Synergistic Effect of Organic Inputs on the Morphophysiological Traits of Sweet Basil (*Ocimum basilicum* L.)

ABSTRACT

The present investigation on"Synergistic Effect of Organic Inputs on the Morphophysiological Traits of Sweet basil (Ocimum basilicum L.)"was conducted from 2023 in Chengam, Tiruvannamalai district. The objective was to evaluate the impact of various organic treatments on the growth and yield characteristics of sweet basil (*Ocimum basilicum* L.). The experiment was carried out is Randomized Block Design with ten treatments and replication thrice. Among the ten different treatments applied, the combination of FYM @ 25 t ha^{-1} + VC @ 2.5 t ha^{-1} + Seaweed extract @ 2% (T_9) consistently outperformed other treatments. This treatment significantly enhanced growth characteristics *viz*., plant height (35.01, 60.33, 86.71 and 110.34 cm), number of leaves $plant^{-1}$(291.34, 540.56, 850.41 and 1010.66), leaf area (482.33, 1673.20, 3581.23 and 4468.67 cm^2) and leaf area index (0.65, 1.33, 2.32 and 3.23), number of primary branches $plant^{-1}$ (21.45, 25.37, 32.17 and 39.46) and secondary branches $plant^{-1}$ (64.72, 76.45, 96.56 and 109.34), plant spread (north - south) (25.32, 33.39, 40.26 and 50.38 cm), plant spread (East- west) (40.56, 55.89, 65.47 and 71.45 cm), at 30, 60, 90 and 120 DAT. The findings indicate that the integration of organic inputs of treatment, T_9 (FYM @ 25 t ha^{-1} + VC @ 2.5 t ha^{-1} + Seaweed extract @ 2%) is highly effective in optimizing the growth of sweet basil.

Key Words : Sweet basil, Organic farming, FYM, Vermicompost, Seaweed extract.

INTRODUCTION

Sweet Basil (*Ocimum basilicum L.*), a widely cultivated aromatic herb, is known for its flavorful foliage (Davis, 1995). it belongs to the Lamiaceae family, comprising 50-150 species of herbs and shrubs native to tropical regions of Asia, Africa and the Americas (Malav *et al*., 2015). Sweet basil is tetraploid, with a chromosome number of 2n=48 (Farooqi & Sreeramu, 2005). Known as the "King of herbs," basil holds commercial, culinary, cosmetic and medicinal value (Meena *et al*.,2013). Overuse of chemical fertilizers depletes soil, while organic fertilizers restore nutrients and enhance soil health. Organic farming of sweet basil boosts pharmaceutical demand for its chemical-free properties, improving oil quality and medicinal value. Organic systems enhance morpho-physiological traits, yield and soil health by increasing organic carbon, phosphorus and microbial activity, ensuring long-term productivity. The overuse of chemical fertilizers has degraded soil health and reduced the quality of medicinal and aromatic plants (MAPs), which are increasingly needed for chemical-free products in the pharmaceutical industry. Organic farming offers a solution by restoring soil fertility, improving crop growth and enhancing essential oil quality. This sustainable approach boosts yields, enhances soil health and meets the demand for high-quality, organically grown MAPs like sweet basil.

MATERIAL AND METHODS

The present investigation on "Synergistic Effect of Organic Inputs on the Morphophysiological Traits of Sweet basil (Ocimum basilicum L.)"was conducted from 2023 in Chengam, Tiruvannamalai district. The experiment was laid out in Randomized Block Design with ten treatments and three replications.Each replications have 30 plants. Five randomly selected plants in each replication were tagged, labelled and used for observation of different growth parameters. The mean of five plants was taken for analysis. The data recorded were subjected to statistical analysis by adopting the standard procedure of Panse and Sukhatme (1985). The critical differences were arrived at 5 per cent probability significance.

RESULT AND DISCUSSION

The data in Table 1 showed significant differences among treatments, with T_9 (FYM @ 25 t ha^{-1} + Vermicompost @ 2.5 t ha^{-1} + Seaweed extract @ 2%) recording the highest plant height (35.01, 60.33, 86.71, 110.34 cm) and number of leaves $plant^{-1}$ (291.34, 540.56, 850.41, 1010.66) followed by T_{10} (FYM @ 25 t ha^{-1} + Vermicompost @ 2.5 t ha^{-1} + Jeevamrutham @ 3%) with plant height of 33.74, 58.05, 83.77, 106.22 cm and number of leaves $plant^{-1}$of 269.69, 510.22, 821.64, 969.12 while the lowest values were observed in the control (T_1) with plant heights of 23.62, 39.81, 60.34 and 73.62 cm and number of leaves $plant^{-1}$of 96.49, 267.50, 591.48 and 636.80 at 30, 60, 90 and 120 DAT.

