RESEARCH ARTICLE

Effect of Organic Inputs on Growth and Herbage Yield of Japanese mint (*Mentha arvensis*)

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ABSTRACT

Mentha is a commercially important herbal spice belonging to the family Labiatae (Lamiaceae). The evergreen herb (foliage) yields essential oil in distillation containing a large mixture of aroma-chemicals in varying compositions. As, the mint leaf is vitally used in our culinary preparations, there is a need to improve the herbage yield and optimize the usage of organic inputs for leaf production. Hence, the trial was taken to investigate the effect of organic manures (FYM, neem cake, vermicompost, biocompost) and biostimulants (Panchagavya and humic acid) on the growth and herbage yield of mint at the Department of Spices and Plantation Crops, Horticultural College & Research Institute, Tamil Nadu Agricultural University, Periyakulam. The highest plant height of 35.22 cm was recorded in plants applied with 50% N as FYM + 25% N as Vermicompost + 25% N as Neem cake + 3% Panchagavya as foliar spray (T_5). The more number of branches per plant of 25.67 was recorded in the plants which received 50% N as FYM + 25% N as Vermicompost + 25% N as Neem cake + 3% Panchagavya as foliar spray (T_5). The highest herbage yield of 7.68 tons per hectare and essential oil content (0.37%) were recorded in the plants raised in the soil supplemented with 50% N as FYM + 25% N as Vermicompost + 25% N as Neem cake + Panchakavya (3%) as foliar spray (T_5). In mint cultivation, the application of organic nutrients and inorganic fertilizers is commonly practiced to increase the herbage yield and quality of leaves. In view of the world demand for organic food, the enhancement of soil health, productivity, and the accessibility of local resources, cultivation under organic farming can be expected.

Keywords: *Bio-stimulants; Herbage; Mint; Organic nutrients; Panchagavya; Vermicompost.*

INTRODUCTION

Mint (*Mentha arvensis*), commonly known as Puthina in Tamil, is a perennial plant that belongs to the family Lamiaceae. It is known as Japanese mint, menthol mint, corn mint, wild mint, and field mint. It is originated in Eurasia; the genus includes 19 species and 13 natural hybrids (Kumar *et al*. 2011). *Mentha* species are rich in polyphenols (Tafrihi *et al*. 2021), and therefore Puthina is an essential medicinal plant (Rahman *et al*. 2014). *Mentha* has many versatile properties like antioxidant, antiallergic, antimicrobial, antiviral, antimycotic, anti-toxigenic, antifungal, antiparasitic, anti-inflammatory, antiseptic, insecticidal, anticancer and antitumor (Tafrihi *et al*. 2021). These properties contribute to its applications in the pharmaceutical and food industries. In addition, it is one of the world's oldest and most popular herbs and is widely used for culinary purposes due to its strong scent and flavour.

World production of Mentha oil is produced mainly from Japanese mint. It contributes more than 50% of Mentha oil production while peppermint oil production represent about 25% of the world's production while spearmint oil represent about 12.5% only (Kumar *et al.,* 2008). India is the largest producer and prominent exporter of menthol mint oil globally. The area under the menthol mint cultivation is about 2.5 lakhs hectare, about five lakh families dependent on menthol mint farming and generating income, more employment possibilities of about 50 million working days per annum (Nikil *et al*. 2021).

In the last few years, India has emerged as an export hub for mentha oil and its derivatives. It has contributed around 80 percent to the total global menthol mint oil production and the contribution had been varied between 14.50 Mt to 29.50 Mt. Apart

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from India, China, Brazil and the United States are significantly contributed to the global menthol mint production (Singh *et al.,* 2021). In India, Uttar Pradesh alone accounts for 80-85% of Indian mint production and remaining 15-20% comes from Punjab, Bihar, M.P., Haryana, Himachal Pradesh etc. The major export destination of menthol mint oil from India includes countries like China, USA, Singapore, Germany, Japan, the Netherlands, UK, Paraguay, Hongkong, Argentina, Brazil and France etc. With increase in production and export of menthol mint oil, consumption demand for menthol mint oil is also rapidly increasing in the international market. It creates billions of employment opportunities through its cultivation, value addition, and marketing.

