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Research Article

EFFECT OF DIFFERENT BIO-FERTILIZERS ON THE GROWTH AND YIELD OF SESAME, *Sesamumindicum* L

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ABSTRACT

Sesame (*Sesamumindicum* L.) is a flowering plant belonging to the family Pedaliaceae.The present study was carried out to study the effect of different bio-fertilizers on the growth and yield of sesame plant. The bio-fertilizers used were Azospirillum, panchagavya, VAM fungi and a mixture of these three fertilizers. Control plant was maintained without any fertilizer application. In Sesamum, higher germination percentage was observed in seeds soaked in the mixture of bio-fertilizers. The shoot length was found to be more in T3 on the 30th day and T1 on the 75th day. The root length was more in T4 on the 30th day and 45th day. On the 75th day of growth, the root length was higher in T1. The fresh weight and dry weight werefound to be more in T1 on the 75 thday. The number of fruits formed was higher in VAM treated plants on the 75thday.

INTRODUCTION

Sesame (*Sesamumindicum* L.) commonly referred to asbeniseed, is described as the "queen of oilseeds" because of its high oil, protein, calcium and phosphorus (Misari and Iwo, 2000) content. It is an erect glandular pubescent, annual herb branching from the base, growing up to a height of 95cms. Fruits (capsules) are 2-5 cm long and 0.5-2 cm in diameter, quadrangular, oblong, compressed, capsules deeply 4 grooved, dehiscent to half way down. Seeds are many, flat, ovate, obovoid, compressed, black or white (Sani*et al*., 2013; Putnam *et al*., 2003). It iswidely naturalized in tropical regions around the world and is cultivated for its edible seeds, which grow in pods.

Sesame seed is one of the oldest oilseed crops known, domesticated well over 3000 years ago (Ram *et al.,* 1990).Roots and leaves are emollient and a decoction of them forms a good hair-wash which will promote hair growth and will blacken them. The leaves are used to treat cholera, diarrhea, dysentery, headache, malignant tumors and respiratory ailments.Vesicular Arbuscular Mycorrhiza (VAM) forms mutualistic symbiosis with the host plant and a positive effect in the absorption of nutrients, plant health and soil fertility, so it gives a positive effect on plant growth (Ramasamy*et al*., 2011). The main role of VAM is to increase the available soil P and hence P uptake increases by macro symbiont (Toljander, 2006). Mate and Saindanshiv (2018) have undertaken a study to evaluate the role of VAM fungi in the growth of groundnut crop plants.

Panchagavya is one of the most important and beneficial manure. It induces large leaves and enhances high level of photosynthesis. Panchagavya means "mixture of five products (cow dung, cow urine, milk, ghee and curd) of cow. Of these, the three direct constituents are cow dung, urine and milk; and the two derived products are curd and ghee. The consequences of panchagavya application are superior growth, yield and quality of crops. It provides major macronutrients, essential micro nutrients, many vitamins, required amino acids, growth promoting substances and beneficial microorganisms for plant well growth (Vimalendran and Wahab, 2013).

Azospirillum is a free-living, microaerophilic, heterophilic, diazotropic bacteria. It is actively involved in heterotrophic nitrogen fixation in several plants. It is also called as plant-growth-promoting bacterium (PGPB), capable of affecting growth and yield of numerous plant species, many of agronomic and ecological significance.

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MATERIALS AND METHODS

The plant taken for the present study was *Sesamumindicum* L.belonging to the family Pedaliaceae. Growth studies were carried out under different treatments of bio-fertilizers namely Vesicular Arbuscular Mycorrhiza, Panchagavya and *Azospirillum*at different stages of growth of the plants.

Collection of the Seeds

Seeds of *Sesamumindicum* L. were obtained from Tamil Nadu Agricultural University, Coimbatore.

Collection of Biofertilizers

The bio-fertilizers such as VAM, Panchagavya and*Azospirillum* were collected from TNAU,Coimbatore.

METHODS

Pot Culture Experiment

The seeds obtained from TNAU, Coimbatore were soaked in different organic fertilizers overnight. Later, the seeds were sown in pots (30cm×30cm×30cm sized pots) containing red soil and sandy soil in the ratio 1:1. The treated pots were maintained in triplicates. The effect of different organic fertilizers on the growth and yield parameters of *Sesamumindicum* L.were assessed.

