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Full Length Research Paper

Investigation of variations of the morphological values and flowering shoot yield in different mint species at Iran

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This experiment was carried out using a randomized complete block design with three replications. The factor studied included mint species (*Mentha longifolia* var. *amphilema* (from Qazvin and Ardabil localities), *Mentha spicata* (from Tehran and Yazd localities), *Mentha piperita* (from Tehran and Ardabil localities) and *Mentha aquatica* (from guilan and Ardabil localities) that were collected at end of flowering stage in Iran during 2007. the results showed that mint species had significant effect on shoot yield, plant height, lateral stem number and leaf width (p 0.01) and leaf length and stem diameter (p < 0.05). *M. longifalia* var. *amphilema* from Qazvin locality was provided highest shoot yield (2,656 kg/ha), plant height (70.67 cm) and stem diameter (4.1 mm). Longest leaf length (4.01 cm) and widest leaf width (2.32 cm) were achieved by *M. piperita* from Tehran locality and highest lateral stem number (39 stem per plant) was obtained by *M. aquatica* from guilan locality. Our findings indicated that were significant difference between morphological values and shoot yield in mint species. Therefore, the selection of species that perform well over a wide range of environments can increase quantity and quality yields of medicinal and aromatic plants.

Key words: Mint species, shoot yield, plant height, lateral stem number, leaf width, stem diameter and leaf length.

INTRODUCTION

Mentha (mint) is a genus of about 25 species (and many hundreds of varieties) of flowering plants in the family Lamiaceae. Species within *Mentha* have a sub cosmopolitan distribution across Europe, Africa, Asia, Australia, and North America. Several mint hybrids commonly occur (Davidson, 1999). Mints are aromatic, almost exclusively perennial, rarely annual, herbs. They have wide-spreading underground rhizomes and erect, branched stems. The leaves are arranged in opposite pairs, from simple oblong to lanceolate, often downy, and with a serrated margin. Leaf colors range from dark green and gray-green to purple, blue, and sometimes pale yellow (Brickell and Zuk, 1997). The flowers are produced in clusters ('verticils') on an erect spike, white to purple; the corolla two-lipped with four sub equal lobes with the upper lobe usually the largest. The fruit is a small, dry capsule containing one to four seeds. While the species that make up the *Mentha* genus are widely distributed and can be found in many environments, most *Mentha* grow best in wet environments and moist soils. Mints will grow 10 - 120 cm tall and can spread over an indeterminate sized area. Due to the tendency to spread unchecked, mints are considered invasive (Brickell and Trevor, 2002). All mints prefer, and thrive in cool, moist spots in partial shade. In general, mints tolerate a wide range of conditions, and can also be grown in full sun. They are fast growing, extending their reach along surfaces through a network of runners. Due to their speedy growth, one plant of each desired mint, along with a little care, will provide more than enough mint for home use. Some mint species are more invasive than others. Even with the less invasive mints, care should be taken when mixing any mint with other plants, lest the mint will take over. To control mints in an open environment, mints

