Effect of organic and inorganic sources of fertilization on growth, yield attributes and quality of Tulsi in lateritic soil

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ABSTRACT

A study was conducted at College of Forestry, Dr Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Maharashtra during 2022-2023 to find out the effect of organic and inorganic sources of fertilization on growth, yield attributes and quality of Tulsi. The treatment comprising 100 per cent RDF + *Azotobacter* 10 kg + vermicompost 10 tonnes per ha proved superior over all other treatment in respect of foliage yield, oil yield and available P_2O_5. At the same time this treatment also resulted in highest electric conductivity, available N and available K_2O along with some other treatments.

Keywords: Tulsi; organic; inorganic; growth; yield; quality

INTRODUCTION

Tulsi is a traditionally highly important crop in Indian community. It has high medicinal and aromatic values and is the reservoir of many secondary metabolites useful for humans. Essential oils and the components of their aroma are very important in various industries, including food flavouring, fragrance, perfumery, medicines, natural food preservatives, spices, aromatherapy and associated medical applications. The genus *Ocimum* (Lamiaceae), which has over 30 species spread throughout tropical and subtropical regions of Asia, Africa, Central America and South America, holds a significant position among potential aromatic plants. Basil is an herb that yields essential oils and grows well in a range of climates and terrain types. Because of its high salt tolerance, alkaline pH and exchangeable sodium content, it is especially well suited for the reclamation of saline and sodic wastelands (Purushothaman et al 2018). *Ocimum basilicum* L, one of the most important fragrant plants, is grown all over the world for its essential oil, which has flavouring, medicinal and industrial uses. The plant has commercial value for its leaves, blooms and seeds. The herb is used in traditional medical systems because of its insecticidal, antifungal and antibacterial qualities (Pramod et al 2020). Basil has been used in many forms by Ayurvedic and Unani doctors to cure ringworm, rashes and other skin ailments. In addition to being a popular culinary herb and ornamental plant, basil oil has been the subject of scientific investigation since 1930. There are more than 150 species of herbs and shrubs in the genus *Ocimum*. As per the pharmaceutical industrial demand with its having high medicinal and aromatic value, Tulsi is a good option to cultivate at farmers' fields for commercial purpose in large scale. The present study was conducted on Tulsi in lateritic soil with a balanced application of fertilizers for getting maximum production for the farmers in Konkan region of Maharashtra.

MATERIAL and METHODS

The field experiment was conducted at the College of Forestry, Dr Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Ratnagiri, Maharashtra during 2022 to 2023. The experiment was framed in randomized block design with three replications and nine treatments. The treatments used were T_1 [100% RDF ($N:P_2O_5:K_2O$ 120:100:100 kg/ha)], T_2 (*Azotobacter* 10 kg/ha), T_3 (Vermicompost 10 tonnes/ha), T_4 (100% RDF + *Azotobacter* 10 kg/ha), T_5 (100% RDF + *Azotobacter* 10 kg/ha) + vermicompost 10 tonnes/ha), T_6 (75% RDF + *Azotobacter* 7.5 kg/ha +

vermicompost 7.5 tonnes/ha), T_7 (100% RDF + vermicompost 10 tonnes/ha), T_8 (*Azotobacter* 10 kg/ha + vermicompost 10 tonnes/ha) and T_9 (Control – no fertilizer). The initial soil pH 6.06, electrical conductivity 0.06 dS/m, soil organic carbon 1.18 per cent, available nitrogen 215.62 kg per ha, available phosphorus 24.10 kg per ha and available potassium 415.80 kg ha were observed in the experimental area. Whole potassium and phosphorus were applied at the time of planting. Nitrogen was applied in two equal split applications. Soil samples from each plot were examined both before and after the crop was harvested. Plant spacing was 60 cm × 60 cm. The oil content was extracted using Clevenger's apparatus (Clevenger 1928). To determine the chemical characteristics of the soil, a representative amount of each soil sample was taken from the initial and at harvest of the cop at a depth of 0 to 30 cm. The sample was then shade-dried, powdered and passed through a <2 mm screen. The soil pH, EC, OC, N, P and K were measured as per the method of Jackson (1973) and the amount of accessible P was calculated using the method of Bray and Kurtz (1945). The experimental data were subjected to analysis of variances (ANOVA) (Fisher and Yates 1963).

RESULTS and DISCUSSION

Data on the effect of organic and inorganic sources of fertilization on soil fertility, foliage and oil yield of Tulsi are given in Table 1.

Maximum foliage yield (22.3 tonnes/ha) was recorded in the treatment T_5 (100% RDF + *Azotobacter* 10 kg/ha + vermicompost 10 tonnes/ha) which was superior to all other treatments. Minimum foliage yield of 17.2, 17.7, 18.1, 18.1 and 18.1 tonnes/ha was recorded in T_9 (Control), T_2 (*Azotobacter* 10 kg/ha), T_1 [100% RDF ($N:P_2O_5:K_2O$ 120:100:100 kg/ha)], T_3 (Vermicompost 10 tonnes/ha) and T_4 (100% RDF + *Azotobacter* 10 kg/ha) respectively, all being at par. Highest oil yield was observed in T_5 (236.1 kg/ha) and lowest in T_9 (69.4 kg/ha).

