The Pharma Innovation Journal 2021; 10(12): 1380-1383

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2021; 10(12): 1380-1383

www.thepharmajournal.com
Received: 05-09-2021
Accepted: 10-11-2021

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Studies on growth and yield of Sabja (*Ocimum basilicum*) influenced by different Organic manures and Biofertilizers

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Abstract
An investigation was carried out at Medicinal and Aromatic Plant Research Station, Rajendranagar, Sri Konda Laxman Telangana State Horticultural University, Mulugu (V & M), Siddipet Dist., Telangana State during the period of 2017-20 to determine the studies on growth and yield of Sabja (*Ocimum basilicum*) influenced by different organic manures and biofertilizers. The experiment consisted 9 treatment combinations *viz*. T_1- Control(without manures and biofertilizers), T_2- FYM 5 t/ha, T_3- Vermicompost 2.0 t/ha, T_4- Neem cake 1.5 t/ha, T_5- Biofertilizer PSB @ 10kg/ha, T_6- Azotobactor @10 kg/ha, T_7 - FYM 5 t/ha + PSB 10 kg/ha + Azotobactor 10 kg/ha, T_8 - Vermicompost 2 t/ha + PSB 10 kg/ha + Azotobactor 10 kg/ha, T_9- Neem cake 1.5 t/ha + PSB 10 kg/ha + Azotobactor 10 kg/ha which was laid out in randomized block design (RBD) with three replications. The result revealed that application of Vermicompost 2 t/ha + PSB 10 kg/ha + Azotobactor 10 kg/ha gave maximum plant height (1.22 m), no. of primary branches (23.12), fresh herbage yield (19.20 t/ha), seed yield (3.20 t/ha) and oil yield (188.26 kg/ha) for growth and yield of sabja.

Keywords: Sabja, *Ocimum basilicum*, biofertilizers, Azotobacter, Vermicompost, organic manures

Introduction
Sabja or Sweet basil (*Ocimum basilicum* L.) is one of the important plant which is grown worldwide for its medicinal, flavoring and industrial properties. Sweet basil belonging to the family Laminaceae and is one of the most important species of the *Ocimum* genus, being a source of essential oil. This genus has more than 30 species. Among the species of this genus, *Ocimum basilicum* has the most economic importance and is grown and utilized throughout the world (El-Gendy *et al*., 2001) [8]. Traditionally, sweet basil has been used as a medicinal plant for various ailments, such as headaches, coughs, diarrhea, constipation, warts, worms and kidney malfunction, antispasmodic, stomachicum, carminative, expectorant, antimalarial, febrifuge and stimulant (Simon *et al*., 1999) [16]. Basil has shown antioxidant, antimicrobial and antitumour activities due to its phenolic acids and aromatic compounds (Gutierrez *et al*., 2008) [10].
The addition of organic fertilizers to agricultural soils has beneficial effects on crop development and yields by improving soil physical and biological properties (Zheljazkov and Warman, 2004) [23]. Organic manures can serve as alternative to mineral fertilizers for improving soil structure (Dauda *et al*., 2008) [6] and microbial biomass (Suresh *et al*. 2004) [19]. Vermicompost is stable granular organic matter, when added to clay soils loosen the soil, provides the passage for the fast entry of air and water. Vermicompost prepared with the help of earthworms. Earthworms consume large quantities of organic matter excrete soil as casts which have several plant growth promoters, enzymes rich in plant nutrients, beneficial bacteria and mycorrhiza. Superiority of vermicompost over FYM in improvement of growth related character might be attributed to its nutritional richness, quick mineralization, more availability of nitrogen and other plant nutrients.
Bio-fertilizers are reasonably safer to the environment than chemical fertilizers consequently, it causes a reduction in environmental pollution. Bio fertilizers are microbial inoculants consisting of living cells of micro-organism like bacteria, algae and fungi alone or combination which may help in increasing crop productivity. Bio fertilizers can influence plant growth directly through the production of phytohormones such as gibberellins, cytokinins and IAA that act as growth regulators and indirectly through nitrogen fixation and production of bio-control agents against soil-borne Phytopathogens and consequently increase formation of

metabolites which encourage the plant vegetative growth and enhance the meristematic activity of tissues to produce more growth (Glick, 2003 and Ahmed and Kibret, 2014) [9, 1]. Among Biofertilizers, beneficial bacteria are *Azotobacter*, *Azospirillum*, *Rhizobium*, symbiotic fungi *Mycorrhizae*; they are essential in crop production. Biofertilizers improve plants' resistance to an unfavorable environment (Sneha *et al*, 2018) [17]. A group of bacteria which can be along with plant belong to Azospirillum, Azotobacter, Pseudomonas, Bacillus species (Tilak *et al.*, 2005) [20].

P-solubilizers are biofertilizers (PSB) which solubilize phosphorus in soil and make it available for plants. They are known to improve growth, yield as well as productivity of crops. Maintenance of nutrients in the soil is most important for healthy plant growth (Devi and Sumathy, 2017) [7].

