Available online www.jocpr.com

Journal of Chemical and Pharmaceutical Research, 2020, 12(12):30-34

Research Article

ISSN: 0975-7384
CODEN(USA): JCPRC5

The Effect of Plant Spacing on Growth and Essential Oil Yield of Peppermint (Mentha Piperita L.)

Taha Mohammed Sharief Mohammed[1]*, Sahar Musa AbdallaMohammed[1]

[1]*Department of Horticulture, Faculty of Agriculture, University of Zalingei, Zalingei, Darfur, Sudan*

ABSTRACT

An experiment was conducted to study the effect of plant spacing on herbaceous yield and oil yield of peppermint (Mentha piperiata L.) in Zalingei during 2018. Four levels of spacing were assigned to complete randomized plot design with four replications. Data on fresh leaf yield, dry leaf yield, fresh aboveground biomass yield, dry above-ground biomass yield essential oil (EO) content and EO yield were collected and analyzed. Row spacing significantly influenced all the parameters except for fresh leaf/stem ratio, dry leaf/stem ratio and EO content during the experiment. Row spacing affected fresh leaf yield, fresh above-ground biomass yield, dry above-ground biomass yield, significantly ($P < 0.05$) and dry leaf and EO yield highly significantly ($P < 0.01$). Fresh leaf and EO yield varied from 3,650.9-10,882.1 and 10.2-18.8 kg/ha, respectively and maximum values were obtained at the harvesting age of 120 days after planting at first harvest. Maximum yield of 62.89 kg/ha fresh leaf obtained with 10 cm row spacing and 0.50 kg/ha EO was obtained with a 40-cm row spacing and not significantly different with 10 cm row.

Keywords: Peppermint; Mentha; Limonene; Herbage yield; Lamiaceae; Mentha Piperiata; plant spacing.

INTRODUCTION

Mentha, commonly called mint, is a genus in the Lamiacae. The genus consists of 25–30 species [1]. Many varieties of mint exist and the cultivars selected for commercial production are generally specific to a geographic area. In the eastern hemisphere the most common species grown and studied is M. arvensis [2]. Mentha arvensis is commonly called field mint, wild mint, corn mint, or Japanese mint [3]. Mentha spicata, spearmint, and M. pepreti, peppermint, are the most common species cultivated in the western hemisphere [4]. Spearmint and peppermint are economic crops that are used raw or processed into oil for a variety of consumption purposes. Although mint grows the best in partially shaded, cool, moist areas [5], it can be grow in a wide range of environments when provide water. Mint tolerates many climates, growing throughout areas of Europe, Asia, North America, Australia and Africa [6]. Mint is propagated by division or from cuttings. Most mint producers harvest 3-4 years before replanting. Mint is harvested for fresh consumption and for processing. Mint hay is mown and dried for several days before being collected for distilling. Mint oil is extracted by steam at distilleries located not far from the mint production areas. Once oil is extracted, dealers create different oil blends for manufactures. Mint has medicinal and culinary uses. In the past, beneficial attributes and uses of the raw mint and mint oil have been passed down through tradition or folklore [7] (Pirbalouti et al., 2010). Fresh mint provides aroma and flavor to many foods [8] (Park et al., 2002). Mint is used in salads, chutneys, garnishes and dips. Mint flowers, stems and leaves are commonly used to make herbal tea, Liqueurs and candies are also flavored with mint. Dried mint is an additive in commercial spice blends [[9] (Kothari and Singh, 1995; [10] Moreno et al., 2002). Mint has historically been used as an anti-inflammatory, a carminative, an antiemetic, and a diaphoretic. Traditionally, mint has been prescribed as a treatment for flatulence, nausea, bronchitis, anorexia, and colitis [11] (McKay and Blumberg, 2006). Mint also is used a gastric stimulate [[12] (Budavari et al., 1989; [13] Gupta, 1991)] and an antispasmodic [14] (Iscan et al., 2002). Mint oil is widely used as a component of commercial medicines such as cough drops and cough syrups and poison ivy [15] (Kor, 2015). Mint oil can be used as a topical analgesic for muscle aches, cramps, arthritis, tendinitis and sprains. Mint oil is an antipruritic and can treat mosquito bites [16] (Khanzada, 2012). Cosmetically mint is used for aromatherapy. Mint is added to products to lend scent and enhance fragrance [17] (Herro and Jacob, 2010). Mint is widely used in beauty products and is added to shampoos, lotions, and balms. Mint is also added to some cigarettes to lessen the bitterness of tobacco [16] (Khanzada, 2012). Mint oil has also been shown to be an environmentally safe insecticide [18] (Nerio et. al, 2010). Both fresh and dried spearmint plants are widely used in a variety of application [19] (Kee et. al., 2017).

