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# COMPARATIVE PERFORMANCE OF SIX MINT GENOTYPES FOR YIELD AND QUALITY

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## Abstract

An experiment was conducted at the research field and laboratory of the Department of Horticulture, Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU) during June to December 2014 to evaluate comparative performance of six mint *(Mentha* sp.*)* genotypes for high yield and quality. Cuttings of previously selected six genotypes of mint (viz., MP-1, MP-4, MP-5, MP-9, MP-18, and MP-19) were used as plant materials. The highest canopy diameter was recorded from MP-4 (7315.3 $cm^2$) followed by that from MP-9 (7213.4 $cm^2$). Plant height ranged from 49.1 to 76.3 cm. The highest foliage yield (2.93 $kg/m^2$) was recorded from MP-1, which was closely followed by that from MP-9 (2.73 $kg/m^2$) and MP-4 (2.66 $kg/m^2$). More or less similar results were obtained in case of dry matter. The highest oil content was found in MP-9 (2.3%), which was statistically similar to that of MP-4 (2.1%) and MP-5 (2.1%). Therefore, MP-1 may be selected for foliage production, MP-4 for oil yield, and MP-9 for both foliage and oil production.

**Keywords**: Mint yield, dry matter, oil content.

## Introduction

Mint (*Mentha* sp.), commonly known as pudina is a perennial plant that belongs to the family Lamiaceae and has approximately 25 species (Harley and Brighton, 1977). The major species are peppermint (*Mentha piperita)*, spearmint (*M. spicata*), wild mint (*M. arvensis*), pennyroyal (*M. pulegium*), and berg mint (*M. citrate*). Peppermint and spearmint are the most commercially exploited species of mint (Sharangdhar, 2008). Mint is native to the Mediterranean and Western Asia, mints interbreed often makes it difficult for even an expert to distinguish all the varieties. All mints contain the volatile oil menthol, which gives mint that characteristic cooling, cleansing feeling (Curci, 2012). Mint is also rich in Vitamins A and C and also contains smaller amounts of Vitamin $B_2$. The chemical compound menthol, which is obtained from mint oil, is well known for its healing properties on the chest and respiratory system (Anon., 2012).

Mint is a storehouse of medicinal properties. It is an air freshener, mouth freshener, antacid, helps in digestive problems, soothes frayed nerves and may even cure cancer. Many people due to rare chances of side effects prefer herbal remedies and their safer products. Mint is widely used in commercially manufactured products, cooking and medicine for its aromatic and flavoursome qualities. Peppermint, one of the most popular species of the mint plant, can be found in toothpaste, chewing gum, mouthwash, soaps, sweets, balms or creams, cough medicine, etc. (Alvi *et al.,* 2001). It is used in medicine, and cosmetic industry all over the world including Bangladesh.

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The United States is the world's main producer of mint oil, which is extracted mainly by steam distillation and solvent extraction (Gupta, 1991). In Asia, India, Afghanistan, and Pakistan are main producers of mint (Sharangdhar, 2008). Considering the importance of this high value profitable crops and world demand, recently, Afghanistan has completed a project on mint with the help of ICARDA. They have collected several genotypes of mint and selected high yielding cultivar that yielded 13.75 tons per hectare foliage compared to a yield range of 5.35-11.40 tons per hectare in other cultivars. It was calculated a net average profit of US$ 8,515/ha and that was much higher than average income from opium poppies. They have also produced mint oil, mint water, and dried mint and sold in domestic and international market under the project activities using simple distillation plant. Moreover, they have trained and engaged 6,340 female members of different families in producing different mint products from which the females earned for their families and help towards empowerment (Anon., 2008).

In Bangladesh, mint is grown scattered all over the country. Although, it has immense importance and demand in different cosmetic and medicine industries as well as to the consumers, but there is no statistics available in this country about area and production of mint. Presently, mint oil is imported from abroad for using in industries. The Department of Horticulture, BSMRAU has collection of 22 genotypes of mint, which were collected through a MoST funded project in the year 2012-13 from different parts of Bangladesh (Hoque, 2013). These collected genotypes have been maintained and characterized in the previous years, and six genotypes have been selected as promising for cultivation. Moreover, *in-vitro* propagation protocol has also been developed from those project activities. Therefore, it is needed to evaluate those promising genotypes of mint and standardize their production package. Considering the above facts, the present investigation has been undertaken to evaluate the selected six mint genotypes with a view to finding out suitable one for commercial cultivation.