Among the Horticulture crops, most of the spices and plantation crops are mainly cultivated by the application of organic manures to maintain its quality. Nitrogen is an element essential to plants; elements such as carbon, oxygen, hydrogen and sulfur combine even more valuable materials such as amino acids, nucleic acids, alkaloids and bases are produced. If nitrogen available to plants, than the limit may cause disturbances in the vital processes of plants that may be in different forms such as high growth, reduce, delay or even stop growth, may increase the incidence (Stewart *et al*, 2000). Since, mint is cultivated for it's green leaf, nitrogen plays a major role on growth, yield and keeping quality. Moreover, nitrogen availability from the applied sources to throughout the crop growth period is also of considerable importance. Research shows that appropriate amounts of nitrogen significantly increased the essential oil of peppermint (Omidbeygi, 2011). As mint is vitally used in our culinary preparations of south India, there is a need to improve the herbage yield and to optimize the usage of organic manures and bio-stimulants for leaf production. Therefore, taking the above facts into consideration, the present investigation has been undertaken to evaluate the effect of different organic manures and bio-stimulants on the growth and herbage yield of mint,

MATERIAL AND METHODS

The field experiment was conducted at the College Orchard, Department of Spices and Plantation Crops, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Periyakulam, during 2020-21 to 2021-22. The trial was taken to study the effect of organic manures (FYM, neem cake, vermicompost, biocompost – Sugar mill pressmud) and biostimulants (Panchagavya and humic acid) on the growth and herbage yield of mint. The field is located at 10˚12' North latitude and 77˚58' East longitude and at an altitude of 356 m above Mean Sea Level. The soil of the experimental field was red sandy loam in texture and pH of 7.3. The plot size was 3 × 3 m with a plant spacing of 40 × 40 cm having 56 plants per plot. The initial nutrient status of the soil was 175:17:312 kg NPK /ha. Regular cultural operations were followed for the mint as prescribed in Horticultural Crop Production Manual (Anon., 2018). The experiment was laid out in randomized block design with nine treatment combinations of organic manure and bio-stimulants replicated thrice. The treatment details are as follows.

Experiment code	Details
T_1	75% N as FYM + 25% N as Vermicompost + 3% Panchagavya
T_2	50% N as FYM +50% N as Vermicompost + 3% Panchagavya
T_3	25% N as FYM+ 75% N as Vermicompost + 3% Panchagavya
T_4	50% N as FYM + 25% N as Vermicompost + 25% N as Biocompost + 3% Panchagavya
T_5	50% N as FYM + 25% N as Vermicompost + 25% N as Neem cake + 3% Panchagavya
T_6	50% N as FYM + 25% N as Vermicompost + 25% N as Biocompost + Humic acid (0.5%)
T_7	50% N as FYM + 25% N as Vermicompost + 25% N as Neem cake + Humic acid (0.5%)
T_8	25% N as FYM + 25% N as Vermicompost + 25% N as Biocompost +25% N as Neem cake +3% Panchagavya + Humic acid (0.5%)
T_9	FYM (25 t/ha) + 75:75:50 NPK kg/ha (RDF)

Organic manures like farmyard manure, neem cake, vermicompost, and biocompost were applied in three split doses at three months intervals after each harvesting per the treatment schedule. The foliar spray of bio-stimulants *viz*., Panchagavya (3%) was given three times using hand sprayer at 30 days intervals. Humic acid (0.5%) was applied through soil application. Irrigation was given once in three days through drip. At the time of harvest (90-120 days after last crop), morphological parameters such as plant height (cm), plant spread (cm), number of branches per plant, number of leaves per branch, leaf area (cm^2) and herbage yield per plant (g) were recorded. In each treatment, five plants per replication were selected at random and utilized for recording observations on the above characters and the mean values were subjected to statistical scrutiny as suggested by Panse and Sukhatme (1985).

