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Growth Of Soybean With Spent Mushroom Substrate: A Sustainable Approach

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Abstract:

The experiment aimed to study the effect of Spent Mushroom Substrate (SMS) on plant height and root nodule formation in soybean plants grown in media amended with different levels of SMS, compared to a control group grown in unamended soil.

The results showed a significant positive impact of SMS on both plant height and root nodule formation in soybean. Plants treated with 20 g of SMS demonstrated the greatest increase in height and root nodule development, followed by those treated with 25 g and 15 g, respectively. These findings suggest that SMS can serve as an effective amendment for enhancing plant growth.

Keywords: Spent Mushroom Substrate (SMS), Soybean Root nodules, Treatment, nitrogen, phosphorus, and potassium fertilizer (NPK).

Introduction

Spent mushroom substrate (SMS), also known as Spent Mushroom Compost (SMC), is the soil-like material that remains after mushroom cultivation. According to Chorover (2000), SMS is a valuable source of carbon, nitrogen, and other essential elements. The addition of SMS to nutrient-poor soils has been shown to improve soil texture, water-holding capacity, and nutrient status. Debosz (2002) described SMS as a rich source of organic matter and macro- and micronutrients, which contribute to increased biological activity in the soil.

Zhao *et al.* (2003) found that nutrients, particularly nitrogen, increase the leaf area index in maize when treated with nitrogen sources like SMS, whereas the leaf area index decreased in plants without a nitrogen source, leading to nutrient deficiencies, especially nitrogen. Ogbodo *et al.* (2009) reported a significant increase in plant height in rice when organic amendments were applied, attributing the taller plants and larger leaf index to improved soil fertility. Similarly, Kadiri and Mustapha (2010) observed that the application of SMS in loamy soils significantly increased plant height, stem girth, leaf number, and total

leaf area in cowpea and tomato plants. Additionally, Patil (2024) demonstrated the positive impact of SMS on the growth of mung bean and jowar plants.

The present investigation was conducted to study the effects of SMS as an organic fertilizer on the growth and height of soybean plants.

Material and Method

Collection of Spent Mushroom Substrate (SMS)

Spent mushroom substrate derived from soybean straw was collected after the cultivation of Pleurotus sajor-caju (Patil and Baig, 2023).

Preparation of the Growth Media

Different quantities of NPK fertilizer (5 g) and SMS (5, 10, 15, 20, and 25 g) were weighed. Each amount was thoroughly mixed with 4 kg of nutrient-depleted garden soil, which was collected from a local farm in Naigaon, Dist. Nanded, Maharashtra, India. The mixtures were then placed into five-liter plastic pots and watered adequately.

Soybean Variety

Seeds of the soybean variety MAUS 158 were used in this experiment, sourced from the local market in Naigaon, Dist. Nanded, Maharashtra, India.

Treatments and Experimental Design

The experiment included seven treatments, each replicated three times. The treatments were defined based on varying concentrations of SMS and the application of inorganic fertilizer as a basal nutrient source.

The treatments were as follows

Control (C): No fertilizer or SMS application in the soil (control group).

T1: 5 g of NPK fertilizer in the soil.

T2: 5 g of SMS compost in the soil.

T3: 10 g of SMS compost in the soil.

T4: 15 g of SMS compost in the soil.

T5: 20 g of SMS compost in the soil.

T6: 25 g of SMS compost in the soil.

The experiment was arranged using a randomized complete block design (RCBD) with three replications per treatment. Each pot contained 4 kg of soil and was placed in open-field conditions. The plants were watered regularly, and growth parameters were measured. Plant height (in centimeters) was recorded at 2, 4, 6, 8, 10, and 12-week intervals using a measuring scale.

Result and Discussion:

Table 1. Effect of SMS on growth of soybean plant (height in cm)

	Weeks					
Treatment	2	4	6	8	10	12
5 g SMS	5	8.8	15	23.5	26.8	28
10 g SMS	5	9.2	16	23.6	27.3	28
15 g SMS	5.5	12.2	18.5	25.5	32.7	34.2
20 g SMS	8.5	15.7	27.5	34.8	36.6	37.9
25 g SMS	8.8	15.1	27.7	32.5	35.8	37
NPK 5 g	5.7	10.5	20.6	28.3	29.4	30.5
Untreated	5	8.5	15.8	22.3	25.5	27.5

Table 2. Effect of SMS on number of root nodule formation on Soybean root

	Weeks					
Treatment	2	4	6	8	10	12
5 g SMS	5	7	11	12	13	16
10 g SMS	6	7	12	14	17	17
15 g SMS	6	8	14	18	20	22
20 g SMS	8	14	20	24	26	29
25 g SMS	6	12	18	21	22	24
NPK 5 g	7	10	12	16	18	20
Untreated	3	7	10	12	13	13

Table 1 presents the data on soybean plant height when treated with different proportions of SMS and 5 g of NPK fertilizer. The maximum growth in height (8.5 to 37.9 cm) was recorded from 2 to 12 weeks of plant age when the soil was treated with 20 g of SMS. However, when the SMS proportion was increased from 20 g to 25 g, the plant height decreased, ranging from 8.8 to 37 cm over the same period. In contrast, with the addition of 5 g of NPK fertilizer, the plant height reached 30.5 cm. These findings are consistent with those reported by Patil, S.S. (2024).

Table 2 presents the data on the effect of SMS on root nodule formation in soybean plants. The experiment showed that as the concentration of SMS in the soil increased from 5 g to 20 g, the number of root nodules also increased. However, with the addition of 25 g of SMS, root nodule formation declined. The highest number of root nodules, ranging from 8 to 29, was recorded from 2 to 12-week-old plants treated with 20 g of SMS. In contrast, plants treated with 25 g of SMS produced 6 to 24 nodules over the same period. When treated with 5 g of NPK fertilizer, 12-week-old plants had 20 root nodules.

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