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## Influence of organic manures and inorganic fertilizers on growth and yield parameters of sweet basil (*Ocimum basilicum* L.)

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### Abstract

A study was conducted to investigate the effect of organic manures and inorganic fertilizers on growth and yield parameters of sweet basil (*Ocimum basilicum* L.). The research was conducted during the early summer season of 2019 with ten treatments which has the organic manures and inorganic fertilizers in combination and in alone in randomized complete block design with three replications. The experiments results showed that organic manures and inorganic fertilizers have a significant effect on growth and yield parameters of sweet basil. The treatment *i.e.* 50% RDN through urea + 50% RDN through poultry manure recorded the higher plant height (79.67 cm), number of primary branches per plant (21.11), number of leaves (1393), fresh herbage yield per plant (701.21 g) and per hectare (36.43 t), dry herbage yield per plant (145.18 g) and per hectare (7.54 t) and oil yield (168.52 kg/ha) followed by 50% RDN through urea + 50% RDN through neem cake.

**Keywords:** Sweet basil, organic manures, inorganic fertilizers, growth, yield

### Introduction

*Ocimum basilicum* L. known as sweet basil/ french basil occurs in nature as a tetraploid (2n=48). The main centres of diversity in this genus are in Africa, South America (Brazil) and Asia and grow mainly in France, Italy, Bulgaria, Egypt, Hungary, South America, Comoro Islands, Thailand, India, Haiti and Guatemala. In India, Basil is cultivated over an area of 25,000 ha and it accounts for annual production of about 250-300 tonnes of oil and the cultivation is mainly concentrated in Uttar Pradesh (Smitha *et al.*, 2014) [19]. The aromatic leaves contain essential oil used in food, medicines, perfumery and cosmetic industries. The major constituents in *Ocimum* oil include linalool, geraniol, citral, eugenol, methyl chavicol, thymol, methyl cinnamate. As a herb, it is used in the indigenous system of medicines owing to its antifungal, antibacterial and insecticidal properties. The leaves and inflorescences of sweet basil are used as a carminative, galactagogue, stomachic and antispasmodic in folk medicine (Pragya *et al.*, 2016) [15].

Organic fertilizers have been known to improve the biodiversity (Enwall *et al.*, 2005; Birkhofer *et al.*, 2008) [10, 3] and may prove a large depository for excess carbon dioxide (Lal, 2004). Organic fertilizers in comparison of the chemical fertilizers have lower nutrient content and are slow releasing but they are as effective as chemical fertilizers over longer periods of use (Naguib, 2011) [13]. Organic farming has time and again proved that it does not only resource-conserving but also productive. Such viable alternative includes vermicompost, FYM, poultry manure and neem cake, *etc.* These organic farming practices work in harmony with nature making use of various indigenously available resources, chief of them being soil, faunal components which establish synchrony in the nutrient cycle. In the present study, some organic manures along with inorganic fertilizer practices were compared with chemical fertilizer application on sweet basil growth and yield.

### Material and Methods

The present study was carried out at College of Horticulture, Venkataramannagudem, Andhra Pradesh from January to April of 2019 with ten treatments *Viz.*, T<sub>1</sub> (75% RDN through

urea + 25% RDN through FYM), T<sub>2</sub> (75% RDN through urea + 25% RDN through vermicompost), T<sub>3</sub> (75% RDN through urea + 25% RDN through neem cake), T<sub>4</sub> (75% RDN through urea + 25% RDN through poultry manure), T<sub>5</sub> (50% RDN through urea + 50% RDN through FYM), T<sub>6</sub> (50% RDN through urea + 50% RDN through vermicompost), T<sub>7</sub> (50% RDN through urea + 50% RDN through neem cake), T<sub>8</sub> (50% RDN through urea + 50% RDN through poultry manure), T<sub>9</sub> (25% RDN through FYM + 25% RDN through vermicompost + 25% RDN through neem cake + 25% RDN through poultry manure) and T<sub>10</sub> (100% RDF (control) (125:75:60 NPK kg/ha). Treatments were replicated thrice in a randomized complete blocks design. Organic fertilizer was applied by broadcasting uniformly in rows to individual plots as per the treatment before one month of transplanting. The inorganic NPK nutrients were supplied in the form of straight fertilizers like urea (125 kg N ha<sup>-1</sup>), single superphosphate (75 kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup>) and muriate of potash (60 kg K<sub>2</sub>O ha<sup>-1</sup>). One-fourth of N and the entire dose of K<sub>2</sub>O and P<sub>2</sub>O<sub>5</sub> were applied as basal application. The remaining dose of 3/4<sup>th</sup> nitrogen was applied in two equal splits at 25 and 50 days after transplanting.