RESULTS AND DISCUSSION

In pooled mean, significant variation in growth attributes was observed due to foliar spray of biostimulants and nutritional treatments (Table 1). The highest plant height of 35.22 cm and a plant spread of 25.48 cm was recorded in plants applied with 50% N as FYM + 25% N as Vermicompost + 25% N as Neem cake + 3% Panchagavya as a foliar spray (T_5). The combined application of organic manures and bio-stimulants exerted a positive effect on the plant height and plant spread at the harvest stage. The increase in plant height and plant spread might be due to improvements in soil physical condition *viz.,* increased water holding capacity, improved particle density, pore spaces, texture and soil available nutrient status (Mbagulu, 1992). Abdullah Adil Ansari (2008) stated that organic amendments like vermicompost and vermiwash promote humification, increased microbial activity and enzyme production, which, in turn, bring about the aggregate stability of soil particles, resulting in better aeration and they also has a property of binding mineral particles like calcium, magnesium and potassium in the form of colloids of humus and clay, facilitating stable aggregates of soil particles for desired porosity to sustain plant growth. The possible reason for the acceleration of growth by the application of panchagavya might be due to the presence of nitrogen, the chief constituent of protein, essential for the formation of protoplasm which leds to cell division and cell enlargement.

A more number of branches per plant of 25.67 was recorded in the plants which received 50% N as FYM + 25% N as Vermicompost + 25% N as Neem cake + 3% Panchagavya as foliar spray (T_5). The number of leaves per plant (205.80) and leaf area (16.53 cm^2) was higher in the treatment T_5 (50% N as FYM + 25% N as Vermicompost + 25% N as Neem cake + 3% Panchagavya (3%)). The increase in the number of shoots, number of leaves, and leaf area might be attributed due to the presence of auxins, cytokinins and gibberellins-like substances present in the combined application of organic manure and foliar spray of panchagavya which would activate the cell division and cell elongation in the axillary buds thereby leading to the formation of more number of shoots and increased the number of leaves and leaf area in mint as attributed by Sridhar (2003) in *Solanum nigrum*, by Prabu and Arumugam Shakila (2013) in Japanese mint and by Irene and Syama (2018) in Palak. In the present study also, a foliar spray of panchagavya (3%) along with the combined application of FYM, vermicompost and neem cake resulted in enhancing the growth parameters. This might be due to the presence of optimum C: N ratio, which on decomposition releases nitrogen in the form of usable nutrient ions such as ammonium and nitrate. This increase in soil mineral constituents might have exerted better growth parameters, since nitrogen is the chief constituent of amino acid and coenzymes of biological importance (Balkly, 1974). This is in concurrence with the findings of Maheswarappa *et al*. (2001) in galangal, Subha *et al.* (2009) in curry leaf and Suresh *et al.* (2018) in mint.

In mint the major yield components are leaves. The highest herbage yield of 30.72 g per plant was recorded in the plants raised in the soil supplemented with 50% N as FYM + 25% N as Vermicompost + 25% N as Neem cake + 3% Panchagavya as foliar spray (T_5). Highest fresh herbage yield of 1.54 kg per plot (3 x 3 m) was recorded in the plants fed with 50% N as FYM + 25% N as Vermicompost + 25% N as Neem cake + Panchakavya (3%) as foliar spray (T_5). The highest estimated herbage yield of 7.68 tons per hectare was recorded in the plants raised in the soil supplemented with 50% N as FYM + 25% N as Vermicompost + 25% N as Neem cake + Panchakavya (3%) as foliar spray (T_5). The result is concurrence with the findings of Chitra *et al*., (2021) in curry leaf. The increased leaf yield might have occurred due to the presence of growth promoting hormones. This result is found to be in accordance with Madhavi Latha and Veena Joshi (2013) in palak and amaranthus, who stated that the application of organics attributed to better growth of plants and higher yields by slow release of nutrients for absorption with additional production of plant growth promoting substances like giberellin, cytokinin and auxins. Abdullah Adil Ansari (2007) observed that better growth of plants and higher yield in onion by slow release of nutrients for absorption with additional nutrients like giberellin, cytokinin and auxins, by the application of organic inputs like vermicompost in combination with vermiwash.

