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Effect of different types of organic sources on vegetative growth in tulsi (*Ocimum sanctum* L.)

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Abstract
The present investigation has been carried out to find out the effect of different types of organic sources on vegetative growth in Tulsi (*Ocimum sanctum* L.). In present study, there were four different organic manures FYM, Vermicompost, Pressmud and a Bio-fertilizer PSB (Phosphorus Solubilizing Bacteria) were used in this experiment. The vegetative growth related character like number of branch, plant height, number of leaves per plant, fresh leaf weight, dry leaf weight and diameter of stem were observed. These characters were significantly affected by the application of different organic manures. The remarkable variations were noted in such vegetative growth characters due to application of various manures and bio- fertilizer application. The number of branchs, plant height, number of leaves per plant, fresh leaf weight, dry leaf weight and diameter of stem were recorded maximum with application of pressmud (7.5 ton/ha).

Keywords: Types, organic sources, vegetative growth, tulsi, *Ocimum sanctum* L.

Introduction
Tulsi (*Ocimum sanctum* L.) belongs to the Ocimum genus and family Lamiaceae, identified for their medicinal significance. The whole plant of Tulsi is used for its medicinal values. The two main varieties of tulsi have been identified *i.e.* black (Krishna tulsi) and green (Rama tulsi). Tulsi plant not used only in Ayurveda and Siddha but also in Greek, Roman and Unani systems of medicine. In a Sanskrit language tulsi is described as "matchless one". In the old literatures tulsi was first described in 4000-5000 B.C. in Rigveda where it is believed to be the "Queen of Herbs". Indigenous basil is distributed in India, Sri Lanka, Bangladesh, Thailand, China, Myanmar and Malaysia. It is one of the highly acceptable plant for the most therapeutic and restorative herbs distributed mainly in the all regions of India.
Ocimum is found in plains and to the altitude of 1800-2000 msl in Himalayas region. It is tropical to sub-tropical in nature which prefers fairly to high rainfall with high humid conditions. Long day and high temperature condition enhanced growth and higher oil production. Partial shade is not beneficial as it affects the oil content. It can tolerate drought and up to some extent of extreme cold conditions. The genus *Ocimum* is an extremely versatile group found in tropical and warm temperature regions of the world.
It is much branched, erect herb 60 to 90 cm in height, leaves are ovate-lanceolate, acuminate opposite about 1.0 to 3.0 cm long margin entire or toothed dotted with minute oil glands, flowers are small purple or white in small compact clusters on spikes, fruit are small having yellowish or reddish colour. The leaves of tulsi contain beta-carotene, sterols, fatty acids, proteins, carbohydrates, volatile oil, fixed oil, mineral matters and vitamin A, B and C. Major volatile oil consist mostly eugenol (~70%), β-elemene (~11.0%), β-caryophyllene (~8%) and germacrene (~2%), with the balance being made up of various trace compounds, mostly terpenes (Padalia *et al*. 2011) [6].

Materials and Methods
In the present study, Tulsi cultivar CIM- Angana was taken an experimental material to find out the "Effect of different types of organic sources on vegetative growth in Tulsi''. The experiment was carried out at Main Experimental Station (Pithla), Department of Horticulture, Narendra Deva University of Agriculture and Technology, Narendra Nagar (Kumarganj), Ayodhya (U.P.) during the year 2016-17. Geographically the experimental site is situated between latitude of 24.47 and 26.75 North and longitude of 82.12 and 83.98 East at the elevation of 118 meters above mean sea level.
After preparation of land, the experiment was laid out as per treatment combination. There were 33 plots and net size of plots was 4×3 m^2. The each plot was well connected to the irrigation channel.

Total 11 treatments were taken following different doses and combinations of organic manures; FYM, Pressmud, Vermicompost and PSB (Phosphorus Solubilising Bacteria). Five plants were randomly selected from each treatment and tagged for recording the observation and average of these five plants were taken for study. The details of experimental materials and methods adopted are being enumerated as below:

Plant Growth Characters

The observation was recorded after 90 days of transplanting (at harvesting time). Five plants were randomly selected from each plot and tagged for recording the observations and average of these five plants were taken for the study. Methods used for recording the various observations were as follows.

The plant height was recorded with the help of meter scale from ground level to highest growing point of the plant in centimeter. For this purpose, five plants from each plot were tagged randomly. The height of these plants were measured and mean value have been presented in centimeter. Number of branches was counted visually at the time of harvesting. Numbers of leaves were counted manually at the harvesting time by plucking the leaves from the plant. The diameter of all selected plants per plot was measured by the vernier calipers and expressed in millimeter. The fresh leaf weight was recorded after harvesting the leaves from each tagged plant from each plot and weighed in electrical balance and expressed in kg per plant. The fresh leaves were harvested from each tagged plant from each plot and then dried in the partial shade. After well drying the leaves, it was weighed in electrical balance and expressed in kg per plant.

Statistical Analysis

Statistical analysis of the data obtained in different set of experiment were calculated, as suggested by Panse and Sukhatme (1985).

Analysis of varience

The standard error (SEm±) of the difference between two treatment means were computed as follows:

$$SEm\pm = \sqrt{\frac{2MSE}{r}}$$

Result and Discussion

Growth attributing correctors

Data pertaining to plant growth characters *viz*. plant height, number of leaves per plant, fresh leaf weight, dry leaf weight, number of branch per plant and diameter of stem revealed that application of 7.5 ton/ha had shown significant effect in increase of plant height, number of leaves per plant, fresh leaf weight, dry leaf weight, number of branch per plant and diameter of stem. The study indicates that pressmud included both macro and micro nutrients, which increased yield and yield attributing characters of tulsi. Application of pressmud greatly increased bacterial and fungal population of soil. Enhancement in fungal, bacterial and actinomycetes populations by application of pressmud in agricultural soils mark their roles in decomposition of organic materials to release nutrients for plants growth and development (Ownen 1954) [5].