**Materials and Methods**

The experiment was conducted at the research field of the Department of Horticulture, BSMRAU, Gazipur during June 2014 to December 2014. Six selected mint genotypes were evaluated to select the best adapted one(s) to the local environmental conditions for high yield and quality. In this regard, cuttings of previously selected genotypes of mint viz., MP-1, MP-4, MP-5, MP-9, MP-18, and MP-19 were used as plant materials. The upper portions of the aerial stem with at least five nodes were used as planting materials. The experiment was designed following the Randomized Complete Block Design with three replications, where the cuttings were planted at a spacing of 45 cm × 45 cm on 05 June 2014. Before planting, plots were fertilized @ 120 kg N/ha, 50 kg P/ha, and 40 kg K/ha (Rahman, 2014). Irrigation, weeding, and other intercultural operations were done as per necessity to raising a good crop. The unit plot size was 1.8 m × 1.2 m. Harvesting was done at 60, 90, and 120 DAP. Data on growth habit, canopy diameter, plant height, branch density, main stem diameter, stem color, stem hair, hair density, leaf length, leaf width, leaf color, leaf shape, foliage yield, dry matter and oil content were recorded. Data on different qualitative parameters were collected following draft descriptor list of *Mentha piperita* L. (Anon., 2011). Soxhlet apparatus was used to extract mint oil according to the method described by Almeida *et al*. (2012), where *n*-hexene was used as solvent. The collected data were analyzed using MSTATC-C program and means were separated using DMRT.

**Results and Discussion**

Growth habit, canopy diameter, plant height, and branch density in different genotypes of mint are presented in Table 1. Among six studied genotypes, five genotypes produced spreading type and only one produced erect type plant. Canopy diameter in the genotypes varied significantly. Canopy diameter was recorded highest in the genotype MP-4 (7315.3 $cm^2$), which was statistically similar with the canopy diameter of MP-9 (7213.4 $cm^2$) but significantly differed from other genotypes. Canopy diameter is an important criterion for a crop as it determines the spacing of that particular crop. Crop that has higher canopy needs higher spacing for producing maximum yield. Canopy diameter was the lowest in the genotype MP-1 (1819.0 $cm^2$). Plant height among the genotypes also varied significantly and ranged from 49.1 cm (MP-18) to 76.3cm (MP-4). The highest plant height was found in the genotype MP-4 (76.3 cm), which was statistically similar with the height of MP-9 (66.3 cm), but significantly differed from others. Hoque (2013) also reported to have more or less similar plant height (25.7 cm to 84.3 cm), which authenticated the present findings. Islam *et al.* (2003) reported to have a variable plant height using different levels of NPK fertilizers. Branch density also varied among the genotypes. The highest plant density (7.0) was recorded in the genotype MP-19 and the lowest branch density (3.0) was recorded in the genotypes MP-4, MP-9, and MP-18 (Table 1). Branch density is an important factor as higher branch density ensures higher amount of leaves, which is expected in a leafy crop like mint.

The highest diameter of main stem (4.7 mm) were recorded in the genotype MP-9, which was statistically similar to MP-4 (4.5 mm) and MP-18 (4.1 mm), but significantly differed with other genotypes. Stem color in the genotypes were purple, violet, purple

**Table 1. Growth habit, canopy diameter, plant height, and branch density in six different genotypes of mint**

| Genotype | Growth habit | Canopy diameter ($cm^2$) | Plant height (cm) | Branch density |
|---|---|---|---|---|
| MP-1 | Spreading | 1819.0 c | 55.5 bc | 5.0 b |
| MP-4 | Spreading | 7315.3 a | 76.3 a | 3.0 c |
| MP-5 | Spreading | 3777.0 b | 55.7 b | 5.0 b |
| MP-9 | Spreading | 7213.4 a | 66.3 ab | 3.0 c |
| MP-18 | Erect | 2075.0 c | 49.1 c | 3.0 c |
| MP-19 | Spreading | 2384.3 bc | 62.1 b | 7.0 a |
| CV(%) | - | 11.9 | 13.4 | 6.6 |
| F-value | - | * | * | * |

Means followed by same letter(s) in a column do not differ significantly by DMRT

green, and green. Stem hair was found absent in all the genotypes except MP-18. Stem hair density of MP-18 was found dense (Table 2).

