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Nitrogen fertilization and potting medium composition in the growth and herbage yield of container-grown Peppermint (*Mentha cordifolia* Opiz.)

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Abstract

The study was conducted to determine the influence of potting medium and nitrogen fertilization on the growth and yield of container-grown peppermint. The type potting medium significantly influenced some growth parameters and herbage yield of peppermint. Plant grown in 2:1 garden soil + compost (M_2) and 2:1:1 garden soil +compost +rice hull charcoal (M_4) had more leaves and lateral branches than those grown in pure garden soil (M_1) and 2:1 garden soil + rice hull charcoal (M_3). Moreover, plants grown in M_4 had the longest internode. Plants grown in M_4 had the highest herbage yield followed by those grown in M_2. These grown in M_2 and M_3 had the lowest herbage yields. Application of 2.0 and 2.5g ammonium sulfate/pot or 119g chicken dung/pot significantly improved growth and herbage yield of peppermint relative to those applied with 1.5g ammonium sulfate/pot and non-fertilized control. Interaction effects of potting medium and nitrogen fertilization on the different growth parameters of peppermint were all not significant.

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Introduction

Peppermint or *hierba buena* identified as *Mentha cordifolia* Opiz of the family Labiatae is one of the many species of plants that is gaining popularity because of its medicinal and industrial value. It is a creeping herb, prostate, slightly hairy, and smooth. The leaves are elliptic to oblong, ovate, about 1.5 to 4.0 cm long, with short stalks tooth in the margin. The narrow, sharply toothed leaves are dotted with minute oil glands. It has long square stems born in axillary headlike whorls, and the calyx teeth are triangular or somewhat lanceolate, and slightly hairy. According to Agravante *et al*. (1989), *hierba buena* does not flower in the Philippines because it is photoperiodic. The plant flowers from July to October in temperate regions (Morton, 1997). Generally, the plant is used as medicine which is a potential substitute of the expensive drug which may not be available in local markets. The medicinal value of plants in curing ailments has been increasingly appreciated not only because of cheaper price and greater availability but also because of their active ingredient which are nature made (Cortes-Maramba *et al*., 1982).

In 1696 *hierba buena* was recommended as medicine for diarrhea. In addition, in United States, the plant is not cultivated in commercial scale because of the volatile oil which is the principal marketable product although there is some demand in crude-drug for dried leaves and flowering tops. Furthermore, research study revealed that its principal industrial use include flavoring for candies, chewing gums, and toothpaste. It is also used as flavorings of many native delicacies.

Locally, *hierba buena* is commonly grown in the backyard. However, container gardening is now gaining popularity among many households particularly in urban and coastal areas where suitable area for backyard hardening is not available. This is more flexible approach as artificial growing media prepared from locally available agricultural wastes (*e.g*. sawdust and rice hull) could be used. In addition, the potted plants could be placed in small vacant such as top of fences and rocks or artificially raised flat form.

One of the most pre-requisite for successful container gardening is the formulation and use of appropriate potting medium and efficient fertilization system. A good potting medium and efficient fertilization system. A good potting medium have both its chemical and physical properties idea for growth and development of the crop raised. Basically, the potting medium must serve as a means of anchorage and support to the plant and reservoir for water and the mineral nutrients for plant growth and development (Davidson *et al.,* 19888). Likewise, the medium must have a pH conducive to plant growth a structure that will permit gaseous exchange to give aeration for the roots and permit water infiltration and movement and most importantly it should be readily available locally (Hartmann *et al*., 1997).

A mixture of garden soil, sand and compost is the commonly used potting medium (Bautista *et al*., 1988). Other mixes particularly those farm wastes such us rice hull, sawdust, and animal manure were also found satisfactory for container growing of many horticultural crops including vegetables (Mabesa and Quisumbing, 1976), coffee seedling (Ampong, 1999) and mango (Dioquino, 1996).

