Morphological characters and N uptake of Mint (*Mentha piperita*) with the growing media composition treatment

Y Hasanah*, F E Sitepu and R R Butar Butar

Faculty of Agriculture, Universitas Sumatera Utara, Jl. Prof. A. Sofyan No. 3 Kampus USU, Padang Bulan, Medan, Indonesia Republic 20155

E-mail: *yaya@usu.ac.id

**Abstract.** Growing media plays an important role as a source of nutrition for plant growth so that the growing media can affect the quality of plant growth. This research aimed to identify the morphological characters and N uptake of mint plants treated with a different composition of growing media. The research was conducted using a Non-Factorial Randomized Block Design with seven treatments of growing media composition and four replications. The treatment is top soil; top soil + biochar (3: 1, v/v), top soil + chicken manure (3: 1, v/v), top soil+oil palm empty fruit bunch (OPEFB) compost (3: 1, v/v), top soil + OPEFB compost+chicken manure (2: 1: 1, v/v/v), top soil+biochar+chicken manure (2: 1: 1, v/v/v) and top soil+biochar+compost (2: 1: 1, v/v/v). The results showed that the composition of the top soil+OPEFB compost (3: 1, v/v) media was the best composition of growing media because it produced the sprouting age, number of shoots, length of shoots and N nutrient uptake of mint plants were higher than the composition of other growing media.

1. **Introduction**

The mint plant belongs to the Lamiaceae family and is one of the aromatic herbs with high economic value due to its active ingredients, aroma and efficacy. This plant is widely used as raw material in the food, beverage and pharmaceutical industries as an antiseptic drug, reducing digestive disorders and headaches, wind oil, balm, toothpaste ingredients, perfumes, cosmetics, candies as well as aromatherapy because of its distinctive aroma that calms the soul. The scent of mint leaves is caused by the essential oil content of menthol oil. Besides, mint leaves also contain flavonoids, triterpenoids, provitamin A, vitamin C, iron, phosphorus, calcium and potassium.

In its classification there are three species of mint, *Mentha arvensis* as menthol producer and coarse mentha oil (Japanese mentha), *Mentha piperita* as producer of peppermint or true mint oil and *Mentha spicata* as spearmint oil producer [1]. The world market share of the three mint species is respectively; 75%, 18% and 7% [2]. *Mentha* spp products are needed by industry, but until now Indonesia has not been able to fulfill it, so it is very dependent on imports [3].

One effort to improve the yield and quality of mint oil in Indonesia can be done by improving mint cultivation techniques. Mint plant growth is strongly influenced by the growth environment and cultivation technology, including planting time, dosage and type of N fertilizer, irrigation, harvest time, pest control and growing media composition.
In this research, the species of *M. piperita* was used as mint planting material, which has the advantage of more spicy menthol content than other mint species. Generally, mint plants are propagated with stem cuttings. The growth of mint stem cuttings requires the right composition of the growing media to achieve good mint growth. Growing media serves as a place to grow and store nutrients and water for plants [4].

Soil is commonly used as a growing media because it is cheap and easily obtained. The application of organic matter into the growing media aims to make porous media and enrich enough nutrients for seedlings. The use of organic-based growing media composition provides advantages because it can provide nutrients for plants [5]. Organic materials which were commonly used in the composition of growing media are manure, compost, biochar paddy husks and oil palm empty fruit bunches. The nutrients contained in the organic ingredients are strived to stimulate mint growth.

Based on the background above, this research aimed to identify the morphological character and N content of mint with various growing media composition.

### 2. Materials and Methods

#### 2.1 Research area and method

This research was a pot experiment conducted at the Faculty of Agriculture Experimental Field, Universitas Sumatera Utara, Medan (± 32 m above sea level) from August to October 2017. The materials used in this research were stem cuttings of mint (*M. piperita*), top soil, OPEFB compost, biochar and chicken manure, 2 kg polybag size. The tools used include hoes, machetes, scales, sieves, buckets, hand sprayers, broach, ovens, rulers and spectrophotometers.