The different bio-fertilizer treatments given were:
T_0-Control
T_1- Vesicular Arbuscular Mycorrhiza
T_2-Panchagavya
T_3-*Azospirillum*
T_4- VAM + Panchagavya + *Azospirillum*

Growth Parameters

Plant samples were uprooted carefully on the 30thday, 45thday, 60thday and 75thday and the following growth parameters were measured and recorded for all the treatments.

1. Root length (cm)
2. Shoot length (cm)
3. Number of leaves
4. Fresh weight (gm)
5. Dry weight (gm)

Root Length

The plants were taken from control pot and other treatment pots and washed to get rid off adhering soil particles. Then, the length of the roots was measured with the help of a scale from root collar point to root tip and expressed in centimeter. Ten seedlings were randomly selected from each treatment and their root length was measured using cm scale and recorded as cm/seedling.

Shoot Length

The shoot length of the plants was measured with the help of scale from the shoot collar point to shoot apex and expressed in centimeter. Ten seedlings were randomly selected from each treatment and their shoot length was measured using cm scale and recorded as cm/seedling. Three readings were taken for statistical analysis.

Number of Leaves

The number of leaves present in the uprooted plants were calculated.

Fresh Weight

Fresh weight of the plants was measured with the help of an electronic digital balance and expressed in grams.

Dry Weight

The collected plant materials were kept in hot air oven at 55°C for 24 hours. Then, the dry weight of the plants was measured using an electronic digital balance and expressed in grams.

Yield Parameters

Number of fruits

The number of fruits obtained on the60th day and 75th day were calculated.

Statistical Analysis

The data obtained from various biometric observations were subjected to statistical analysis as per the procedure of Panse and Sukhatme (1978).

RESULTS AND DISCUSSION

The study conducted in the oil-seeded crop *Sesamumindicum* L. showed the following results.

Growth Parameters

Germination

The viable seeds of *Sesamumindicum* L. were soaked overnight in different organic fertilizers and the germination percentage was calculated and tabulated (Table 1).The germination percentage was more (93%) in seeds treated with mixture of organic fertilizers viz., VAM + Panchagavya + *Azospirillum*.

Shoot Length

The growth parameters measured in terms of shoot length showed more length in T_3 (23.83 ± 0.76 cm) on the 30th day (Table 2). On the 45th day and 75th day, the shoot length was observed to be more in T_1 and the values were 36.23 ± 0.25 cm and 50.73 ± 1.17 cm respectively. On the 60th day of the growth, the shoot length was more in T_4 (46.00 ± 2.18 cm) (Plate 1 to 4).

Table 1 Germination percentage of *Sesamumindicum* L**.**

Treatments	Percentage
T_0	89
T_1	87
T_2	89
T_3	89
T_4	**93**

Table 2 Shoot length (cm) of *Sesamumindicum* L. at different stages of growth

Treatments	30th day	45th day	60th day	75th day
T_0	14.07 ± 0.90	25.40 ± 0.53	36.03 ± 3.85	38.12±0.32
T_1	22.00 ± 1.00	**36.23 ± 0.25**	44.93 ± 1.10	**50.73±1.17**
T_2	18.67 ± 0.58	28.50 ± 0.50	34.90 ± 0.36	47.90±0.36
T_3	**23.83 ± 0.76**	24.50 ± 0.50	44.20 ± 0.35	44.37±0.32
T_4	21.00 ± 1.00	34.17 ± 0.29	**46.00 ± 2.18**	48.10±0.10
SEd	0.7052	0.3515	1.6757	0.4789
CD(P<0.05)	1.5713	0.7832	3.7338	1.0670

Values are given as mean ± SD from 3 samples in each group

Plate 1 Growth of *Sesamumindicum* L. on the 30th day

Plate 2 Growth of *Sesamumindicum* L. on the 45th day

Plate 3 Growth of *Sesamumindicum* L. on the 60th day

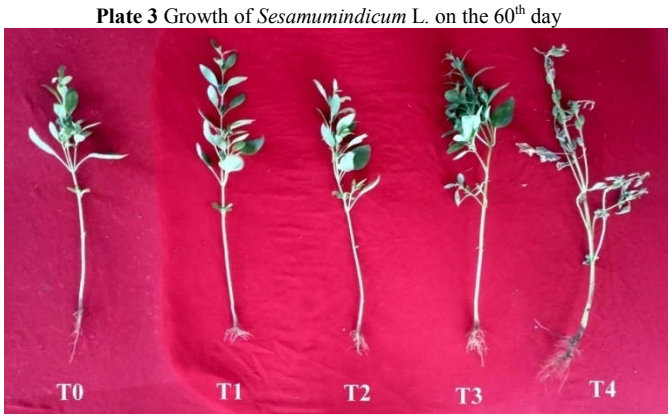

Plate 4 Growth of *Sesamumindicum* L. on the 75th day

Root Length

The root length of *Sesamum* at different stages of the growth was measured and tabulated (Table 3). The root length was more in T_4 on the 30th day and 45th day and the value observed was 6.43 ± 0.40 cm. On the 60th day, control plant showed a higher root length of 5.73 ± 0.646 cm. On the 75th day of growth, the root length was higher in T_1 (6.47 ± 0.25 cm).