Each experimental plot size was 2.7 m long and 1.8 m wide with a spacing of 30 cm between the plants and 45 cm between the rows. There was a space of 30 cm between the plots and 60 cm between replications. Basil variety Cim-Saumya (CIMAP) was sown in plug trays with 99 cells. The plug trays were filled with a mixture of coco peat, vermiculite and perlite were used in (2:1:1) ratio. Thirty five days old healthy and uniformly rooted seedlings of sweet basil were transplanted to the field. Weeding was done manually and flood irrigation was given in intervals of 3-4 days in initial stages and subsequently, irrigation was given depending on the soil moisture condition. The crop was harvested at ground level during the last week of April 2019. Fresh herbage weight from each plot was converted to per hectare and it was expressed in tones (t). To determine the essential oil content (%), a sample of 100 g of basil fresh herb from each plot were collected and mixed with 300 ml distilled water and then were subjected to hydrodistillation for 3 h using a Clevenger apparatus (Clevenger, 1928) [6]. The data was analysed as per ANOVA outlined by Panse and Sukhatme (1985) [14]. Statistical significance was tested by 'F' value at 5 per cent level of significance. The critical difference at 0.05 levels was worked out for the significant effects.

## Results and discussion

### Growth parameters

Growth parameters of sweet basil differed significantly due to application of different levels of RDN through poultry manure along with inorganic fertilizer (Table 1).

### Plant height (cm)

Data presented in Table 1 revealed that application 50% RDN through urea + 50% RDN through poultry manure *i.e.* T<sub>8</sub> recorded significantly higher plant height (79.67 cm) and it was on par with T<sub>7</sub> *i.e.* 50% RDN through urea + 50% RDN through neem cake (78.97 cm). However, T<sub>9</sub> *i.e.* 25% RDN through FYM + 25% RDN through vermicompost + 25% RDN through neem cake + 25% RDN through poultry manure recorded the lowest plant height of 73.99 cm. Significant increase in plant height in the present study might be due to the differential response of nutrient combinations ensured ready availability of nutrients for initial requirement through the inorganic source and at slow pace as long term availability through organic source which has a role in cell division, other

physiological processes and resulted in higher plant height. Similar report has been reported by Choudhary *et al.* (2011) [15] in fenugreek, the application of 50% RDN through organic source + 50% RDN through inorganic was found superior over sole application of 100% RDN through organic or inorganic sources, while by only poultry manure application has been reported by Ahmad *et al.* (2011) [2] in marjoram, Rahman *et al.* (2014) [16] in tulsi and pudina.

### Number of primary branches per plant

The application of 50% RDN through urea + 50% RDN through poultry manure (T<sub>8</sub>) recorded the maximum number of primary branches (21.11) and it was on par with T<sub>7</sub> *i.e.* 50% RDN through urea + 50% RDN through neem cake (20.44) and T<sub>6</sub> *i.e.* 50% RDN through urea + 50% RDN through vermicompost (19.78). However, T<sub>9</sub> *i.e.* 25% RDN through FYM + 25% RDN through vermicompost + 25% RDN through neem cake + 25% RDN through poultry manure recorded the less number of primary branches per plant (17.11). Present result might be attributed to the readily available nutrients through inorganic fertilizers and effect of organic fertilizer that improves physical, chemical, and biological properties of soil *i.e.* increasing soil organic matter, cation exchange capacity, water holding capacity and availability of mineral nutrients and this in turn, increases number of primary branches and also this can be attributed to the reason that the taller plants could bear more number of branching nodes. These results are in harmony with those obtained by Soumya (2008) [20] in stevia, Dadiga and Jain (2017) [7] in coriander.