There was no effect of treatments on pH and organic carbon of the soil. The electric conductivity was higher (0.09, 0.08, 0.08, 0.07, 0.07, 0.07 and 0.07 dS/m) in T_5, T_6 (75% RDF + *Azotobacter* 7.5 kg/ha + vermicompost 7.5 tonnes/ha), T_7 (100% RDF + vermicompost 10 tonnes/ha), T_1, T_3, T_4 and T_8 (*Azotobacter* 10 kg/ha + vermicompost 10 tonnes/ha) respectively, which were at par. On the other hand lower electric conductivity (0.5 dS/m) was observed in T_9 which was at par with T_2 (0.06 dS/m), T_1 (0.07 dS/m), T_3 (0.07 dS/m), T_4 (0.07 dS/m) and T_8 (0.07 dS/m).

Available N was recorded maximum in T_5 (243.67 kg/ha), T_6 (238.00 kg/ha), T_7 (234.33 kg/ha) and T_4 (231.33 kg/ha), which were at par and minimum in T_9 (212.67 kg/ha), T_2 (219.17 kg/ha) and T_1 (224.67 kg/ha), the three treatments being at par. Available P_2O_5 was highest in T_5 (24.10 kg/ha) and lowest in T_9 (13.74 kg/ha). Highest available K_2O was recorded in T_5 (460.33 kg/ha), T_6 (455.00 kg/ha), T_7 (449.00 kg/ha) and T_4 (446.33 kg/ha), which were at par and lowest in T_9 (410.67 kg/ha).

In their study on sweet basil, Al-Mansour et al (2017) revealed that application of recommended FYM (10 tonnes/ha) along with recommended NPK (160:80:80 kg/ha) recorded the highest fresh herbage yield (39.95 and 19.37 tonnes/ha), essential oil content (0.48 and 0.45%) and essential oil yield (199.7 and 107.58 kg/ha) in the main crop and ratoon respectively.

Moghaddam and Gurbuz (2013) reported that in basil, mean essential oil ratio in herb was 0.49 and 0.44 per cent, essential oil ratio in leaf was 0.59 and 0.54 per cent, essential oil yield in herb was 19.4 and 23.7 litres per ha and essential oil yield in leaf was 12.8 and 16.1 litres per ha during 2007 and 2008 respectively. Nitrogen fertilizer had statistically insignificant effect on oil ratio of herb and leaves during two years of experiment.

Pramod et al (2020) showed that organic manures and inorganic fertilizers had a significant effect on growth and yield parameters of sweet basil. The treatment 50 per cent RDN through urea + 50 per cent RDN through poultry manure recorded the higher plant height (79.67 cm), number of primary branches per plant (21.11), number of leaves (1,393), fresh herbage yield per plant (701.21 g) and per hectare (36.43 tonnes), dry herbage yield per plant (145.18 g) and per hectare (7.54 tonnes) and oil yield (168.52 kg/ha) followed by 50 per cent RDN through urea + 50 per cent RDN through neem cake.

In an experiment conducted on hybrid *O kilimandscharicum* and *O basilicum* variety CIM-Shishir of *Ocimum* at Dapoli, Maharashtra, Ganve et al (2023) reported that plant height (110.80 cm), number of primary branches (8.05), fresh biomass yield (537.75

Table 1. Effect of organic and inorganic sources of fertilization on soil fertility, foliage and oil yield of Tulsi

Treatment	Foliage yield (tonnes/ha)	Oil yield (kg/ha)	pH	EC (dS/m)	OC (%)	Available N (kg/ha)	Available P_2O_5 (kg/ha)	Available K_2O (kg/ha)
T_1	18.1	110.7	6.14	0.07	1.32	224.67	19.14	431.33
T_2	17.7	125.0	6.08	0.06	1.30	219.17	17.79	426.67
T_3	18.1	97.2	6.09	0.07	1.31	230.06	21.67	444.67
T_4	18.1	97.2	6.18	0.07	1.34	231.33	21.42	446.33
T_5	22.3	236.1	6.25	0.09	1.40	243.67	24.10	460.33
T_6	20.1	138.9	6.20	0.08	1.37	238.00	23.70	455.00
T_7	19.3	111.1	6.22	0.08	1.35	234.33	22.06	449.00
T_8	19.1	125.0	6.17	0.07	1.32	227.33	21.79	439.00
T_9	17.2	69.4	6.02	0.05	1.23	212.67	13.74	410.67
Mean	18.9	123.4	6.15	0.07	1.33	229.03	20.60	440.30
SE±(m)	0.34	0.32	0.06	0.01	0.07	4.42	0.61	4.96
$CD_{0.05}$	1.02	0.96	NS	0.02	NS	13.26	1.81	14.87

