost and biofertilizer on RGR of black soybean

Conclusion

The utilization of compost and biofertilizers represents a promising avenue for enhancing the growth and productivity of black soybean crops. Compost provides a valuable source of nutrients, improves soil structure, and supports microbial activity, leading to enhanced plant growth and soil fertility. Biofertilizers, with their beneficial microorganisms, contribute to nutrient availability, root development, and stress tolerance in black soybean plants, promoting sustainable agricultural practices. Results revealed that use of treatment T_4 (Vermicompost at 2.5 kg/ha + *Phosphate solubilizing bacteria* at 2.5 kg/ha) recorded significantly higher plant height, number of leaves, dry weight, fresh weight and T_4 (Vermicompost at 2.5 kg/ha + *Phosphate solubilizing bacteria* at 2.5 kg/ha) was also observed best in CGR (g m^{-2} day^{-1}) and RGR (g g^{-1} day^{-1}). By integrating compost and biofertilizers into cultivation techniques, farmers can improve crop yields, reduce reliance on synthetic fertilizers, and foster environmental sustainability in black soybean production. Further research and adoption of these organic amendments are key to realizing the full potential of compost and biofertilizers in optimizing the growth of black soybean and contributing to a more resilient and productive agricultural ecosystem.

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