Azotobacteris a free living (non-symbiotic), aerobic, nitrogen fixing organism and this gram negative bacteria belongs to family Azotbacteriaceae. Azotobacterprefers to thrive mainly in soil close to roots. For their multiplication the food is derived either form dead organic matter present in the soils or from root exudates excreted by the developing roots. In this routine course of activity they fix atmospheric nitrogen. Thus released nitrogen is quickly absorbed by the plant. Subba Rao (1993)[18] reported that *Azotobacter*cells are not usually present on the rizoplane (root surface) but are in abundant in the rhizosphere (the soil immediately surrounding roots.) Yadav and Chaudhauri (1999) [22] reported that *Azotobacters*, besides fixing the atmospheric nitrogen, are also known to synthesize and secrete auxins, vitamins, growth promoting substances and antifungal antibiotics.

Reza *et al.* (2015) [14] claimed that substituting chemical fertilizers by organic manures and biofertilizers, could consider as a good farming system improve the ecosystem and soil health as a step for achieving sustainability in agriculture.

The objective of the present study was to study the effect of organic manures and bio-fertilizers on vegetative growth and oil yield of *Ocimum basilicum* L.

Material and Methods

The experiment entitled"Studies on growth and yield of Sabja (*Ocimum basilicum*) influenced by different Organic manures and Biofertilizers" was carried out for three years (2017-2020) at Medicinal and Aromatic Plant Research Station Rajendranagar, SKLTSHU, Mulugu, Siddipet district.The meteorological data was collected from the Agricultural Research Institute, Rajendranagar for the experimental period of three years (2017-2020). It comes under sub tropical zone and is situated at latitude of $17^{0}30^{1}$ N and longitude of $78^{0}42^{1}$ E. It was normal weather data on total rainfall, maximum and minimum temperature, relative humidity, that prevailed during the period of experimentation. The land used under the experimental layout was red with good drainage and low water holding capacity with uniform texture. The soil characteristics were, pH 7.20, electrical conductivity 0.67 dSm-1, organic carbon 0.32%, Available Nitrogen 120 kg/ha, Available Phosphorus 48 kg/ha and Available Potassium 60 kg/ha. Good soil fertility management ensures adequate nutrient availability to plant and improve their growth.

The experiment was designed in Randomised Block Design with three replications with the spacing of 45*45m. Complete dosage of organic manures like FYM, Vermicompost, Neem cake and biofertilizers like Azotobacter, PSB were applied at the time of final ploughing.

The plant height was recorded before each harvest from ground level to the tip of plant with the help of measuring tape and was expressed in meters (m)**.** Fresh herbage yield was estimated by harvesting the crop with sickle 15cm above the ground level and immediately weighted for obtaining plot yield. Then plot yield was transformed to yield per hectare which was expressed in terms of tonnes. Seeds are collected by threshing to obtain seed yield which is expressed in terms of tonnes. Fresh leaves essential oil was estimated using Clevenger's apparatus (Clevenger, 1928) [3].

Results and Discussion

Growth Parameters

The plant height was significantly influenced by organic manures and biofertilizers at all stages of crop growth (Table 1). The maximum plant height (1.22 m) was recorded with treatment T_8 having Vermicompost 2 t/ha + PSB 10 kg/ha + Azotobactor 10 kg/ha which was on par (1.16 m) with T_7 having FYM 5t/ha + PSB 10 kg/ha + Azotobactor 10 kg/ha. With increase in the availability of nutrients considerably resulting in positive effect on growth parameters. This increased plant height may be due to increased uptake of primary nutrients, which might have enhanced cell division and cell elongation. These results are in conformity with the findings of Kumaran *et al.*, (1998) [12]. The increase in height of plants and number of leaves plant^{-1} with the application of Azotobacter and Vermicompost has also been reported by Nazir *et al.* (2006) [14] and Tripathi *et al.* (2010) in strawberry.

A significant difference was observed on number of primary branches per plant due to the application of organic manures and biofertilizers (Table 1). The maximum number of branches (23.12) was recorded with T_8 having Vermicompost 2 t/ha + PSB 10 kg/ha + Azotobactor 10 kg/ha. Significant increase in number of primary branches per plant was recorded due to increased absorption of nutrients which resulted in increase in the synthesis of carbohydrates, chlorophyll content and increased activity of hormones produced by Phosphate solubilizing bacteria (PSB). The PSB root treatment might have increased phosphate availability in the soils which in turn helped better proliferation of root growth and uptake of other nutrients to a greater extent. These results are in agreement in brinjal with those of Prabhu *et al.* (2003) [13] and Wange and Kale (2004) [12].

In this investigation, days taken for initiation of flowering was significantly influenced by application of organic manures and bio fertilizers. Among the treatments, T8having Vermicompost 2 t/ha + PSB 10 kg/ha + Azotobactor 10 kg/ha application recorded minimum number of days to flowering (40 days) The induction of early flowering was due to better nutritional status of the plants. Increased production of leaves might have helped to elaborate more photosynthetic and induced flowering, thus effecting early initiation of flower bud.