Moreover, container grown plants may require efficient fertilization system since they are growing in small volume of soil medium which in most cases could not sufficiently supply the nutrient requirement of the crop. Nutrients that are needed in higher amount and those that could be easily lost such as nitrogen should therefore be regularly supplied to container-grown crops. In the study of Stockberger, *hierba buena* requires 29kg N/ha or more t/acre of rotten stable manure.

This study was conducted to evaluate the growth performance of potted peppermint as affected by different potting medium, nitrogen fertilization and probable interaction effect.

Materials and methods

Growing Media Preparation

Compost, garden soil, and rice hull charcoal were used as components of the different potting media mixes. Compost, consisting mainly of decomposed rice straw and chicken dung were gathered from the compost pit and from nearest poultry house, respectively.

These were air dried for five days to pasteurize them. Periodic turning and mixing were done during the five-day drying period to attain uniform drying. The garden soil was collected from the experiment field. Stones, roots and other debris were excluded. This was also air-dried for five days and then pulverized. The rice hull charcoal was collected from the nearest rice mill. The different media components were thoroughly mixed with garden soil following the ratio specified in the different treatments. The proportion was measured based on volume.

Preparation of Sando bags and Potting Media

Plastic sando bags (0.75mm thick) measuring 8 x 20 cm were prepared and used as the container. Holes were made at the bottom and sides for drainage with the use of puncher. The bags were filled with the prepared media up to 3.5cm below the mouth. Equal volume/amount of medium were placed in each bag.

Preparation of planting Materials and Planting

Terminal cuttings of peppermint were used. Cuttings with 6-8 pairs of leaves and about a palm's length or approximately 13 cm were prepared. One cutting was planted in each bag, by burying the first three nodes into the media with the aid of a dibble. The newly planted cuttings were individually covered with banana bracts for the first five days.

Experimental Design and Treatment

The experiment was laid out in two-factor experiment arranged in a Randomized Complete Block Design (RCBD). There were three replications with five sample per treatment per replicate. The first factor was potting medium and second was nitrogen fertilization. The following treatments were evaluated. Factor A includes M_1-garden soil, M_2-2:1 garden soil+ compost (v/v), M_3-2:1 garden soil+ rice hull charcoal (v/v), and M_4- 2:1:1 garden soil + compost + rice hull charcoal (v/v); For factor B (Nitrogen Fertilization)

F_0-non-fertilized, F_1-1.5g ammosul/pot, F_2-2.0g ammosul/pot, F_3-2.5 g ammosul/pot, F_4-chicken dung 119 g/pot or 2.38 g N/ha. The N content of chicken dung was estimated at 1.31% (Gutierez, 1998). The bags are arranged at a distance of 50 cm x 50 cm in an open field. Alleyways of 1m were provided between treatments and replications, respectively.

Fertilizer Application

Ammonium sulfate (21-0-0) and chicken dung were used as source of N. Half of the total amount of ammonium sulfate was applied one month after planting in the holes made 3 cm round the base of the plant using dibble. The other half was applied one moth after the first application. The whole amount of chicken dung was applied one month after planting by mixing it with potting media.

Care of the Plant

All cultural practices essentials in raising peppermint were followed. These include providing shade of the newly planted cuttings, regular weeding and watering.

Harvesting

The herbage was harvested by cutting the vines 2cm from the base 98 days from planting using sharp scissors.

Data Gathered

Percent survival.

This was determined by counting the number of live plants one month after planting.

Growth measurement.

These includes the length of the vines, diameter of the vines, internode length, length and width of the leaves, number of leaves/vine and number of lateral branches.

Herbage yield.

These includes the fresh weight, dry weight and moisture content

Chemical Analysis.

Before planting, samples of potting medium were collected randomly from the sample pots. These were thoroughly mixed, air-dried and 1kg composite sample for each potting medium was brought to the soil research testing and plant analysis laboratory of the Department of Agronomy and Sil Science (DASS) for NPK, O.M and pH determination.

Agro-Climatic Data

Data on weekly temperature (maximum-minimum), amount of rainfall and relative humidity of the experimental area were obtained from VISCA-PAGASA Agro-meteorological station.