Leaf characters of different mint genotypes are presented in Table 3. Leaf color in MP-4 was dark green, MP-1, and MP-5 was light green, while in others, it was green. Length of leaf varied from 4.1 to 8.7 cm. The highest leaf length was found in the genotype MP-4 (8.7 cm), which was statistically similar with the length of MP-9 (7.6 cm) and MP-18 (8.0cm) but significantly differed from the others. The highest width of leaf was observed in the genotype MP-1 (2.9 cm) and that was statistically similar with other genotypes except MP-5 (2.3 cm). Variable shape of leaves was produced by different genotypes. However, leaf shape in MP-18 was lanceolate, MP-1 and MP-5 was ovate-oblong, MP-9 was ovate-lanceolate, MP-19 was ovate, and in MP-4 was oblong-lanceolate (Table 3).

Foliage yield, dry matter and oil content in different mint genotypes are presented in Table 4. It is revealed from the table that foliage yield per plant ranged from 312.5g to 536.7g. The highest foliage yield per plant was recorded in the genotype MP-9 (536.7g), which was statistically similar to the foliage yield of MP-1 (519.2g) and MP-4 (483.3g) but significantly differed from other genotypes. Likewise, foliage yield (kg/m$^2$) also varied significantly and ranged from 1.96 kg/m$^2$ to 2.93 kg/m$^2$ (Table 4). This differed with a project completion report, where the recorded foliage yield was found to range from 2.67 kg/m$^2$ to 6.87 kg/m$^2$ in different local mint genotypes (Anon., 2008). The difference in yield might be due to locality, production technique, season, management practice, and prevailing environment. Hoque *et al*. (2015) recorded more or less similar yield in different mint genotypes, which supported the present findings. Kattimani (2000) recorded to have an average of 28.36 mt/ha total biomass yield in mint, where they used 8-9 cm long runner cuttings bearing 2-3 pair of small leaves as planting material. Moreover, he used 60 cm row spacing, which was different from the present investigation.

Dry matter (%) of leaf in the studied genotypes also varied significantly. The highest leaf dry matter was recorded in the genotype MP-1 (19.3%), which was statistically similar to that of MP-9 (17.5%), MP-18 (19.1%), and

**Table 2. Main stem diameter, stem color, stem hair and stem hair density in six different genotypes of mint**

| Genotype | Main stem diameter (mm) | Stem color | Stem hair | Stem hair density |
|---|---|---|---|---|
| MP-1 | 3.4 c | Purple | Absent | Nil |
| MP-4 | 4.5 ab | Purple green | Absent | Nil |
| MP-5 | 3.2 c | Violet | Absent | Nil |
| MP-9 | 4.7 a | Violet | Absent | Nil |
| MP-18 | 4.1 a | Green | Present | Dense |
| MP-19 | 3.9 bc | Purple | Absent | Nil |
| CV(%) | 12.1 | - | - | - |
| F-value | * | - | - | - |

Means followed by same letter(s) in a column do not differ significantly by DMRT

**Table 3. Color, length, width of fully grown leaf and length of petiole in six different mint genotypes**

| Genotype | Color of leaf | Length of leaf (cm) | Width of leaf (cm) | Leaf shape |
|---|---|---|---|---|
| MP-1 | Light green | 5.4 b | 2.9 a | Ovate-oblong |
| MP-4 | Dark green | 8.7 a | 2.6 ab | Oblong-lanceolate |
| MP-5 | Light green | 4.1 b | 2.3 b | Ovate-oblong |
| MP-9 | Green | 7.6 a | 2.8 a | Ovate-lanceolate |
| MP-18 | Green | 8.0 a | 2.6 ab | Lanceolate |
| MP-19 | Green | 4.6 b | 2.8 a | Ovate |
| CV(%) | - | 9.6 | 10.2 | - |
| F-value | - | * | * | - |