Farmyard manure (FYM) promotes microbial growth, accumulates humus and provides phytohormones that aid plant growth, even with reduced chemical fertilizers (Gupta *et al*., 1983). The basal application of vermicompost (VC) enhances plant height by promoting cell division and enlargement. The combination of organic manures like FYM and VC ensures balanced nutrient supply, increasing the number of nodes and internodal length, thus boosting plant height. Similar results were observed by Malav *et al*. (2015), Baraa *et al*. (2017), Jalil Dehghan Saman *et al*. (2017) and Rajit Ram *et al*. (2019a) in *Ocimum spp.*

Table 1. Effect of organic inputs on plant height (cm) and Number of leaves plant^{-1} in sweet basil(*Ocimum basilicum* L.)

Treatments	Plant height (cm)				Number of leaves plant^{-1}			
	30DAT	60 DAT	90 DAT	120 DAT	30DAT	60DAT	90DAT	120DAT
T_1– Control	23.62	39.81	60.34	73.62	96.49	267.50	591.48	636.80
T_2- FYM @ 25t ha^{-1}	24.88	42.09	63.26	77.38	118.14	297.83	620.25	678.34
T_3- VC @ 5 t ha^{-1}	26.15	44.37	66.20	81.50	139.09	328.18	649.02	719.88
T_4- FYM @ 25t ha^{-1}+ VC @ 2.5 t ha^{-1}	29.59	51.21	74.99	93.86	204.74	419.20	735.32	844.50
T_5- FYM @ 25 t ha^{-1}+ Seaweed extract @2%	28.68	48.93	72.06	89.74	183.09	388.86	706.56	802.96
T_6 - FYM @ 25 t ha^{-1}+ Jeevamrutham @ 3%	27.42	46.65	69.13	85.62	161.44	358.51	677.79	761.42
T_7- VC @ 5 t ha^{-1} + Seaweed extract @2%	32.48	55.77	80.85	102.10	248.04	479.88	792.87	927.58
T_8- VC @ 5 t ha^{-1} + Jeevamrutham@ 3%	31.21	53.49	77.92	97.98	226.39	449.54	764.10	886.04
T_9- FYM @ 25 t ha^{-1} + VC @ 2.5 t ha^{-1}+ Seaweed extract @2%	35.01	60.33	86.71	110.34	291.34	540.56	850.41	1010.66
T_{10} - FYM @ 25 t ha^{-1}+ VC @ 2.5 t ha^{-1}+ Jeevamrutham@ 3%	33.74	58.05	83.77	106.22	269.69	510.22	821.64	969.12
S.ED	**0.57**	**0.98**	**1.43**	**1.80**	**4.13**	**8.19**	**14.1**	**16.2**
CD (P = 0.05)	**1.15**	**1.97**	**2.89**	**3.62**	**8.38**	**16.47**	**28.36**	**32.67**

Table 2. Effect of organic inputs on leaf area (cm^2) and leaf area indexin sweet basil(*Ocimum basilicum* L.)