Singh *et al*. (2018) have carried out studies on the use of panchagavya for the sustainable production of vegetable crops. Panchagavya could be used as an organic growth- promoter for small and marginal vegetable growers (Boomathi *et al*., 2006).

Shekh *et al.* (2018) have proved that foliar spraying of panchagavya and seaweed extract is as good as soil application of FYM.

Studies carried out by Gayathri *et al*. (2015) on the use of different concentration of panchagavya on the vegetable crops have shown that 8% concentration could bring about change in the growth of plants.

Earlier Nahar *et al*. (2008) have shown an increase in growth and yield of sesame in response to N fertilizer application. A significant increase in all the investigated morphological characters was obtained as an effect of bio-fertilizer in sesame plants (Boghdady *et al*., 2012).

Fresh Weight

The growth parameter in terms of fresh weight of the plant was measured by uprooting the whole plant and tabulated (Table 4). The fresh weight was found to be more in T_3 on the 30th day and 60th day and the values were 1.78 ± 0.20 g and 5.34 ± 0.55 grespectively. On the 45th day, the fresh weight of the plant was found to be more in plants treated with the mixture of organic fertilizers (3.56 ± 0.40 g). On the 75th day, the fresh weight was observed to be more in T_1 (8.07 ± 0.15 g).

Dry Weight

The uprooted *Sesamum*plants from control pot and bio-fertilizer treated pots, after measuring the fresh weight was kept in Hot air oven for calculating the dry weight. The dry weight was calculated and tabulated (Table 5). The dry weight was more in T_3 (0.90 ± 0.31 g)

Table 3 Root length (cm) of *Sesamumindicum*L. at different stages of growth

Treatments	30th day	45th day	60th day	75th day
T_0	2.83 ± 0.29	4.37 ± 0.32	**5.73±0.646**	3.03±0.15
T_1	3.17 ± 0.86	6.17 ± 0.35	5.03±0.15	**6.47±0.25**
T_2	3.50 ± 0.50	4.43 ± 0.21	4.97±0.35	3.03±0.15
T_3	4.43 ± 0.40	4.83 ± 0.29	3.93±0.31	4.43±0.21
T_4	**6.43 ± 0.40**	**6.43 ± 0.40**	4.40±0.10	5.10±0.26
SEd	0.4326	0.2625	0.2974	0.1726
CD(P<0.05)	0.9638	0.5848	0.6626	0.3845

Values are given as mean ± SD from 3 samples in each group

Table 4 Fresh weight (g) of *Sesamumindicum*L. at different stages of growth

Treatments	30th day	45th day	60th day	75th day
T_0	0.71 ± 0.28	1.65±0.17	4.33 ± 0.15	5.50 ± 0.10
T_1	1.30 ± 0.29	2.76±0.12	3.57 ± 0.21	**8.07 ± 0.15**
T_2	1.66 ± 0.38	1.35±0.17	3.03 ± 0.04	4.43±0.15
T_3	**1.78 ± 0.20**	2.57±0.29	**5.34 ± 0.55**	3.10±0.30
T_4	1.48 ± 0.18	**3.56±0.40**	5.03 ± 0.15	5.40±0.10
SEd	0.2241	0.2055	0.2293	0.6618
CD(P<0.05)	0.4993	0.4578	0.5108	1.4746

Values are given as mean ± SD from 3 samples in each group

Table 5 Dry weight (g) of *Sesamumindicum* L. at different stages of growth

Treatments	30th day	45th day	60th day	75th day
T_0	0.09 ± 0.01	0.13±0.15	0.21 ± 0.04	0.45±0.18
T_1	0.58 ± 0.34	0.17±0.04	0.66 ±0.12	**1.05±0.17**
T_2	0.25 ± 0.12	0.94±0.52	0.66 ±0.12	0.80±0.13
T_3	**0.90 ± 0.31**	1.18±1.06	0.44 ±0.18	0.42±0.16
T_4	0.19 ± 0.06	**1.74±1.26**	**1.07 ±0.06**	0.74±0.11
SEd	0.1759	0.6334	0.0927	0.1230
CD(P<0.05)	0.3920	1.4114	0.2066	0.2740

Values are given as mean ± SD from 3 samples in each group

on the 30th day of growth. On the 45th day and 60th, the dry weight was higher in T_4 and the values were 1.74 ± 1.26 g and 1.07 ± 0.06 g respectively. On the 75th day, the dry weight was found to be more in T_1 (1.05 ± 0.17 g).