### Number of secondary branches per plant

The highest number of secondary branches (85.89) was recorded in T<sub>7</sub> *i.e.* 50% RDN through urea + 50% RDN through neem cake and followed by T<sub>8</sub> *i.e.* 50% RDN through urea + 50% RDN through poultry manure (85.78), T<sub>6</sub> *i.e.* 50% RDN through urea + 50% RDN through vermicompost (84.33), whereas T<sub>9</sub> *i.e.* 25% RDN through FYM + 25% RDN through vermicompost + 25% RDN through neem cake + 25% RDN through poultry manure had recorded the least number of secondary branches (63.67). The number of secondary branches per plant was influenced significantly concerning the combined application of organic manures and inorganic fertilizers which might be due to the increased rates of photosynthesis and photosynthates. This character is also found to be related to the endogenous hormonal level and apical dominance in the plant. These results are in accordance with the findings of Shivanna *et al.* (2011) [18] in kalmegh, Yeboah *et al.* (2012) [22] in *Artemisia annua*, Dadiga and Jain (2017) [7] in coriander and Veena *et al.* (2017) [21] in chilli.

### Number of leaves

The application of 50% RDN through urea + 50% RDN through poultry (T<sub>8</sub>) manure had recorded the significantly higher number of leaves (1393) which was on par with T<sub>7</sub> *i.e.* 50% RDN through urea + 50% RDN through neem cake (1369.89) and T<sub>6</sub> *i.e.* 50% RDN through urea + 50% RDN through vermicompost (1300.34). However, T<sub>1</sub> *i.e.* 75% RDN through urea + 25% RDN through FYM had recorded the less number of leaves (986.89). The number of leaves is dependent on the plant height, number of nodes and also on the number of branches both primaries and secondaries arising on the main shoot of the plant. More number of branches per plant is likely to produce more leaves. These results are in agreement with the findings of Rahman *et al.*

(2014) <sup>[16]</sup> in tulsi and pudina, Chamroy *et al.* (2015) <sup>[4]</sup> in chilli and Ihenacho *et al.* (2015) <sup>[11]</sup> in turmeric.

### Leaf area per plant (cm<sup>2</sup>)

The application of 50% RDN through urea + 50% RDN through poultry (T<sub>8</sub>) manure had recorded the highest leaf area per plant (15717.82 cm<sup>2</sup>) which was on par with T<sub>7</sub> *i.e.* 50% RDN through urea + 50% RDN through neem cake (15064.96 cm<sup>2</sup>) and T<sub>1</sub> *i.e.* 75% RDN through urea + 25% RDN through FYM had recorded the lowest leaf area per plant (7625.28 cm<sup>2</sup>). The significant increase in leaf area per plant in plot treated with poultry manure along with inorganic fertilizer over the rest of the treatments could be due to release of adequate quantity of nutrients at appropriate times for better production of number of photosynthetically active leaves per plant, production of carbohydrates and its utilization in buildup of cells and their elongation. These results were in agreement with the findings of Shivanna *et al.* (2011) <sup>[18]</sup> in kalmegh and El-Sayed *et al.* (2018) <sup>[8]</sup> in lemongrass.

### Plant spread (cm<sup>2</sup>)

The application of 50% RDN through urea + 50% RDN through poultry (T<sub>8</sub>) manure had recorded significantly the highest plant spread (3300.2 cm<sup>2</sup>) which was on par with T<sub>7</sub> *i.e.* 50% RDN through urea + 50% RDN through neem cake (3169.6 cm<sup>2</sup>). However, T<sub>1</sub> *i.e.* 75% RDN through urea + 25% RDN through FYM had recorded the lowest plant spread (2016.8 cm<sup>2</sup>). Plant spread increased significantly, which may be due to the robust nature of plant growth at this level as is evident by more number of branches and leaves. The improvement in morphological parameters under the influence of poultry manure application with inorganic fertilizers might have resulted in the larger canopy. Present findings were in agreement with the findings of Shivanna *et al.* (2011) <sup>[18]</sup> in kalmegh as the combined application of poultry manure and inorganic fertilizers increased the number of branches and plant spread.