Treatments	Leaf area (cm^2)				Leaf area index			
	30 DAT	60 DAT	90 DAT	120 DAT	30 DAT	60 DAT	90 DAT	120 DAT
T_1 – Control	331.85	967.69	2026.57	2447.81	0.38	0.79	1.33	2.15
T_2- FYM @ 25t ha^{-1}	348.57	1046.08	2199.31	2672.35	0.41	0.84	1.44	2.26
T_3- VC @ 5 t ha^{-1}	365.29	1124.46	2372.05	2896.89	0.43	0.91	1.55	2.38
T_4- FYM @ 25t ha^{-1}+ VC @ 2.5 t ha^{-1}	415.44	1359.64	2890.26	3570.51	0.53	1.09	1.88	2.75
T_5- FYM @ 25 t ha^{-1}+ Seaweed extract@2%	398.73	1281.25	2717.53	3345.97	0.50	1.03	1.77	2.63
T_6 - FYM @ 25 t ha^{-1}+ Jeevamrutham @ 3%	382.01	1202.86	2544.79	3121.43	0.47	0.97	1.66	2.50
T_7- VC @ 5 t ha^{-1} + Seaweed extract @2%	448.89	1516.42	3235.75	4019.59	0.59	1.21	2.10	2.99
T_8- VC @ 5 t ha^{-1} + Jeevamrutham@ 3%	432.17	1438.03	3063.01	3795.05	0.56	1.15	1.99	2.87
T_9 - FYM @ 25 t ha^{-1} + VC @ 2.5 t ha^{-1}+ Seaweed extract @2%	482.33	1673.20	3581.23	4468.67	0.65	1.33	2.32	3.23
T_{10} - FYM @ 25 t ha^{-1}+ VC @ 2.5 t ha^{-1}+ Jeevamrutham@ 3%	465.61	1597.80	3408.49	4244.13	0.62	1.27	2.21	3.11
S.ED	**7.97**	**26.2**	**55.9**	**69.2**	**0.01**	**0.20**	**0.36**	**0.52**
CD (P = 0.05)	**16.02**	**502.82**	**112.44**	**139.20**	**0.021**	**0.042**	**0.074**	**0.106**

Note: FYM–farm yard manure, VC- vermicompost

Table 3. Effect of organic inputs on plant spread North – South (cm) and Plant spread East - West (cm) in sweet basil (*Ocimum basilicum* L.)

Treatments	plant spread North – South (cm)				Plant spread East - West(cm)			
	30 DAT	**60 DAT**	**90 DAT**	**120 DAT**	**30 DAT**	**60 DAT**	**90 DAT**	**120 DAT**
T_1 – Control	16.68	23.13	24.33	35.16	26.79	32.49	39.37	46.07
T_2 - FYM @ 25t ha^{-1}	17.64	24.26	26.10	36.85	28.32	35.09	42.26	48.88
T_3 - VC @ 5 t ha^{-1}	18.60	25.40	27.87	38.55	29.85	37.69	45.17	51.71
T_4 - FYM @ 25t ha^{-1}+ VC @ 2.5 t ha^{-1}	21.47	28.83	33.18	43.62	34.43	45.48	53.87	60.17
T_5 - FYM @ 25 t ha^{-1}+ Seaweed extract@2%	20.50	27.69	31.41	41.93	32.91	42.89	50.97	57.35
T_6 - FYM @ 25 t ha^{-1}+ Jeevamrutham@ 3%	19.55	26.54	29.64	40.24	31.38	40.29	48.07	54.52
T_7 - VC @ 5 t ha^{-1} + Seaweed extract @2%	23.40	31.11	36.72	47.00	37.50	50.68	59.66	65.81
T_8 - VC @ 5 t ha^{-1} + Jeevamrutham@ 3%	22.44	29.97	34.95	45.30	35.97	48.09	56.77	62.99
T_9 - FYM @ 25 t ha^{-1} + VC @ 2.5 t ha^{-1}+ Seaweed extract @2%	25.32	33.39	40.26	50.38	40.56	55.89	65.47	71.45
T_{10} - FYM @ 25 t ha^{-1}+ VC @ 2.5 t ha^{-1}+ Jeevamrutham@ 3%	24.36	32.25	38.49	48.69	39.03	53.29	62.57	68.63
S.ED	**0.40**	**0.55**	**0.63**	**0.83**	**0.66**	**0.87**	**1.03**	**1.15**
CD (P = 0.05)	**0.82**	**1.11**	**1.28**	**1.68**	**1.33**	**1.76**	**2.08**	**2.32**

Table 4. Effect of organic inputs onnumber of primary and secondary branches plant $^{-1}$in sweet basil(*Ocimum basilicum* L.)