Means followed by same letter(s) in a column do not differ significantly by DMRT

MP-19 (18.2%) but significantly differed with other genotypes (Table 4). Islam (2013) found variable dry matter in mint by using different spacings and planting materials. In case of oil content, a significant variation was found among the genotypes and it ranged from 1.1 to 2.3%. The genotype MP-19 produced the highest oil content (2.3%), which was statistically similar to MP-4 (2.1%) and MP-5 (2.1%) and significantly differed from that of other genotypes. This result slightly differed from the findings reported by Islam *et al.* (2003). They obtained a range of 0.75- 1.82% oil content in Mint. This discrepancy might be due to differences of cultivars, locations, management practices, nutrient content of plants, age of plant, and many other factors (Hoque, 2013). Yaseen *et al*. (2000) reported to have low oil production in different cultivars of mint at closer spacing. Whereas, Ali *et al.* (1999) found that plants harvested repeatedly whenever they attained a height of 15.0 cm produced maximum leaf dry matter and oil content in mint. Srivastava *et al.* (2000) reported that the harvest of immature or over mature mint plants gave lower yields of oil, which had higher percentages of inferior terpenoids. Vikrant *et al*. (2004) obtained maximum mint oil when they applied nitrogen @160 kg N/ha. Kumar *et al*. (1999)

**Table 4. Foliage yield, dry matter, and oil content in six different mint genotypes**

| Genotype | Foliage yield/ plant (g) | Foliage yield ($kg/m^2$) | Dry matter (%) of leaf | Oil content (%) |
|---|---|---|---|---|
| MP-1 | 519.2 ab | 2.93 a | 19.3 a | 1.3 c |
| MP-4 | 483.3 ab | 2.66 a | 16.1 bc | 2.1 a |
| MP-5 | 312.5 c | 1.97 b | 14.5 c | 2.1 a |
| MP-9 | 536.7 a | 2.73 a | 17.5 ab | 2.3 a |
| MP-18 | 314.1 c | 1.96 b | 19.1 a | 1.7 b |
| MP-19 | 433.1 b | 2.31 ab | 18.2 ab | 1.1 d |
| CV(%) | 11.2 | 11.2 | 11.5 | 13.4 |
| F-value | * | * | * | * |

Means followed by same letter(s) in a column do not differ significantly by DMRT

and Verma *et al*. (2010) also recorded varied amount of oil in different types of mint.

## Conclusion

On the basis of above results and discussion, it may be concluded that the genotypes MP-1, MP-4, MP-9, and MP-19 may be put to further evaluation in RYT for release as varieties. MP-1 and MP-19 may be considered for foliage production and MP-4 and MP-9 may be considered for oil extraction.

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## References

Ali, M. S., D. Yazdani, B. H. Naghdi, M. Ahwazi and F. Nazari. 1999. Effect of nitrogen and phosphorus fertilizer levels and harvesting schedule on dry matter and oil yield in peppermint (*Mentha pipperita*). *J. Medicinal Aromat. Pl. Sci.* 21: 927-930.

Almeida, P. P., N. Mezzomo and S. R. S. Ferreira. 2012. Extraction of *Mentha spicata* L. volatile compounds: Evaluation of process parameters and extract composition**.** *Food Bioprocess Technol*. 5(2): 548-559.

Alvi, M. N., S. Ahmad and K. Rehman. 2001. Preparation of menthol crystals from mint- (*Mentha arvensis*). *Int. J. Agri. Biol.* 3(4): 527-528.

Anonymous. 2012. A guide to mint with information on the nutritional value of mint and ideas for use. (*Available in: http://www.helpwithcooking.com/ herb-guide/mint.html; retrieved on 11/10/2014*).