Number of Leaves

The number of leaves of *Sesamum* during different days of growth was measured and tabulated (Table 6). The leaf number was more in T_3 on the 30th day (10.33 ± 0.58) and 45th day (14.00 ± 1.73). On the 60th day, the number of leaves was found to be more in T_4 (16.33 ± 1.53). On the 75th day, control plants showed more number of leaves (21.33 ± 0.58).

Girth of the Stem

The girth of the stem was measured on the 45th, 60th and 75th day and tabulated (Table 7). The girth was found to be more on all the days in T_4 ie., plants treated with VAM + Panchagavya + *Azospirillum*).

Yield Parameter

Number of Fruits

The yield of *Sesamum* was calculated by counting the number of fruits formed and tabulated (Table 8). The fruits started forming on the 60th day. On the 60th day, control plant showed more fruit formation (5.33 ± 0.58). On the 75th day, the number of fruit was more in control as well as plants treated with VAM fungi (8.67 ± 0.58).

Table 6 Number of leaves in *Sesamumindicum* L. at different stages of growth

Treatments	30th day	45th day	60th day	75th day
T_0	5.67 ± 0.58	9.67±0.58	11.00 ± 1.00	**21.33±0.58**
T_1	8.33 ± 0.58	10.00±0.00	14.67 ± 0.58	12.00±1.00
T_2	7.67 ± 0.58	9.33±0.58	12.00 ± 1.00	8.67±0.58
T_3	**10.33 ± 0.58**	**14.00±1.73**	13.67 ± 0.58	7.67±0.58
T_4	7.67 ± 0.58	11.00±1.00	**16.33 ± 1.53**	14.67±0.58
SEd	0.4714	0.7888	0.8165	0.5578
CD(P<0.05)	1.0504	1.7576	1.8193	1.2428

Values are given as mean ± SD from 3 samples in each group

Table 7 Girth (cm) of the stem of *Sesamumindicum*L. at different stages of growth

Treatments	45th day	60th day	75th day
T_0	1.17±0.15	1.43 ± 0.21	0.95±0.06
T_1	1.48±0.21	1.57 ± 0.06	1.17±0.06
T_2	1.00±0.10	1.43 ± 0.12	1.00±0.10
T_3	1.17±0.15	1.83 ± 0.06	0.70±0.20
T_4	**1.77±0.15**	**2.10 ±0.36**	**1.27±0.06**
SEd	0.1700	0.1606	0.0894
CD(P<0.05)	0.3787	0.3577	0.1993

Values are given as mean ± SD from 3 samples in each group

Table 8 Number of Fruits of *Sesamumindicum*L. at different days

Treatments	60th day	75th day
T_0	**5.33 ±0.58**	**8.67±0.58**
T_1	4.00 ±0.00	**8.67±0.58**
T_2	4.33 ±0.58	6.33±0.58
T_3	4.67 ±0.58	6.67±0.58
T_4	2.33 ±0.58	5.33±0.58
SEd	0.4216	0.4714
CD(P<0.05)	0.9395	1.0504

Values are given as mean ± SD from 3 samples in each group

Rao *et al*. (2015) have carried out a study on comparative yield analysis of chilli by application of vermicompost and panchagavya and showed enhancement in the growth parameter of chilli plant.

The inoculation of consortia of three Bio-fertilizers; *Azospirillum*, *Pseudomonas fluorescens* and VAM was efficient in increasing the growth of Cashew graft under nursery conditions (Shankarappa*et al*., 2017).Now-a-days, Bio-fertilizers have emerged as a highly potent alternative to chemical fertilizers due to their eco-friendly, easy to apply, non- toxic and cost effective nature (Mazid and Khan, 2014).

The use of *Azospirillum*, Panchagavyaand VAM fungi improves the growth potential of the crop plants. It also increases the yield and maintenance of soil health for sustainableagriculture. However, quantitative understanding of the ecological factors that control the performance of biological N_2 fixation systems of the bacterium in crop fields is essential for promotion and successful adoption of the bio-fertilizer production technology.

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