Treatments	Number of primary branches plant $^{-1}$				Number of secondary branches plant $^{-1}$			
	30 DAT	**60 DAT**	**90 DAT**	**120 DAT**	**30 DAT**	**60 DAT**	**90 DAT**	**120 DAT**
T_1 – Control	12.27	14.48	18.76	23.89	27.46	40.27	45.89	58.58
T_2 - FYM @ 25t ha^{-1}	13.28	15.69	20.25	25.62	31.60	44.28	51.52	64.22
T_3 - VC @ 5 t ha^{-1}	14.31	16.90	21.74	27.35	35.74	48.31	57.14	69.86
T_4 - FYM @ 25t ha^{-1}+ VC @ 2.5 t ha^{-1}	17.36	20.53	26.21	32.54	48.16	60.36	74.04	86.78
T_5 - FYM @ 25 t ha^{-1}+ Seaweed extract @2%	16.35	19.32	24.72	30.81	44.02	56.35	68.41	81.14
T_6 - FYM @ 25 t ha^{-1}+ Jeevamrutham@ 3%	15.33	18.11	23.23	29.08	39.88	52.33	62.78	75.50
T_7 - VC @ 5 t ha^{-1} + Seaweed extract @2%	19.41	22.95	29.19	36.00	56.44	68.41	85.30	98.06
T_8 - VC @ 5 t ha^{-1} + Jeevamrutham@ 3%	18.39	21.74	27.70	34.27	52.30	64.39	79.67	92.42
T_9 - FYM @ 25 t ha^{-1} + VC @ 2.5 t ha^{-1}+ Seaweed extract@2%	21.45	25.37	32.17	39.46	64.72	76.45	96.56	109.34
T_{10} - FYM @ 25 t ha^{-1}+ VC @ 2.5 t ha^{-1}+ Jeevamrutham @ 3%	20.43	24.16	30.68	37.73	60.58	72.43	90.93	103.70
S.ED	**0.33**	**0.39**	**0.50**	**0.62**	**0.95**	**1.17**	**1.42**	**1.68**
CD (P = 0.05)	**0.67**	**0.80**	**1.01**	**1.26**	**1.92**	**2.36**	**2.92**	**3.38**

Note: FYM–farm yard manure, VC- vermicompost

Seaweed extracts improve plant growth due to growth-promoting hormones (IAA, IBA, cytokinins), trace elements (Fe, Cu, Zn, Co, Mo, Mn, Ni), vitamins and amino acids, as noted by Katarzyna Chojnacka *et al*. (2012), Wajahatullah Khan *et al*. (2009) and Craige (2011). Organic manures enhance leaf production due to the optimal C:N ratio in FYM, which releases nitrogen (ammonium and nitrate) during decomposition. Increased nitrogen levels stimulate leaf production, larger leaf areas and greater plant spread, as nitrogen is vital for amino acids and co-enzymes (Venkatesan, 2009). Similar findings were reported by Ashashri Shinde *et al*. (2013) in ashwagandha, Mansour *et al*. (2017) in sweet basil, Patke *et al*. (2018), Ram *et al*. (2019b) in Indian basil (*Ocimum sanctum* L. cvs. Cim-Ayu and Cim-Angana), Aloe vera and Gunda *et al*. (2022) in sweet basil. Nitrogen in vermicompost also boosts leaf production, supported by findings from Suresh and Senthilnathan (2018). This is consistent with studies by Padmapriya *et al*. (2010) in gymnema, Tiwari and Roy (2014) in gloriosa, Khanzadeh and Naderi (2015) in periwinkle, Hidangmayum and Sharma *et al*. (2017) and Suresh *et al*. (2018) in Japanese mint. Seaweed extracts, containing growth substances, further enhance vegetative growth and yield by influencing cellular metabolism (El-Miniawy *et al*., 2014).

The data in Table 2 revealed significant differences among treatments in leaf area (cm^2) and leaf area index. T_9 (FYM @ 25 t ha^{-1} + Vermicompost @ 2.5 t ha^{-1} + Seaweed extract @ 2%) recorded the highest leaf area (482.33, 1673.20, 3581.23 and 4468.67 cm^2) and leaf area index (0.65, 1.33, 2.32 and 3.23). This was followed by T_{10} (FYM @ 25 t ha^{-1} + Vermicompost @ 2.5 t ha^{-1} + Jeevamrutham @ 3%) with leaf area of 456.61, 1597.80, 3408.49 and 4244.13 cm^2 and leaf area index of 0.62, 1.27, 2.21 and 3.11. The lowest values were recorded in T_1 (Control), with leaf area of 331.85, 967.69, 2026.57 and 2447.81 cm^2 and leaf area index of 0.38, 0.79, 1.33 and 2.15 at 30, 60, 90 and 120 DAT.