CONSTITUENTS

The constituents found in spearmint are shown in Table 1. Carvone, a phenolic compound, is the main constituent found in spearmint oil, followed by limonene [[20] (Jirovetz et. al., 2002 and [21] Snoussi et. al., 2015)]. Carvone is reported to be potential in inhibiting bacterial growth [22] (Helander et. at., 1998), as well as to act as fungicide [23] (Smid et. al., 1995) and insect repellent [24] (Lee et. al., 1997). Carvone also reversibly suppresses the sprouting in stored potatoes or flower bulbs [24] (Kerstholt et. al., 1997).

Compound	**Percentage (%)**	Compound	Percentage (%)
β - myrcene	0.25	Trans-carveol	0.30
Limonene	11.50	Carvone	78.76
Γ-terpinene	0.16	Dihydrocarvyl acetate	0.57
Menthone	1.01	L-carveol	0.32
Menthol	1.00	β – bourbonene	1.23
Terpinen-4-ol	0.99	Trans-caryophyllene	1.04
Ɑ-terpinol	0.31	γ – amorphene	0.21
Dihydrocarveol	0.22	ɑ-amorphene	0.16
Cis-dihydrocarveol	1.43	Other compounds	Other compounds
Dihydrocarvone	0.43	Total	100.00

(Adapted from Shahbazi, [25])

Material and Methods

The field experiment was conducted at the department of horticulture nursery of the faculty of agriculture of University of Zalingei during summer season of 2018. The nursery is located 1km away from Zalingei Nyala road at 12°.56 N latitude and 23°.30 E longitude and about 900 meters above the mean sea level. Summer is hot and dry; winter is cold and it’s raining in autumn. The experimental design was complete randomize plot design with four plant spacing and four replications. The crop was kept free from weeds by hand weeding. Sampling was performed from 4 middle rows in appropriate times. Plants were harvested at physiological maturity stage when plants lower leaves turn into yellowed. Five plants randomly were selected in each plot to measure the plant height, crop spread, and herbage yield, oil and suckers yield. The data relating to each character were analyzed statistically by applying the technique of analysis of variance and the significance was tested by "F" test (statistix 8). The data relating to each character were analyzed statistically by applying the technique of analysis of variance and the significance was tested by "F" test (statistix 8).

Results and Discussion

Herbage yield

Herbage yield is considered to be a function of various source of planting materials were planted (Table 2). The highest herbage (62.89. kg/ha) and branches yield (99.09kg/ha) were recorded with the closer plant spacing compared with the wider spacing. Among the plant spacing treatments, wider space (40cm) was recorded the highest herbage (no of leaves) yield (87) and fresh weight for the whole plant biomass (77.05kg/ha) and fresh leave weight (47.68 kg), respectively, in comparison to closer spacing (10-20 cm) treatment. Plant spacing (10-20 cm) also showed that significantly higher herbage yield (318.2 g/m2) compared to 40 cm spacing (Table 2). Its might be due to influenced by closer and wider spacing on herbage and suckers yield m2 contributed maximum yield which ultimately increased the yield. Similar results were supported by [25] Nakawuka et al., 2014, [26] Patra et al., 2000 and [27] Rathi et al., 2014 and [28] Shormin, 2009.