Characteristics of experimental soil, compost of oil palm empty fruit bunches (OPEFB), chicken manure and biochar are presented in Table 1.

| Parameter               | Experimental Soil<sup>1)</sup> | OPEFB Compost<sup>2)</sup> | Chicken Manure<sup>2)</sup> | Biochar<sup>2)</sup> |
|-------------------------|------------------------------|---------------------------|---------------------------|---------------------|
| Nitrogen (%)            | 0.53                         | 2.48                      | 1.38                      | 0.25                |
| P-total (%)             | 0.20                         | 0.87                      | 1.39                      | 0.33                |
| K-total (%)             | 0.02                         | 0.97                      | 1.47                      | 0.65                |
| C-organic (%)           | 0.45                         | 41.70                     | 13.15                     | 2.14                |
| pH                      | 4.40                         | na                        | Na                        | na                  |
| Mg (%)                  | na                           | na                        | Na                        | 0.12                |
| Ca (%)                  | na                           | 4.45                      | Td                        | 0.12                |
| Water Content (%)       | na                           | 69.00                     | 23.35                     | 48.07               |

Description:  
<sup>1)</sup>Socfin Indonesia Ltd. Laboratory  
<sup>2)</sup>Indonesian Oil Palm Research Institute, Medan Laboratory  
na = not analysed

#### 2.2 Procedures

This research was a pot experiment using a non-factorial randomized block design with 7 types of treatment and 4 replications, thus there were 28 experimental units. The growing media composition was K<sub>1</sub> (top soil), K<sub>2</sub> (top soil + biochar = 3: 1, v/v), K<sub>3</sub> (top soil + chicken manure = 3: 1, v/v), K<sub>4</sub> (top soil + OPEFB compost = 3: 1, v/v), K<sub>5</sub> (top soil + OPEFB compost + chicken manure = 2: 1: 1, v/v/v); K<sub>6</sub> (top soil + biochar + chicken manure = 2: 1: 1, v/v/v) and K<sub>7</sub> (top soil + biochar + compost = 2: 1: 1, v/v/v).
The research began with land preparation in the form of land clearing from weeds, garbage and remnants of roots. The research plot was made with a size of 50 cm x 50 cm with a spacing between squares was 20 cm and a distance between blocks was 40 cm, then the containment frame was made using a bamboo that was curved in a semicircle with a length of 6 m, width 3 m and height 80 cm and covered with a lid framework with transparent plastic. Growing media in accordance with the treatment was put into a polybag of 2 kg size based on the volume ratio. Planting material in the form of mint stem cuttings comes from healthy mother trees. The cuttings with 5 segments were measuring and a length of about 10 cm was cut using a sharp cutter. Furthermore, the planting material was planted in polybags that have been prepared and watered until moist. The base of the stem that is embedded in the soil is about 2.5 cm. The planting was carried out in the afternoon. After being planted, the containment was carried out for 2 weeks. The watering was done every morning and evening. Plant caterpillar pest control was carried out using pesticides with active ingredients of deltamethrin at a dose of 1 ml/litre of water.

The variables observed included sprouting age (days after planting/DAP), the number of shoots, shoot length and N uptake of the shoot. The N content of the plant was analysed by the Kjeldahl method.

2.3. Data Analysis

Data were analysed by analysis of variance, if there were significant differences then proceed with Duncan's Multiple Range Test at the level of $\alpha = 5\%$.