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should be planted in deep, bottomless containers sunk in the ground, or planted above ground in tubs and barrels (Bradley, 1992). Some mints can be propagated by seed. Growth from seed can be an unreliable method for raising mint for two reasons: mint seeds are highly variable - one might not end up with what one presupposed was planted and some mint varieties are sterile. It is more effective to take and plant cuttings from the runners of healthy mints. The most common and popular mints for cultivation are peppermint (*Mentha piperita*), spearmint (*Mentha spicata*) and (more recently) apple mint (*Mentha suaveolens*). Mints are supposed to make good companion plants, repelling pest insects and attracting beneficial ones. Mints are susceptible to whitefly and aphids. Harvesting of mint leaves can be done at anytime. Fresh mint leaves should be used immediately or stored up to a couple of days in plastic bags within a refrigerator. Optionally, mint can be frozen in ice cube trays. Dried mint leaves should be stored in an airtight container placed in a cool, dark, dry area (Ortiz, 1992). Mint was originally used as a medicinal herb to treat stomach ache and chest pains, and it is commonly used in the form of tea as a home remedy to help alleviate stomach pain. During the middle ages, powdered mint leaves were used to whiten teeth. Mint tea is a strong diuretic. Mint also aids digestion, in a way that it breaks down the fats. In recent years, it has been often recommended for treating obesity (Quattrocchi, 1974). *Mentha aquatica* (water mint) is a perennial plant in the genus *Mentha* native throughout Europe, except for the extreme north, and also northwest Africa and southwest Asia (Huxley, 1992). It is an herbaceous rhizomatous perennial plant growing to 90 cm tall. The stems are square in cross section, green or purple, and variably hairy to almost hairless. The rhizomes are wide-spreading, fleshy, and bear fibrous roots. The leaves are ovate to ovate-lanceolate, 2 - 6 cm long and 1 - 4 cm broad, green (sometimes purplish), opposite, toothed, and vary from hairy to nearly hairless. The flowers are tiny, densely crowded, purple, tubular, and pinkish to lilac in color; flowering is from amidst to late summer. Water mint is pollinated by insects, and also spreads by underground rhizomes, like other species of mint. All parts of the plant have a distinctly minty smell (Blamey and Grey-Wilson, 1989) . *Mentha longifolia* (horse mint) is a species in the genus *Mentha* (mint) native to Europe, Western and Central Asia (east to Nepal and the far west of China), and Northern and Southern (but not tropical) Africa (Huxley, 1992). It is a very variable herbaceous perennial plant with a peppermint-scented aroma. Like many mints, it has a creeping rhizome, with erect to creeping stems 40 - 120 cm tall. The leaves are oblong-elliptical to lanceolate, 5 - 10 cm long and 1.5 - 3 cm broad, thinly to densely tomentose, green to greyish-green above and white below. The flowers are 3 - 5 mm long, lilac, purplish, or white, produced in dense clusters (verticillasters) on tall, branched, tapering spikes; flowering in amidst to late summer. It spreads via rhizomes to form clonal colonies (Blamey and Grey-Wilson, 1989). *M. spicata* (spear mint or spearmint) is a species of mint native to much of Europe and South-west Asia; though its exact natural range is uncertain due to extensive early cultivation. It grows in wet soils (Huxley, 1992). It is an invasive species in the great lakes region where it was first sighted in 1843. It is an herbaceous rhizomatous perennial plant growing 30 - 100 cm tall, with variably hairless to hairy stems and foliage, and a wide-spreading fleshy underground rhizome. The leaves are 5 - 9 cm long and 1.5 - 3 cm broad, with a serrated margin. spearmint produces flowers in slender spikes, each flower pink or white, 2.5 - 3 mm long and broad (Blamey and Grey-Wilson, 1989). *M. piperita* (peppermint or brandy mint) is one of the most popular tonic herbs known to modern man. It is well known flavoring agent. Peppermint has been a popular home remedy for digestive ailments for two centuries in India. *M. piperita* is currently one of the most economically important aromatic-medicinal herbs produced in India. Scientific studies have not only confirmed the traditional uses of the plant but also encouraging the use of peppermint as a direct or adjunct therapy in modern practice. Peppermint is a sterile hybrid derived from a cross between *M. aquatica* and *M. spicata*. Peppermint is a perennial herb, growing up to 3 feet in height, and propagation is by underground stolons. The stems are usually reddish-purple and smooth. The leaves are fragrant, toothed and hairy on the underside. Flowers are bisexual and zygomorphic pinkish or purple color. *M. piperita* bloom from July through august in whorls and terminal spikes. The fruit consists of four 1- seeded nutlets (Blamey and Grey-Wilson, 1989). The genus *Mentha* includes aromatic herbs of difficult taxonomic classification due to a great variability in their morphological characters and frequent hybridisation. previous investigations of their essential oils have revealed the existence of an important chemical polymorphism (Lawrence, 1978) and several varieties and chemotypes have been described for *M. spicata* (Kokkini and Vokou, 1989; Misra et al., 1989; Pino et al., 1998), *M. longifolia* (Maffei, 1988; Venskutonis, 1996), *M.* suaveolens (Hendriks et al., 1976) and *M. diemenica* (Brophy et al., 1996) among others. *Mentha pulegium* l., commonly known as pen-nyroyal, is traditionally used in the treatment of flatulent dyspepsia and intestinal colic due to its carminative and antispasmodic properties (Newall et al., 1996). Previous reports (Lawrence, 1998; Pino et al., 1996) on the composition of its essential oil showed that pulegone was the main constituent, and its percentage ranged from 25 - 92%. *Mentha rotundifolia* (l.) huds is a hybrid between *M. longifolia* (l.) l. and *M. suaveolens* ehrh, whose essential oil has been the object of several studies (Kokkini and Vokou, 1989; Hendriks et al., 1976; Umemoto, 1998), and different chemotypes have been characterized. Some authors have considered *M. rotundifolia* (l.) huds. As a synonym of *M. suaveolens* ehrh (Hendriks et al.,

Table 1. Analysis of variance.

		Mean squares					
Source of variation	**DF**	**Plant height**	**Leaf length**	**Leaf width**	**Stem diameter**	**Lateral stem number**	**Shoot yield**
		11.325	0.384	0.07	0.457	2.167	10156.924
Replication	2	302.344 **	1.073*	0.717**	2.097*	126.738**	797063.865**
Species of mint	7	16.156	0.202	0.077	0.278	1.881	8660.803
Error	14	7.05	14.43	15.08	18.96	5.06	4.97
cv (%)							

** and * indicates Significance at 1% and 5% levels respectively.

Table 2. Means comparison of determined values of mint.

