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Short communication

Organic manures a convincing source for quality production of Japanese mint (*Mentha arvensis* L.)

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ABSTRACT

Indiscriminate use of inorganic fertilizers is deleterious to soil health. Application of organic manures helps to maintain soil microbial population, soil fertility as well as enhance the oil quality of Japanese mint. Keeping in view, an experiment was conducted at G.B. Pant University of Agriculture and Technology, Pantnagar, district U.S. Nagar (Uttarakhand), India during 2013–2014 to study the response of organic manures on vegetative growth, herbage yield, oil recovery and oil quality in Japanese mint. The experimental treatments consisted of application of farmyard manure (FYM), vermicompost and poultry manure either singly or in combination along with control. The crop was transplanted on sandy loam soil, having pH 7.4 to study growth and yield parameters without degrading soil quality by using various nutrient compositions. In this investigation, highest yield attributes and oil yield of Japanese mint were recorded in combined application of FYM, vermicompost and poultry manure as compared with other treatments.

1. Introduction

Japanese mint or menthol mint (*Mentha arvensis* L.), belongs to the family Lamiaceae, a vast group of aromatic herbs of notable economic values. Its commercial cultivation makes for its essential oil, which is the main source of natural menthol (Croteau et al., 2005; Upadhyay et al., 2014). India ranks first in the global production and export of mint oil as well as its derivatives. Transplanting of Japanese mint in the months of March and April using nursery raised plantlets has been found to be successful and is being adopted by the majority of small and marginal mint growers in the Indo-Gangetic plains of north India. Nowadays, chemical fertilizers are indiscriminately used to boost up the agricultural production. This has drained the soil and a gradual loss of soil productivity while organic fertilizers paved the way to replenish the essential nutrients for improving soil health and crop productivity. Nutrient management through organic manures make a hygienic and beneficial way of disposal and utilization of waste and residues. Application of vermicompost in field crops is also gaining popularity due to its ultimate benefits to farmers. Use of farmyard manure (FYM), poultry manure, vermicompost, biofertilizers, neem cake, etc., has become imperative in medicinal and aromatic plants to meet the nutritional and health demand of the crop. Not only the type of cultivar but also the agronomical practices and environmental conditions affect the composition of sensory important compounds of aromatic oils (Jirovetz et al., 2003). Mint oil is used as an environment-friendly insecticide. Such essential oil has a variety of industrial applications such as therapeutic and cosmetic industries. To retain this environment friendly property of Japanese mint, organic production must be encouraged. Organic fertilizers are low-cost and eco-friendly inputs which have tremendous potential for supplying nutrients which can reduce the over-dependence on chemical fertilizers. The use of organic soil amendments has been associated with desirable soil properties including higher plant available water holding capacity and cation exchange capacity and lower bulk density, and can foster beneficial microorganisms (Drinkwater et al., 1995). Benefits of compost amendments to soil include pH stabilization and faster infiltration rate due to enhanced soil aggregation (Stamatiadis et al., 1999). Therefore, nowadays a trend of cultivation of medicinal and aromatic plants with the use of organic manures is increasing at a rapid pace, as they maintain the health of soil and form essential part of the sustainable farming. Keeping the views of the above aspects, the present research work was, therefore, undertaken to find out the response of organic manures on the vegetative and yield parameters of Japanese mint.

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Table 1
Treatment details of the experiment.

S. no.	Treatment	Treatment details
1.	T_1	Control
2.	T_2	Recommended doses of FYM (30 Mg ha^{-1})
3.	T_3	Recommended doses of vermicompost (15 Mg ha^{-1})
4.	T_4	Recommended doses of poultry manure (7.5 Mg ha^{-1})
5.	T_5	50% FYM (15 Mg ha^{-1}) + 50% vermicompost (7.5 Mg ha^{-1})
6.	T_6	50% FYM (15 Mg ha^{-1}) + 50% poultry manure (3.75 Mg ha^{-1})
7.	T_7	50% vermicompost (7.5 Mg ha^{-1}) + 50% poultry manure (3.75 Mg ha^{-1})
8.	T_8	33% FYM (10 Mg ha^{-1}) + 33% vermicompost (5 Mg ha^{-1}) + 33% poultry manure (2.5 Mg ha^{-1})

Table 2
Effect of different treatments on vegetative attributes of Japanese mint.