From the above discussion, consequently, it may be concluded that menthol-mint was most responsive to whole shoot treatment and wider space (30-40 cm) for growth, essential oil and suckers yield in comparison with upper portion of shoot (top plant part) and lower portion of shoot (lower plant part) treatments along with closer (10-20 cm)) spacing treatment under irrigated conditions of Zalingei. Thus, it is concluded that combined application of whole shoot treatment and wider spacing (30-40 cm) may serve as a potent source for the eco-friendly, economically, and quality cultivation of menthol-mint in northern Indian plain zones.

Table (2) Effect of spacing on yield and oil content

spacing	leaves	branches	height	Yield (g/m^2)	oil	Fresh leaves yield kg/ha	Fresh whole plant yield kg/ha	Dry whole plant yield kg/ha
10cm	83.80 a	13.15 a	8.32 A	318.2 a	0.46 a	62.89 a	99.09 a	22.73 a
20cm	58.65 a	10.65 a	9.00 A	315.2 a	0.45 a	52.27 b	77.72 b	17.40 b
30cm	79.20 a	11.55 a	9.82 A	301.8b	0.44 a	43.81 c	65.83 b	13.76 c
40cm	87.00 a	11.15 a	9.10 A	270.2b	0.50 a	47.68 bc	77.05 b	16.58 bc
LSD	48.68	6.9272	3.1794	31.65	0.05	5.85	13.70	3.17

CONCLUSION

Results showed that the narrower spacing (20 cm) showed a significant increase in plant height, number of leaves and herb yield than 30 cm and 40 cm spacing. In contrast, wider spacing (40 cm) significantly promotes branching. However, oil content not greatly affected by spacing, while seasonal variation affected oil content.

REFERENCES

[1] Ali MS, Saleem M, Ahmad W, Parvez M, Yamdagni R. *A chlorinated monoterpene ketone, acylated b-sitosterol glycosides and a flavanone glycoside from Mentha longigolia (Lamiaceae).* Phytochemistry. **2002**,59,889–895.

[2] Kumar S, Bahl JR, Bansal RP, Kukreja AK, Garg SN, Naqvi AA, Luthra R, Sharma S, Kumar S, Dwivedi S, Singh AK. *Profiles of the essential oils of Indian menthol mint Mentha arvensis cultivars at different stages of crop growth in northern plains*. J. of Medicinal and Aromatic Plant Sciences.**2000**,22,774-786.

[3] Singh AK, Raina VK, Naqvi AA, Patra NK, Kumar B, Ram P, Khanuja SPS. *Essential oil composition and chemo arrays of menthol mint (Mentha arvensis L. f. piperascens Malinvaud ex. Holmes) cultivars*. Flavors and Fragrance Journal.**2005**,20,302-305.

[4] Ullah N, Khurram M, Amin MU, Khan TA, Khayyam SU, Khan FA, Najeeb U, Ullah S. *Impact of geographical locations on Mentha spicata antibacterial activities.* J.Medicinal Plants Research .**2012,**6,1201-1206.

[5] Bradley PR. *A handbook of scientific information on widely used plant drugs. British Herbal Pharmacopoeia. British Herbal Medicine Association.* British herbal compendium. Hackensack.**2002**,1.

[6] Brickell C, Zuk JD. *The American Horticultural Society, Encyclopedia of Garden Plants*.**1997.**

[7] Pirbalouti AG, Malekpoor F, Enteshari S, Yousefi M, Momtaz H, and Hamedi, B. *Antibacterial activity of some folklore medicinal plants used by Bakhtiari tribal in Southwest Iran*. International Journal of Biology. **2010**, 2,55.

[8] Park KJ, Vohnikova Z. and Brod FPR. *Evaluation of drying parameters and desorption isotherms of garden mint leaves (Mentha crispa L.)*. J. Food Engineering.**2002**, 51,193-199.

[9] Kothari, S.K. and Singh, U.B. *The effect of row spacing and nitrogen fertilization on scotch spearmint (Mentha gracilis Sole).* Journal of Essential Oil Research.**1995**,7,287–297.

[10] Moreno L, Bello R, Primo-Yúfera E, Esplugues Phar*macological properties of the methanol extract from Mentha suaveolens Ehrh*. Phytotherapy Research.**2002**,16,10-13.

[11] McKay DL, Blumberg JB. *A review of the bioactivity and potential health benefits of peppermint tea (Mentha piperita L.)*. Phytotherapy Research.**2006**,20,619-633.