Treatment	**Plant height (cm)**	**Leaf length (cm)**	**Leaf width (cm)**	**Stem diameter (mm)**	**Lateral stem number (stem per plant)**	**Shoot yield (kg/ha)**
M. longifolia var. amphilema from Qazvin	70.67 A	3.17 ABC	1.87 AB	4.1 A	29.32 BC	2656 A
M. longifolia var. amphilema from Ardabil	53.5 C	2.02 C	1.13 C	1.83 B	24 DE	2208 B
M. spicata from Tehran	52.33 C	3.17 ABC	1.33 C	2.13 CD	22 E	1896 CD
M. spicata from Yazd	38 D	2.47 BC	1.04 C	2.5 BCD	18 F	1810 D
M. piperita from Tehran	57.66 C	4.01 A	2.43 A	3.8 AB	26.67 CD	2117 BC
M. piperita from Ardabil	58.3 BC	3.3 ABC	2.13 B	2.2 CD	25.33 DE	2009 BCD
M. aquatica from Ardabil	57.68 C	2.93 ABC	2.2 AB	2.4 CD	32.34 B	1108 E
M. aquatica from Guilan	60 AB	3.57 AB	2.32 AB	3.27 ABC	39 A	1190 E

Means within the same column and factor, followed by the same letter are not significantly difference (P < 0.05).

1976). Biological yield obtained from *M. pulegium* l. and *M. rotundifolia* (l.) huds. In Uruguay the highest biological yield was provided from *M. pulegium* than *M. rotundifolia* (Lorenzo et al., 2002). In greenhouse study conducted in India, the morphological values of *Mentha arvensis, M. piperita, Mentha citrate, M. spicata* and *Mentha viridis* were evaluated. The results showed that highest development of larvae was achieved from *M. spicata* (Sagar and Sagar, 2006). The research objective was to evaluate shoot yield and morphological values in mint species at Iran.

MATERIALS AND METHODS

This experiment was carried out using a randomized complete block design with three replications. The factor studied included mint species (*M. longifolia* var. amphilema (from Qazvin and Ardabil localities), *M. spicata* (from Tehran and Yazd localities), *M. piperita* (from Tehran and Ardabil localities) and *M. aquatica* (from guilan and Ardabil localities) that were collected at the end of flowering stage. To determine shoot yield, plant height, lateral stem number, leaf width, stem diameter and leaf length, 10 plants were selected randomly from each species at the end of flowering stage. The data were subjected to analysis of variance (ANOVA) using statistical analysis system (SAS) computer software at $p < 0.05$ (SAS Institute Cary, USA 1988).

RESULTS

Final results showed that mint species had significant effect on shoot yield, plant height, lateral stem number and leaf width (p 0.01) and leaf length and stem diameter ($p < 0.05$, Table 1). *M. longifalia* var. *amphilema* from Qazvin locality were provided highest shoot yield (2,656 kg/ha), plant height (70.67 cm) and stem diameter (4.1 mm). Longest leaf length (4.01 cm) and widest leaf width (2.43 cm) were achieved by *M. piperita* from Tehran locality and highest lateral stem number (39 stems per plant) was achieved by *M. aquatica* from guilan locality (Table 2).

DISCUSSION

The selection of compatible species with growth environ-ment is important factor in controlling shoot dry matter species of mint. Countries need to perennial medicinal plants that furnish high-quality yields for farmers during all phases of the growing season. However, most medici-nal plants used in this region have been developed and released based on values related to their establishment and production rather than their nutritive quality. Well

established species of mint will release partially because of good seedling vigour and ease of seedling establishment. Species of mint were all released primarily because of high shoot and seed yields. It is well established that maturation of shoot tissue has a detrimental effect on whole plant nutritive quality, although less is known about the effect of maturity on specific species that are widely grown in Iran. Shoot yield in *M. longifalia* var. *amphilema* from Qazvin locality differed, with all species. The difference between *M. longifalia* var. *amphilema* from Qazvin locality and all species were related more to traits such as plant height, lateral stem number and width and length of leaves. Other species evaluated with a view to diversifying the range of options available and reducing overdependence on a single species that may be prone to disease and pest attack. For instance, *Mentha aquatica* is susceptible to root putrefaction. Species of mint are almost always required for to provide dry matter in the plants during the growing season. The introduction of genetically modified species of mint resistant to drought, weed, diseases and pests will increase the potential of production into fields.

Medicinal plants are composed of a community of plants that may differ in phenotypic plasticity, adaptation to grazing. An analysis of species population dynamics over time can provide a basis for understanding temporal trends of botanical composition and dry matter production within the fields of medicinal plants. Perennial medicinal plants, which often harvest mixed species in the field, are composed of tillers, each constituting an independent plant growth unit. Field management can modify tiller morphology, developmental growth, and tiller dynamics over time. Short harvesting height regimes, plants tiller density increased and tiller weight/size decreased. Individual tiller size may change in a compensatory manner, usually described by the "self-thinning" law, until plants reach their physiological potential under the applied management and environmental conditions.

Conclusion

The results showed that *M. longifalia* var. *amphilema* from Qazvin locality were provided highest shoot yield. Our data indicated that were significant difference between morphological values and shoot yield in mint species. Therefore, the selection of species that perform well over a wide range of environments can increase quantity and quality yields of mint.

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