Treatments	Plant height (cm)	Plant spread (cm)	Number of primary branches plant^{-1}	Number of secondary branches plant^{-1}	Number of leaves plant^{-1}	Fresh weight plant^{-1} (g)	Dry weight plant^{-1} (g)	Total biomass plant^{-1} (g)	Leaf nitrogen content (%)
T_1	26.85	12.00	22	108	86	44.83	15.70	73.66	3.00
T_2	29.57	15.38	23	139	132	60.87	21.13	83.51	3.57
T_3	31.01	19.08	27	163	175	68.78	23.31	89.48	3.67
T_4	30.38	18.15	31	184	141	72.41	24.46	86.15	3.50
T_5	30.33	19.27	33	232	125	75.85	26.32	93.82	3.57
T_6	30.79	19.30	30	182	131	67.10	23.25	88.79	3.20
T_7	34.32	22.62	47	327	231	77.01	27.78	97.48	3.73
T_8	38.33	27.38	47	346	247	91.12	29.93	107.03	3.87
$CD_{(5\%)}$	1.91	2.50	7.01	2.73	17.91	4.45	0.68	3.83	0.21

T_1—control; T_2—recommended doses of FYM (30 Mg ha^{-1}); T_3—recommended doses of vermicompost (15 Mg ha^{-1}); T_4—recommended doses of poultry manure (7.5 Mg ha^{-1}); T_5—50% FYM (15 Mg ha^{-1}) + 50% vermicompost (7.5 Mg ha^{-1}); T_6—50% FYM (15 Mg ha^{-1}) + 50% poultry manure (3.75 Mg ha^{-1}); T_7—50% vermicompost (7.5 Mg ha^{-1}) + 50% poultry manure (3.75 Mg ha^{-1}); T_8—33% FYM (10 Mg ha^{-1}) + 33% vermicompost (5 Mg ha^{-1}) + 33% poultry manure (2.5 Mg ha^{-1}).

2. Materials and methods

2.1. Experimental site

The experiment was carried out during 2013–2014 at the Medicinal Plants Research and Development Center, G.B. Pant University of Agriculture and Technology, Pantnagar, district U.S. Nagar (Uttarakhand), India. Geographically, Pantnagar is situated at the foot hills of Himalayas at 29° North latitude and 79.3° East latitude. The altitude of the place is 244.0 m above mean sea level. The Tarai region is characterized by humid subtropical climate with maximum temperature ranging from 30 °C to 43 °C in summer and minimum ranging from 4.5 °C to 26.7 °C in winter. The summers are hot and dry, winters are cold and rains are heavy (average rainfall 1400 mm). Monsoon occurs from the third week of June to the end of September. July and August are the wettest months (mean 350–425 mm rainfall). The mean relative humidity remains almost 80–90% at 7:00 a.m. from mid of June to end of February and then it steadily decreases to 50% by the first week of May and remains till mid June. Frost can be expected from the last week of December to middle of February. Occasionally light rains are expected during winter.

2.2. Experimental design and details of treatments

The crop was transplanted in second fortnight of April, 2013 as per the randomized complete block design with three replications. The crop was transplanted at 45 cm and 30 cm as row to row and plant to plant spacing, respectively. Well rooted plants of *M. arvensis* cv. 'CIM-Saryu' of uniform size and 35 days stage were transplanted in the experimental field followed by a light irrigation. The total treatments (Table 1) and experimental units were 8 and 24, respectively. Quantity of organic manures applied to each treatment was calculated as per recommended dose of farmyard manure, vermicompost, and poultry manure as 30 Mg ha^{-1}, 15 Mg ha^{-1}, and 7.5 Mg ha^{-1}, respectively. The numerical data of all the components were subjected to analysis of variance (ANOVA) using randomized block design to calculate critical difference (CD). Statistical analysis of data was done following standard procedures (Snedecor and Cochran, 1967).

2.3. Observations

The crop was harvested at 90 days after transplanting in the field. Observations on fresh biomass yield were recorded by cutting the crop at ground level. Observations were recorded on vegetative parameters of growth (plant height, plant spread, number of primary branches plant^{-1}, number of secondary branches plant^{-1}, number of leaves plant^{-1}, fresh weight plant^{-1}, dry weight plant^{-1}, total biomass plant^{-1} and leaf nitrogen content) and on the yield parameters; fresh herbage yield (kg ha^{-1}), oil content (%), oil yield (kg ha^{-1}), and menthol content (%). The essential oil content in the fresh biomass was estimated by the hydro-distillation method using a Clevenger apparatus. Nitrogen was determined in plant sample through micro Kjeldahl digestion and distillation method. A total of ten leaves per plot were sampled from the lower part of the plant. The leaves were firstly washed with distilled water and then dried at 90 °C to prevent dry weight losses due to continuous respiration. The dried plant tissues were grinded and then these samples were kept in air tight polythene containers such as plastic bags to prevent absorption of water from the humid environment. The ready samples were processed for leaf nitrogen determination through micro Kjeldahl digestion and distillation method. Menthol content in essential oils was determined by gas chromatography (GC) analysis of the oil samples.

3. Results and discussion

The data related to the vegetative parameters of growth (Table 2) clearly showed significant differences between different treatments. Sole application of poultry manure 7.5 Mg ha^{-1} (T_4) recorded maximum number of primary branches plant^{-1} (31), number of secondary branches plant^{-1} (184), fresh weight plant^{-1} (72.41 g), dry weight plant^{-1} (24.46 g), while maximum