### Yield parameters

Yield parameters of sweet basil differed significantly among all the treatments for all yield characters due to the application of different levels of RDN through poultry manure along with inorganic fertilizer (Table 2).

### Fresh herbage yield

Significant differences were recorded among the different treatments to fresh herbage yield per plant and hectare. The T<sub>8</sub> which received 50% RDN through urea + 50% RDN through poultry manure had recorded the maximum fresh herbage yield per plant (701.21 g) and per hectare (36.43 t), which was on par with T<sub>7</sub> *i.e.* 50% RDN through urea + 50% RDN through neem cake, per plant (692.20 g) and per hectare (35.96 t), T<sub>6</sub> *i.e.* 50% RDN through urea + 50% RDN through vermicompost, per plant (685.36 g) and per hectare (35.60 t), T<sub>5</sub> *i.e.* 50% RDN through urea + 50% RDN through FYM, per plant (678.17 g) and per hectare (35.23 t) T<sub>4</sub> *i.e.* 75% RDN through urea + 25% RDN through poultry manure, per plant (645.20 g) and per hectare (33.52 t). The minimum fresh herbage yield per plant (577.27 g) and per hectare (29.99 t) was recorded in T<sub>1</sub> *i.e.* 75% RDN through urea + 25% RDN through FYM.

The increase in fresh weight of herbage in treatments may be due to combined application of organic manures and

inorganic fertilizers which increased the photosynthetic activity, nitrogen metabolism and auxin content in the plants, in turn, improved the height, number of primary branches, number of leaves, leaf area per plant and all these growth parameters were correlated with the fresh herb yield of plant and results in higher whole biomass of the plant. These results are in line with Ahmad *et al.* (2011) <sup>[2]</sup> in marjoram, Shahi and Singh (2013) <sup>[17]</sup> in lemongrass and Rahman *et al.* (2014) <sup>[16]</sup> in tulsi and pudina.

### Dry herbage yield

Significant differences were recorded among the different treatments for dry herbage yield per plant. The T<sub>8</sub> which received 50% RDN + 50% RDN through poultry manure had recorded the maximum dry herbage yield per plant (145.18 g) and per hectare (7.54 t) which was on par with T<sub>7</sub> *i.e.* 50% RDN through urea + 50% RDN through neem cake per plant (137.50 g) and per hectare (7.14 t), T<sub>6</sub> *i.e.* 50% RDN through urea + 50% RDN through vermicompost per plant (133.71 g) and per hectare (6.95 t), whereas the minimum dry herbage yield per plant (83.50 g) and per hectare (4.34 t) was recorded in T<sub>1</sub> *i.e.* 75% RDN through urea + 25% RDN through FYM, followed by T<sub>2</sub> *i.e.* 75% RDN through urea + 25% RDN through vermicompost per plant (93.66 g) and per hectare (4.87 t).

The combination of organic manures and inorganic sources of nutrients ensured the readily available nutrients for initial requirement through the inorganic source at a slow pace and long period availability of nutrients through organic manures. The continuous availability of nutrients resulted in more nutrient uptake by plant ensures more dry matter accumulation at all growth stages results in higher dry weight of herb per plant as well as per hectare which are in conformity with Choudhary *et al.* (2011) <sup>[5]</sup> in fenugreek, Elza *et al.* (2014) <sup>[9]</sup> in *Achillea millefolium* and El-Sayed *et al.* (2018) <sup>[8]</sup> in Citronella.

### Oil yield

The data on oil yield of sweet basil presented in the Table 2. Significant differences were recorded among the different treatments with respect to oil yield per hectare of sweet basil. The treatment T<sub>8</sub> which received 50% RDN through urea + 50% RDN through poultry manure had recorded the maximum oil yield per hectare (168.52 kg) which was on par with T<sub>7</sub> *i.e.* 50% RDN through urea + 50% RDN through neem cake (162.59), T<sub>10</sub> *i.e.* 100% RDF (125:75:60 kg/ha) (158.30 kg), T<sub>5</sub> *i.e.* 50% RDN through urea + 50% RDN through FYM (152.37 kg) and T<sub>6</sub> *i.e.* 50% RDN through urea + 50% RDN through vermicompost (150.89 kg). The minimum oil yield per hectare (121.35 kg) was recorded in the plants supplied with 75% RDN through urea + 25% RDN through FYM (T<sub>1</sub>).