Results and discussion

Chemical Properties of Different potting media

Some chemical properties of the different potting medium used in the experiment are shown in Table 1. Based on PCARRD standard, the pure garden soil (M_1) was slightly acidic (pH5.95), has medium organic matter content but has low N (0.10%) and P(0.0020%) contents. The combination of 2:1 garden soil and compost (M_2) and 2:1 garden soil + compost + rice hull charcoal (M_4) contents. The medium (M_3) which is a combination of 2:1 garden soil and rice hull charcoal was basic in reaction (pH 7.25) with medium organic matter, low N but adequate P content.

Table 1. Some Chemical properties of the different potting medium used in growing peppermint (before planting).

Media	pH	Chemical Properties		
		Organic Matter (%)	Total N (%)	Total P (%)
M_1-garden soil	5.95	2.70	0.10	0.0020
M_2-2:1 garden soil +compost	6.05	6.62	0.28	0.22
M_3- 2:1 garden soil+ rice hull	7.25	2.89	0.20	0.09
M_4-2:1:1 garden soil + compost + rice hull charcoal	6.95	6.81	0.48	0.45

Horticultural Characteristics

The percent survival, vine diameter, vine length and length of the leaves of peppermint were not significantly influenced by the kind of potting media (Table 2). In contrast, internode length and width, number of leaves and number of lateral branches were significantly affected by the kind of potting medium. Peppermint plants from cuttings planted in 2:1:1 garden soil + compost rice hull charcoal (M_4) had the longest internodes. Moreover, plants grown in 2:1 garden soil (M_1) had comparable internode length. On the other hand, plants grown in M_3 and M_4 have significantly more leaves and branches than those grown in M_1 and M_3. The superior growth of peppermint plants in M_2 and M_4 could be attributed to the added nutrients particularly the N and P from compost (Table 1). Furthermore, the good performance of peppermint plants grown in M_2 and M_4 could also be attributed to the pH of the medium which were within the suggested range (pH 6 to 7) considered by Michalak and Thomson (1994) to be ideal for growing of peppermint. On the other hand, the poor performance of plants grown in M_1 and M_3 could be due to lower N and P contents of the media (Table 1). Except for plant survival, applications of ammonium sulfate or chicken dung significantly influence the growth performance of peppermint plants. Regardless of the potting medium, plants applied with 1.5 g ammonium sulfate/pot (F_1), 2.0g ammonium sulfate/pot (F_2) and 2.5 ammonium sulfate/pot (F_3) and 119 g chicken dung/pot (F_4) produced longer vines and bigger leaves than the non-fertilized control (F_0).

Among the fertilizer-treated plants, those applied with 119g chicken dung/pot and ammonium sulfate at the rate of 2.0 and 2.5g/pot had better growth than those applied with 1.5g/pot. Those applied with chicken dung had comparable growth performance with those applied with 2.5g ammonium sulfate/pot. The peppermint plants responded positively to the applied N either from ammonium sulfate or from chicken dung. In the study of Looewenfield indicated that peppermint requires about 29kg nitrogen /hectare for satisfactory growth. There was no significant interaction effect of potting media and nitrogen fertilizer application on the growth of potted peppermint plants.

Herbage Yield

Herbage yield (fresh and dry weight) of peppermint plants were significantly influenced by the kind of potting medium and fertilizer application (Table 3). Regardless of fertilizer treatment, cuttings planted in M_4 gave the highest yield followed by cutting planted in M_2. Cuttings planted in M_1 and M_3 had the lowest yield. Again, the compost in M_4 and M_2 which improved the N and P contents of the media and favorable pH of the medium would explain the high yield produced by the plants grown in these two media.

Table 2. Growth Performance of container-grown peppermint as influenced by type of potting medium and nitrogen fertilization.