In the present study, days to first harvest was significantly influenced by application of organic manures and bio fertilizers. Among the treatments, T8having Vermicompost 2 t/ha + PSB 10 kg/ha + Azotobactor 10 kg/ha application recorded minimum number of days to attain first harvest (84.5 days). The reduction in the number of days to first harvest due to combined application of organic manures and biofertilizers may be attributed due to added supply of nutrients and proliferous root system developed early under balanced nutrient application resulting in better absorption of water and nutrients with improved physical environment. The results are

in conformity with Jose *et al.* (1998).

Yield parameters

Fresh herbage yield per hectare showed a significant difference due to the application of organic manures and biofertilizers (Table 1). The maximum fresh herbage yield (20.70 t/ha) was recorded with T_8 having Vermicompost 2 t/ha + PSB 10 kg/ha + Azotobactor 10 kg/ha which was on par (19.20/ha) with T_7 having FYM 5 t/ha + PSB 10 kg/ha + Azotobactor 10 kg/ha. The content of soil nutrient enhanced with application of organic manures, that had positive effect on the growth parameters, herbage and oil yield (Khalid *et al.* 2006) [11].

Seed yield significantly influenced by the application of organic manures and biofertilizers are presented in Table-1. The maximum seed yield (3.20 t/ha) was recorded with T_8 having Vermicompost 2 t/ha + PSB 10 kg/ha + Azotobactor 10 kg/ha which was on par (3.10 t/ha) with T_7 having FYM 5t/ha + PSB 10 kg/ha + Azotobactor 10 kg/ha. Baviskar *et al.* (2011) [2] reported that the maximum fruit weight (125.87 g) and number of fruits per plant (1569.33) was recorded when the plants treated with combined application of 250 g PSB + 250 g *Azotobacter* per plant in sapota.

The significant difference in oil yield per hectare was noticed due to different treatments. The data on oil yield per hectare pertaining to different treatments are presented in Table- 1. Significantly highest oil yield per hectare (188.26 kg/ha) was recorded in T8 having Vermicompost 2 t/ha + PSB 10 kg/ha + Azotobactor 10 kg/ha. Oil production is the most important parameter in basil farming. Integrated nutrient management improve the chemical, physical and biological soil proprieties that reflect positively on plant growth and oil yield (Patra *et al*. 2000). Roshanpour *et al.,* (2014) studied the effect of biofertilizers on quantity and quality of basil essential oil content. The present results have shown that the highest essential oil content and the minimum caryophyllene oxide in essential oil were obtained after applying each three biofertilizers *Azotobacter chroococcum, Azospirillum lipoferum, Bacillus circulans.*

Table 1: Studies on growth and yield of Sabja (*Ocimum basilicum*) influenced by different Organic manures and Biofertilizers

Treatments	Plant height (m)	No. of primary branches/plant	Days taken for initiation of flowering	Days to first harvest	Freshher bage Yield(t/ha)	Seed yield/ plant(g/plant)	Seed yield/ha (t/ha)	Oil yield (kg/ha)
T_1	0.92	17.20	46	94.2	8.86	61.02	2.18	120.15
T_2	1.08	20.78	42	90.2	17.79	70.31	2.80	160.70
T_3	1.10	20.90	41	88.0	18.70	74.12	2.91	170.70
T_4	0.90	18.91	45	93.0	14.74	63.12	2.20	142.90
T_5	1.01	19.12	45	92.69	14.32	64.32	2.40	155.20
T_6	1.00	19.01	44	91.5	13.90	63.19	2.35	150.17
T_7	1.16	21.45	41	88.0	19.20	78.12	3.10	180.79
T_8	1.22	23.12	40	84.5	20.70	80.01	3.20	188.26
T_9	1.02	20.10	42	91.0	16.50	68.12	2.80	158.32
SEM+-	0.65	1.24	1.08	1.18	1.30	2.53	0.04	15.17
C.D 5%	0.11	1.08	0.92	0.34	2.85	2.10	0.1	8.2

T_1- Control(without manures and biofertilizers)
T_2- FYM 5 t/ha
T_3- Vermicompost 2.0 t/ha
T_4- Neem cake 1.5 t/ha
T_5- Biofertilizer PSB @ 10kg/ha
T_6- Azotobactor @10 kg/ha
T_7 - FYM 5 t/ha + PSB 10 kg/ha + Azotobactor 10 kg/ha
T_8 - Vermicompost 2 t/ha + PSB 10 kg/ha + Azotobactor 10 kg/ha
T_9- Neem cake 1.5 t/ha + PSB 10 kg/ha + Azotobactor 10 kg/ha

Conclusion

From this investigation, the highest fresh herbage yield, seed yield and oil yield was recorded in the treatment T_8 having Vermicompost 2 t/ha + PSB 10 kg/ha + Azotobactor 10 kg/ha. From the above results, it may be stated that the practice of using organic manures and biofertilizers in integrated manner is beneficial in improving the growth and yield of sabja.

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