T_1: 100% RDF (N:P_2O_5:K_2O 120:100:100 kg/ha), T_2: *Azotobacter* 10 kg/ha, T_3: Vermicompost 10 tonnes/ha, T_4: 100% RDF + *Azotobacter* 10 kg/ha, T_5: 100% RDF + *Azotobacter* 10 kg/ha + vermicompost 10 tonnes/ha, T_6: 75% RDF + *Azotobacter* 7.5 kg/ha + vermicompost 7.5 tonnes/ha, T_7: 100% RDF + vermicompost 10 tonnes/ha, T_8: *Azotobacter* 10 kg/ha + vermicompost 10 tonnes/ha, T_9: Control – no fertilizer

q/ha), oil content in fresh herb (0.70%) and oil yield (221.25 kg/ha) were highest in response to FYM (10 tonnes/ha) + 100 per cent NPK application. The dose of fertilizer FYM (10 tonnes/ha) + 100% NPK (160:80:80 kg/ha) increased the growth, fresh biomass yield, oil content and oil yield in hybrid aromatic Tulsi.

At Anand, Gujarat, Smitha et al (2019) reported that in *O sanctum*, application of 100 per cent N equivalent through FYM + AMC (N fixing, P and Zn solubilising and plant growth promoting microbes) recorded maximum dry herb yield (6.30 tonnes/ha), essential oil content (1.71%) and essential oil yield (10.79 kg/ha).

In northern dry zone of Karnataka, Yashaswini et al (2021) observed that application of 75 per cent RDN + RD P_2O_5 and K_2O + vermicompost 5 tonnes + *Azospirillum* 10 kg + *Azotobacter* 10 kg per ha recorded significantly higher fresh herbage yield (69.91 q/ha) and dry herbage yield (41.31 q/ha) with a B-C ratio of 4.11 in *O sanctum* compared to other treatments.

Ram et al (2019) reported that at Prayagraj, Uttar Pradesh, the cultivars of Indian basil Cim-Ayu and Cim-Angana attained highest plant height per plant (1.17 and 1.73 m respectively) with PSB 10 tonnes + neem cake 1.5 tonnes per ha, diameter of main stem (1.16 and 1.71 m respectively) with FYM 10 tonnes + PSB 10 tonnes + neem cake 1.5 tonnes + *Azotobacter* 6.0 kg per ha, total number of leaves per plant (1,608.90 and 1,547.90 respectively) with FYM 10 tonnes + PSB 10 tonnes + neem cake 1.5 tonnes + *Azotobacter* 6.0 kg per ha, total number of branches per plant (17.33 and 15.63 respectively) with FYM 10 tonnes + PSB 10 tonnes + neem cake 1.5 tonnes + *Azotobacter* 6.0 kg per ha and highest plant spread (87.88 and 88.74 cm respectively) with FYM 10 tonnes + PSB 10 tonnes + neem cake 1.5 tonnes + *Azotobacter* 6.0 kg per ha.

Mohamed et al (2015) evaluated the effect of bio-fertilizers (nitrobein + phosphorein) used with half or full doses of chemical fertilizer in presence of Algreen 600 foliar spray at 1 g per litre and organic fertilizer (compost 10 m^3/fed) on *O basilicum* cv Genovese plants and observed that the applied treatments of fertilizers and Algreen 600 as well as their combinations significantly increased most growth parameters viz plant height, number of branches, fresh and dry weight of plant. Also, oil yield in leaves gave the maximum values when plants treated with bio-fertilizers, Algreen 600 and 50 per cent NPK + bio-fertilizer + Algreen 600 treatments as compared with those of individual application of chemical fertilizer or untreated ones. They recommended that the treatments of bio-fertilizer, Algreen 600 and NPK at 50 per cent + bio-fertilizer + Algreen 600 could be used to improve growth and oil productivity of basil plant.

At Bengaluru, Karnataka, Al-Mansour and Vasundhara (2019) reported that in *O basilicum*, the

combined application of recommended FYM (10 tonnes/ha) and NPK (160:80:80 kg/ha) registered the highest oil yield in the main crop (211.94 and 187.46 l/ha) and in ratoon (144.36 and 70.81 l/ha) during 2015 and 2016 respectively. The chemical compositions of the essential oil for sweet basil were affected by fertilizers in the main crop and ratoon. The application of NPK (160:80:80 kg/ha) + FYM (10 tonnes/ha) resulted in the best quality.

CONCLUSION

It can be concluded that the application of 100 per cent RDF + *Azotobacter* 10 kg per ha + vermicompost 10 tonnes per ha showed significant improvement in soil fertility, herbage yield and oil yield of Tulsi. In the Konkan region of Maharashtra, productivity of Tulsi and soil fertility can be enhanced by only balanced integrated use of organic and inorganic fertilizers in lateritic soil.

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