Treatment	% Survival	Vine		Internode	Leaves			Number of Leaves Lateral branches
		Diameter (mm)	Length (cm)	Length (cm)	Number /vine	Length (cm)	Width (cm)	
Potting Media								
M_1-garden soil	99.66	0.24	26.16	1.70b	12.33b	1.78	1.40b	29.93b
M_2-2:1 garden soil +compost	94.02	0.24	26.72	1.67b	15.07a	1.81	1.41b	33.80a
M_3- 2:1 garden soil+ rice hull	92.67	0.25	27.52	1.69	13.26b	1.76	1.45a	28.80a
M_4-2:1:1 garden soil + compost + rice hull charcoal	98.67	0.25	27.84	1.81a	15.07a	1.73	1.44a	28.27b
Nitrogen Fertilization								
F_0-unfertilized control	100	0.20c	21.72c	1.56c	11.00c	1.68b	1.33d	22.75d
F_1-1.5 g ammosul/pot	100	0.22c	25.97b	1.68b	13.25b	1.72b	1.38c	28.25c
F_2-2.5 g ammosul/pot	98.33	0.25b	28.33a	1.73b	14.33ab	1.77ab	1.42c	32.50b
F_3-1.5 g ammosul/pot	90.86	0.26ab	29.10a	1.76b	14.92ab	1.82a	1.47b	36.50a
F_4-119 g ammosul/pot	92.08	0.29a	30.18a	1.84a	16.08a	1.86a	1.52a	37.58
CV(%)	18.10	11.31	9.08	5.42	3.63	6.48	13.08	15.93

Treatment means within a column followed by the same letter(s)are not significantly different at 5% level DMRT.

Regardless of potting media, application of ammonium sulfate and chicken dung significantly influenced the herbage yield of peppermint. Based on dry weight of herbage, application of 2.0 to 2.5g ammonium sulfate/pot significantly increased herbage yield of peppermint. Application of 1.5g ammonium sulfate/pot did not improve the dry matter yield relative to the unfertilized control. Furthermore, plants applied with 119g chicken dung/pot had comparable yield to plants applied with 2.5 ammonium sulfate/pot. Again, application of nitrogen either from ammonium sulfate or from chicken dung significantly improved growth and yield of peppermint. It appears that peppermint would respond to application of organic fertilizer particularly, chicken dung as indicated in the highest yield obtained compared to inorganic treated plants. The kind of potting and the fertilizer treatment did not influence the moisture content of peppermint herbage. Furthermore, the combined effects of potting medium and fertilizer on the yield of peppermint were not significant.

Table 3. Herbage yield of container-grown peppermint as influenced by potting media and nitrogen fertilization.

Treatment	Fresh weight (g/pot)	Dry weight (g/pot)	Moisture Content (%)
Potting Media			
M_1-garden soil	62.22c	17.69c	72.59
M_2-2:1 garden soil +compost	89.71b	30.09b	66.36
M_3- 2:1 garden soil+ rice hull	60.14c	19.29c	69.10
M_4-2:1:1 garden soil + compost + rice hull charcoal	123.00a	42.40a	66.40
Nitrogen Fertilization			
F_0-unfertilized control	53.16e	16.74d	72.98
F_1-1.5 g ammosul/pot	72.30d	22.31cd	68.68
F_2-2.5 g ammosul/pot	84.29c	26.88bc	68.78
F_3-1.5 g ammosul/pot	97.07b	32.85ab	66.78
F_4-119 g ammosul/pot	109.52a	38.05a	65.90
CV(%)	14.20	28.00	13.30

Treatment means within a column followed by the same letter(s) are not significantly different at 5% level DMRT.

Conclusion

The type of potting medium significantly influenced some growth parameters and the herbage yield of container-grown peppermint. Plants grown in medium 2 and medium 4 had superior growth (vigorous) and therefore higher herbage yield than those grown in pure garden soil and medium 3.

The application of 2.0 and 2.5g ammonium sulfate/pot and 119g chicken dung per pot significantly improved the growth and yield relative to those applied with 1.5g ammonium sulfate per pot and unfertilized control. Application of 11g chicken dung/pot had comparable yield (dry weight basis) with those plants applied with 2.5g ammonium sulfate/pot.

The interaction effect of the type of potting medium and nitrogen fertilization on all growth and yield parameters of peppermint evaluated in the study were all not significant.

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