The increase in leaf area and leaf area index with the application of organic manure could be related to better nutrition allocated to leaf development, due to nutrient release by microorganisms in the soil, which in turn increased plant growth as a result of the production of more assimilates and increased cell division and cell size (Selosse*et al*., 2004). This finding is similar to the results of Jayasri (2010), Harishkumar *et al*. (2019) and Ram *et al*. (2019a). Meanwhile, the foliar spraying of seaweed extract (*Ascophyllum nodosum*) influenced the vegetative growth of the plant (Gheorghe Cristian Popescu and Monica Popescu, 2014). Increased vegetative growth might have been due to the presence of nutrients and hormonal levels in brown seaweed. These results are in close agreement with Salama and Raina (2015) and Veeranan Uthirapandi *et al*. (2018) in sacred basil.

The data in Table 3 showed significant differences among treatments, with T_9 (FYM @ 25 t ha^{-1} + Vermicompost @ 2.5 t ha^{-1} + Seaweed extract @ 2%) recording the highest number of primary branches plant-1 (21.45, 25.37, 32.17, 39.46) and secondary branches plant-1 (64.72, 76.45, 96.56, 109.34), followed by T_{10} (FYM @ 25 t ha^{-1} + Vermicompost @ 2.5 t ha^{-1} + Jeevamrutham @ 3%) with primary branch counts of 20.43, 24.16, 30.68, 37.73 and secondary branch counts of 60.58, 72.43, 90.93, 103.70. The lowest number of primary and secondary branches was observed in the control (T_1) with 12.27, 14.48, 18.76, 23.89 for primary branches and 27.46, 40.27, 45.89, 58.58 for secondary branches at 30, 60, 90 and 120 DAT.

The increased number of branches as a result of higher nitrogen content from FYM was attributed to the involvement of nitrogen in the physiological processes of the plant, which stimulated growth and, thus, the increased number of branches per plant at higher nitrogen levels were observed. Almost identical results have been reported by Kandil *et al*. (2009) in Holy Basil, Asgharipour (2011),Rahman *et al*. (2014) in Holy Basil and Naggar *et al*. (2015) and EL-Sayed*etal*. (2015) in basil. The basal application of vermicompost stimulated bacterial activity in the soil, nitrogen accumulation and nutrient availability in the plant, resulting in enhanced plant growth (Mohammad Reza Befrozfar *et al*., 2013). Similar results were obtained by Soheila Shahriari *et al*. (2015) in basil and Chandana *et al*. (2018) in kalmegh and Mohit Lal *et al*. (2018) in sacred basil.According to Dhriti Battacharyya *et al*. (2015), seaweeds affected plant growth due to the effects of oligosaccharides, hormone-like elicitors, betaines and minerals that promoted cell division, protein synthesis and improved stress tolerance.

The data in Table 4 showed significant differences among treatments, with T_9 (FYM @ 25 t ha^{-1} + Vermicompost @ 2.5 t ha^{-1} + Seaweed extract @ 2%) recording the highest plant spread North-South (25.32, 33.39, 40.26, 50.38 cm) and East-West (40.56, 55.89, 65.47, 71.45 cm), followed by T_{10} (FYM @ 25 t ha^{-1} + Vermicompost @ 2.5 t ha^{-1} + Jeevamrutham @ 3%) with plant spread North-South of 24.36, 32.25, 38.49, 48.69 cm and East-West of 39.03, 53.29, 62.57, 68.63 cm. The lowest plant spread was observed in the control (T_1), with North-South measurements of 16.68, 23.13, 24.33, 35.16 cm and East-West measurements of 26.79, 32.49, 39.37, 46.07 cm at 30, 60, 90 and 120 DAT.

The superior performance for branches per plant might have been due to the higher availability of nutrients from planting to harvest. The results are in line with those of Munnu Singh (2011) in geranium and Singh and Wasnik (2013) in rosemary Mansour *et al*. (2017)and Netam *et al*. (2020) in basil.

CONCLUSION

Based on the findings of the present study, it can be concluded that combined application of FYM @ 25t ha^{-1} + Vermicompost @ 2.5 t ha^{-1} + Sea weed extract @ 2% has beneficial effect on the growth of Sweet basil.

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