The highest essential oil content (0.37%) was recorded in the plants raised in the soil supplemented with 50% N as FYM + 25% N as Vermicompost + 25% N as Neem cake + Panchakavya (3%) as foliar spray (T_5). In aromatic plant such as Mnit essential oils were increased with increase of leaf area (Guillén *et al*, 1996). The possible reason for the improvement of essential oil content by organic manure application with foliar spray of panchagavya might be due to supply of sufficient quantity of nitrogen, which was essential compound in many amino acids and lipids associated with the production of more number of leaves, which consequently would have increased the number of oil glands resulting in higher oil content. Similar influences were also reported by Panduranga Shenoy (1980) in davana (*Artemisia pallens* Wall.), Arularasu (1995) in *Ocimum Sanctum*, Hazarika *et al.* (1978) in palmarosa and Vadivel and Sampath (1981) in bergamot mint and Sadasakthi (1986) in marjoram.

The BCR was the highest (2.81) in T_5 *i.e.*, application of 50% N as FYM + 25% N as Vermicompost + 25% N as Neem cake + Panchakavya (3%) as foliar spray followed by T_4 (50% N as FYM + 25% N as Vermicompost + 25% N as Biocompost + 3% Panchagavya) (2.51). The treatment T_9 (control) recorded the lowest BCR (1.63) (Table 1).

Yield is a complex phenomenon which can be controlled both by morphological and physical parameters, and it can also be manipulated by either genetic factors or cultural operations. In the present investigation, the highest number of laterals, number of leaves and herbage yield were registered in the treatment which received the combined application of FYM, vermicompost, neem cake and foliar application of panchagavya 3 per cent. The results of the study are in line with the findings of Singh and Ramesh (2002).

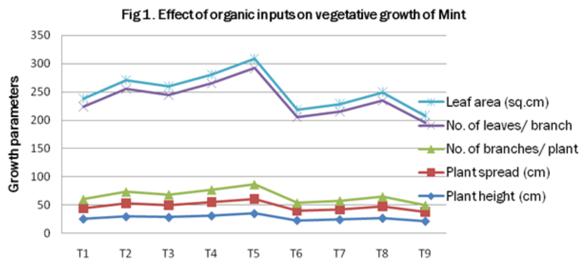

Table 1. Effect of organic inputs on herbage yield and BCR of Mint

Treatments	Herbage yield/plant (g)	Herbage yield / plot (kg) (3 x 3 m)	Herbage yield/ hectare (t)	BCR
T_1	22.20	1.11	5.55	2.15
T_2	26.12	1.31	6.53	2.44
T_3	24.80	1.24	6.20	2.29
T_4	27.32	1.37	6.83	2.51
T_5	30.72	1.54	7.68	2.81
T_6	20.16	1.01	5.04	1.75
T_7	21.35	1.07	5.34	1.96
T_8	23.64	1.18	5.91	2.27
T_9	18.88	0.94	4.72	1.63
Mean	**23.91**	**1.20**	**5.98**	-
SEd	**0.40**	**0.02**	-	-
CD (0.05)	**0.84**	**0.05**	-	-

Conclusion

Based on the findings of the present study, it can be concluded that combined application of (T_5) 50% N as FYM + 25% N as Vermicompost + 25% N as Neem cake + Panchakavya (3%) as foliar spray has beneficial effect on the growth, yield and oil content of mint.

Ethics statement

No specific permits were required for the described field studies because no human or animal subjects were involved in this research.

Originality and plagiarism

We ensure that we have written and submitted only entirely original works, and if we have used the work and/or words of others, that has been appropriately cited.

Consent for publication

All the authors agreed to publish the content.

Competing interests

There was no conflict of interest in the publication of this content

Data availability

All the data of this manuscript are included in the MS. No separate external data source is required. If anything is required from the MS, certainly, this will be extended by communicating with the corresponding author through corresponding official mail: rchitra@tnau.ac.in.

Author contributions

Research grant, Idea conceptualization, Experiments, Guidance, Writing-original draft, Writing-reviewing & editing – RC.

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