Data obtained on plant height from the experiment revealed that there has been significant effect of various organic fertilizer on plant height in tulsi. The maximum height of plant (85.85 cm) was found with pressmud @ 7.5 ton/ha and minimum (59.84 cm) was found in control. Such result may be found due to properties of Pressmud that it does not contains any substances which are unfavorable for microbial action. It also includes plant growth regulators, hormones, auxins, enzymes and vitamins resulting in improvement of soil aeration and better root proliferation (PM Diaz 2016) [1].

Data on number of branches per plant indicated the significant variation due to application of various organic treatments. The maximum number of branches per plant (17.25) was found due to application of pressmud (7.5 ton/ha) as compared to other organic treatments which might be due to it contains microorganisms which aid in mineralization of plant nutrients in the soil and make them amenable to the plant roots, these microbes produce enzymes, auxins and other growth regulators, amino acids and many other organic acids which help in the proliferation of the root hairs & lateral roots of the tap root/fibrous root system and rectifies the micronutrient deficiency of the soil, increases the biomass yield of crop (AS Jurwakar *et al.*, 1993) [3]. So that, pressmud play major in increasing the number of branches per plant. Similar results were observed by Ghulam, S.; Khan M.J.; Usman K. and Ullah S. (2012) [2] in lentil.

Data on number of leaves per plant indicated that there were significant variation due to application of various organic treatments. The maximum number of leaves per plant (1128.60) was found due to application of Pressmud (7.5 ton/ha) as compared to other organic treatments which might be due to the role of pressmud in increasing number of branches per plant. Similar results were observed by Pandey, C.S. and Singh, Pal (2006) [7]. In bramhi.

Data on fresh leaf weight (kg/plant) indicated significant variation due to application of various organic treatments. The maximum fresh leaf weight (0.119 kg) was found due to application of pressmud (7.5 ton/ha) as compared to other organic treatments and all the pressmud doses were significantly superior over control which might be due to the role of pressmud in increasing fresh leaf weight kg/plant. Similar results were observed by Pandey, C.S. and Singh, Pal (2006) [7]. In bramhi.

Data on dry leaf weight (kg/plant) showed significant variation due to application of various organic treatments. The maximum dry leaves weight kg (0.043 kg) was found due to application of Pressmud (7.5 ton/ha) as compared to other organic treatments which might be due to the role of pressmud in increasing dry leaf weight (kg/plant). Similar results were observed by Ghulam, S.; Khan M.J.; Usman K. and Ullah S. (2012) [2] in lentil.

Data pertaining to diameter of stem indicated significant variation due to application of different organic treatments. The maximum diameter of stem (25.38 mm) was found due to application of pressmud (7.5 ton/ha) as compared to other organic treatments and found minimum (17.75 mm) in control. The increment in diameter of stem might be due to the role of pressmud in increasing of diameter of stem. Similar results also observed by Kothari, S.K., Bhattacharya, A.K., Singh, C.P., Singh, K. and Sushil Kumar (2000) [4] in tulsi.

Table 1: Effect of different type of organic sources in Plant growth characters.

Sl. No.	Treatments	Plant growth Attributing characters					
		Plant height (cm)	Number of branches per plant	Number of leaves per plant	Fresh leaves weight (kg per plant)	Dry leaves weight (kg per plant)	Diameter of stem (mm)
1.	Control	59.84	10.39	625.85	0.066	0.024	17.75
2.	FYM 5 t/ha	66.03	14.29	840.93	0.089	0.032	20.34
3.	FYM 7.5 t/ha	81.13	15.55	1044.88	0.110	0.040	23.95
4.	Vermicompost 2.5 t/ha	63.92	13.44	768.72	0.081	0.029	19.46
5.	Vermicompost 3.5 t/ha	63.35	13.54	804.74	0.085	0.031	19.66
6.	Pressmud 5 t/ha	72.30	14.42	918.37	0.097	0.035	21.14
7.	Pressmud 7.5 t/ha	85.85	17.25	1128.60	0.119	0.043	25.38
8.	Biofertilizer (PSB) 12 kg/ha	60.24	11.42	676.96	0.071	0.026	18.14
9.	FYM 5 ton/ha + PSB 12 kg/ha	74.10	14.91	927.11	0.098	0.036	21.85
10.	Vermicompost 2.5 t/ha + PSB 12 kg/ha	74.12	15.49	935.84	0.099	0.036	22.45
11.	Pressmud 5 t/ha + PSB 12 kg/ha	79.70	16.82	1066.10	0.112	0.041	25.13
SEm ±		5.81	0.32	1.94	0.01	0.01	1.79
C.D. at 5%		NS	0.95	4.94	0.03	NS	NS

Conclusion

The maximum plant height (85.85cm) was recorded with the application of pressmud 7.5 ton/ha as compare to other treatments. The maximum number of branch (17.25) and number of leaves (1128.60) were observed with the application of pressmud 7.5 ton/ha as compare to other treatments. The maximum fresh leaves weight (0.119 kg) was recorded with the application of pressmud 7.5 ton/ha as compare to other treatments. The maximum dry leaves weight (0.043 kg) and diameter of stem (25.38 mm) were recorded with the application of pressmud 7.5 ton/ha as compare to other treatments.

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