Essential oil yield highly depends on herbage yield than the oil content of basil because there was not much difference in oil content between the treatments and result obtained in the present study may be due to the influence of nitrogen in promoting the vegetative growth, which resulted in increased herbage production, consequently, essential oil yield increased to a greater extent. Similar results were reported by Ateia *et al.* (2009) <sup>[1]</sup> in thyme, Ahmad *et al.* (2011) <sup>[2]</sup> in marjoram and El-Sayed *et al.* (2018) <sup>[8]</sup> in citronella.

**Table 1:** Effect of organic manures and inorganic fertilizers on growth parameters of sweet basil (*Ocimum basilicum* L.)

Treatments	Plant height (cm)	Number of primary branches	Number of secondary branches	Number of leaves	Leaf area per plant (cm <sup>2</sup> )	Plant spread (cm <sup>2</sup> )
T <sub>1</sub>	74.54	18.00	73.89	986.89	7625.28	2016.8
T <sub>2</sub>	75.37	18.11	74.11	1000.67	9360.33	2041.8
T <sub>3</sub>	75.96	18.22	77.00	1051.11	10080.33	2138.2
T <sub>4</sub>	76.10	18.44	79.22	1135.89	11020.42	2609.2
T <sub>5</sub>	77.01	18.67	83.00	1225.67	12735.80	2726.3
T <sub>6</sub>	77.28	19.78	84.33	1300.34	13970.37	2835.4
T <sub>7</sub>	78.97	20.44	85.89	1369.89	15064.96	3169.6
T <sub>8</sub>	79.67	21.11	85.78	1393.00	15717.82	3300.2
T <sub>9</sub>	73.99	17.11	63.67	1110.22	9499.24	2464.5
T <sub>10</sub>	77.24	19.11	80.78	1098.78	10548.73	2605.8
S. Em ±	0.63	0.48	1.74	37.96	441.27	148.32
C D @ 0.05	1.88	1.42	5.17	112.80	1311.08	440.68

**Table 2:** Effect of organic manures and inorganic fertilizers on yield parameters of sweet basil (*Ocimum basilicum* L.)

Treatments	Fresh herbage yield		Dry herbage yield		Oil yield (kg/ha)
	Plant <sup>-1</sup> (g)	Hectare <sup>-1</sup> (t)	Plant <sup>-1</sup> (g)	Hectare <sup>-1</sup> (t)	
T <sub>1</sub>	577.27	29.99	83.50	4.34	121.35
T <sub>2</sub>	600.27	31.18	93.66	4.87	136.95
T <sub>3</sub>	630.17	32.74	104.08	5.41	146.73
T <sub>4</sub>	645.20	33.52	112.45	5.84	147.88
T <sub>5</sub>	678.17	35.23	124.78	6.48	152.37
T <sub>6</sub>	685.36	35.60	133.71	6.95	150.89
T <sub>7</sub>	692.20	35.96	137.50	7.14	162.59
T <sub>8</sub>	701.21	36.43	145.18	7.54	168.52
T <sub>9</sub>	632.67	32.87	109.44	5.69	136.37
T <sub>10</sub>	633.70	32.92	110.41	5.74	158.30
S. Em ±	22.52	1.17	6.65	0.35	6.38
C D @ 0.05	66.92	3.48	19.77	1.03	18.95

## Conclusion

The outcome of the present investigation revealed that among the different combination of organic manures and inorganic fertilizers, significantly higher plant height, number of primary branches, number of leaves, leaf area per plant, plant spread, fresh herbage yield per plant and hectare, dry herbage yield per plant and per hectare and oil yield per hectare were obtained with the application of 50% RDN through urea + 50% RDN through poultry manure. Hence, the incorporation of 50% of recommended N through urea and the remaining fifty per cent recommended N through poultry manure may be recommended for basil crop to acquire higher herbage of sweet basil.

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