[12] Budavari S, O'Neil MJ, Smith A, Heckelman PE. *The Merck Index. An encyclopedia of chemicals, drug, and biologicals*.**1989**,11.

[13] Gupta R. *Agrotechnology of medicinal plants. In: Wijesekera, R.O.B. (ed). The medicinal plant industry. CRC Press, Boca Raton.***1991**,43–57.

[14] Iscan G, KIrimer NESE, Kürkcüoglu M, Baser HC, Demirci F. *Antimicrobial screening of Mentha piperita essential oils*. Journal of Agricultural and Food Chemistry.**2002**,50,3943-3946.

[15] Kor NM. *Physiological and pharmaceutical properties of peppermint as a multipurpose and valuable medicinal plant: A Systematic Review*. Journal of Medical Science,**2015**,4,413-420.

[16] Khanzada SA, Naeemullah M, Munir A, Iftikhar S, Masood S. *Plant parasitic nematodes associated with different Mentha species.* Pakistan Journal Nematology.**2012,**30,21-26.

[17] Herro E. Jacob SE. *Mentha piperita (peppermint).* Dermatitis.**2010,**21,327-329.

[18] Nerio LS, Olivero-Verbel J, Stashenko E. *Repellent activity of essential oils: a review. Bioresource Technology*.**2010**,101,372-378.

[19] Kee LA, Shori AB, Baba AS. *Bioactivity and health effects of Mentha spicata.* Integr Food Nutr Metab,**2017**, 5(1),1-2.

[20] Jirovetz L, Buchbauer G, Shahabi M, Ngassoum MB. *Comparative investigations of the essential oil and volatiles of spearmint*. Perfume Flavor.**2002,**27,16-22.

[21] Snoussi M, Noumi E, Trabelsi N, Flamini G, Papetti A, De F. *Mentha spicata essential oil: chemical composition, antioxidant and antibacterial activities against planktonic and biofilm cultures of Vibrio spp. strains.* Molecules.**2015**,20, 14402–14424.

[22] Helander IM, Alakomi HL, Latva-Kala K, Mattila-Sandholm *Characterization of the action of selected essential oil components on Gram-negative bacteria*. J Agri Food Chem.**1998**,46,3590-3595.

[23] Patra, D.D., Anwar, M. and Chand, S. *Integrated nutrient management and waste recycling for restoring soil fertility and productivity in Japanese mint (Mentha arvensis) and mustard (Brassica juncea) sequence in Uttar Pradesh, India. Agric*. Ecosystem. Environ,2000,80,260-75.

[24] Smid EJ, de Witte Y, Gorris LG. *Secondary plant metabolites as control agents of postharvest Penicillium rot on tulip bulbs. Postharvest Biol Technol*.**1995**,6, 303-312.

[25] Kerstholt RPV, Ree CM, Moll HC. *Environmental life cycle analysis of potato sprout inhibitors*. Indus Crops Prod.**1997**, 6,187-194.

[26] Lee S, Tsao R, Peterson C, Coats JR. *Insecticidal activity of monoterpenoids to western corn rootworm (Coleoptera: Chrysomelidae), two spotted spider mites (Acari: Tetranychidae), and house fly (Diptera: Muscidae).* J Econo Entomol.**1997**, 90,883-892.

[27] Shahbazi Y. *Chemical Composition and In Vitro Antibacterial Activity of Mentha spicata Essential Oil against Common Food-Borne Pathogenic Bacteria*. JPathog. **2015**,5.

[28] Nakawuka P, Peters TR, Gallardo KR, Gonzalez DT. Okwany, R.O, Walsh DB, *Effect of deficit irrigation on yield, quality and costs of the production of native spearmint*. J. Irrig. **2014**,20,140- 149.

[29] Rathi AS, Kumar A, Mishra MK, Kumar R.Kant L. *Intercropping of menthol mint (Mentha arvensis L.) in bed planted wheat (Triticum aestivum L.) in Rampur district of Uttar Pradesh. J. Krishi Vigyan*. **2014**,2(2), 53-55.