Anonymous. 2008. Final report on "Cultivation of mint as a viable alternative livelihood in East and North East of Afghanistan". RALF-02-11. Ministry of Agriculture, Irrigation and Livestock (MAIL), and Kabul University.

Anonymous. 2011. Draft descriptor list *Mentha piperita* L. working group on medicinal and aromatic plants, November 2011. *European Cooperative Programme for plant Genetic Resources (ECPGR).* Rome, Italy. Pp. 1-10.

Curci, C. 2012. Things you didn't know about mint but should have (*Available in: http://www.senioryears.com/mint.html, Retrieved on 12/06/2014*).

Gupta, R. 1991. Agrotechnology of medicinal plants. *In:* Wijesekera R.O.B. (ed). *The Medicinal Plant Industry.* Florida, CRC Press, USA. Pp. 43–57.

Harley, R. M. and C. A. Brinhton. 1977. Chromosome numbers in the genus *Mentha* L. *Botanic J. Linn. Soc*. 74: 71 – 96.

Hoque, M. A. 2013. Final report on "*Collection, Characterization and Evaluation of available Mint* (*Mentha* sp.) *genotypes in Bangladesh*". Minsitry of Science & Technology and Department of Horticulture, BSMRAU, Gazipur. Pp. 1-32.

Hoque, M. A., R. Rumman, K. T. Akter, M. T. I. Choudhury and M. W. Faisal. 2015. Morphological characterization and evaluation of twenty two mint genotypes. *Research & Reviews: J. Crop Sci. Technol.* 4(1): 4-12.

Islam, A., K. T. Osman and M. Rahman. 2003. Effect of N, P, and K fertilizers on growth and herb and oil yield of *Mentha arvensis* in Bangladesh. *J. Medicinal Aromat. Pl. Sci.* 25(3): 661-667.

Islam, S. 2013. Effects of stem cutting and spacing on yield and quality of mint- An unpublished MS Thesis. Department of Horticulture, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur 1706.

Kattimani, K. N. and Y. N. Reddy. 2000. Effect of planting material and spacing on growth, biomass, oil yield and quality of Japanese mint (*Mentha arvensis* L.). *J. Essential Oil Bearing Pl*. 3(1): 33-43.

Kumar, S., J. R. Bahl, P. Shukla, A. Singh, G. Ram, R. P. Bansal and S. Sharma. 1999. Screening of genotypes of menthol mint *Mentha arvensis* for high yield of herbage and essential oil under the late cropping conditions of the sub-tropical Indo-Gangetic plains. *J. Hort. Sci. Biotechnol*. 74: 680-684.

Rahman, A. 2014. Growth and yield of mint in response to planting time and NPK fertilization. An unpublished MS Thesis. Department of Horticulture, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur 1706.

Sharangdhar, S. 2008. Mint- The cool herb (*Available in: http://completewellbeing.com/article/the-cool-herb/ Retrieved on 14/07/2014*).

Srivastava, R. K., A. Kalra, A. K. Singh, S. Kumar, R. P. Bansal, V. K. S. Tomar, J. R. Bahl, A. A. Naqvi and S. Sharma. 2000. Optimum crop age of menthol mint *Mentha arvensis* cv. Kosi crops in the Indo- Gangetic plains for high yields of menthol essential oil. *J. Medicinal Aromat. Pl. Sci.* 22(1B): 771-773.

Verma, R. S., L. Rahman, R. K. Verma, A. Chauhan, A. K. Yadav and A. Singh. 2010. Essential oil composition of menthol mint (*Mentha arvensis*) and peppermint (*Mentha piperita*) cultivars at different stages of plant growth from Kumaon region of Western Himalaya. *Open Access J. Medicinal Aromat. Pl.* 1(1): 13-18.

Vikrant, V. R., B. P. Singh and R. P. Singh. 2004. Oil production and returns of Japanese mint as influenced by nitrogen and cutting management. *Annals Biol*. 20(1): 27-29.

Yaseen, M., T. Uddin, B. Kumar and S. Kumar. 2000. Economic evaluation of menthol mint varieties under low spacings in north India plains. *J. Medicinal Aromat. Pl. Sci*. 22: 805-807.