3. Results and Discussions

3.1. Sprouting age

Based on Table 2, it can be seen that the fastest sprouting age was in the K4 treatment, namely top soil : OPEFB compost = 3 : 1, while the latest sprouting age was in K2 treatment, namely top soil : biochar = 3 : 1. The appearance of shoots is affected by the texture of the growing media. The composition of top soil growing media: OPEFB Compost = 3 : 1 has a light texture so it can create good aeration and drainage conditions to support root growth. Akanbi [6] stated that the plant root system is strongly influenced by plant growth media. A good growing media has good porosity and texture characteristics, sufficient water retention and sufficient nutrients. Elias [7] stated that OPEFB compost has the advantage, i.e. containing nutrients needed by plants, including N, P, K, C, Ca and Mg. In addition, OPEFB compost can improve soil physical, chemical and biological properties, assist the solubility of nutrients needed by plants, is homogeneous and reduces the risk of plant pest carriers.

Table 2. Morphological characters of Mint plants with growing media composition treatment

| Treatment                                      | Sprouting age (DAP) | Number of shoots per shoot | Shoot length (cm) |
|------------------------------------------------|---------------------|---------------------------|------------------|
| K1 (top soil)                                  | 6.15 ab             | 4.67b                     | 9.43b            |
| K2 (top soil + biochar = 3:1)                  | 8.59a               | 4.66b                     | 11.81b           |
| K3 (top soil + chicken manure = 3:1)           | 8.05ab              | 18.73ab                   | 17.31ab          |
| K4 (top soil + OPEFB compost = 3:1)            | 4.10b               | 25.23a                    | 24.21a           |
| K5 (top soil + OPEFB compost : chicken manure = 2:1:1) | 4.70ab              | 23.20a                    | 24.21a           |
| K6 (top soil + biochar : chicken manure = 2:1:1) | 6.95ab              | 19.06ab                   | 25.26a           |
| K7 (top soil + biochar :OPEFB compost = 2:1:1) | 6.70ab              | 19.90ab                   | 27.11a           |

Description: The numbers followed by the same letter showed no significant difference on the Duncan Multiple Range Test at the level of $\alpha = 5\%$.

The results of OPEFB compost analysis (Table 1) supported this statement because OPEFB compost contains high C-organic content, namely 41.70%, 69.00% moisture content and 2.48% N content. This was what reinforced that the K4 growing media composition produced the fastest shoots. The addition of organic matter has a direct influence on plant physiology such as increasing plant growth because organic fertilizer is very helpful in improving soil properties.
Growing media composition of top soil : biochar = 3 : 1 resulted in a late sprouting age (8.59 days after planting). Biochar is a soil conditioner that functions as a carbon deposit in the soil, works to bind and store CO2 from the air and prevent it from being released into the atmosphere, reducing greenhouse gas emissions, improving soil conditions and having the ability to hold water and nutrients in the soil [8-10]. Biochar used in this research came from paddy husk which was processed by pyrolysis. The results of biochar analysis (Table 1) showed that the C-organic content is quite low (2.14%). This allowed a slower shoot appearance due to the poor soil texture and low nutrients.

3.2. Number of shoots
The highest number of shoots was found in the K4 growing media composition treatment, namely top soil + OPEFB compost = 3: 1 and K5, namely top soil + OPEFB compost + chicken manure = 2: 1: 1. (Table 2). Based on the analysis results in Table 2 it can be seen that the content of N, P and K nutrients in OPEFB compost and chicken manure is higher than biochar. A high level of N in a growing media composition allows a better plant growth, characterized by the number of shoots formation. In this phase, N is needed for cell division which is included in the metabolic part of the plant.

3.3. Shoots length
Based on Table 2 it can be seen that the application of organic matter into the growing medium increases the length of the shoot. It can be seen that the growing media composition with organic matter application, namely K3-K7, produces longer shoots than K1 and K2. The application of biochar into the growing media of K2 had not been able to increase the length of shoot. This is because the biochar which was used only contained a little of N, P, K and C-organic compared to OPEFB compost and chicken manure (Table 1). Whereas, if the growing media is added with chicken manure or OPEFB compost (K6 and K7), hence the real role of growing media is seen in increasing shoot length.

Chicken manure and OPEFB compost play a significant role in the biological and physical properties of the soil and are a source of N, P and K. Nutrients N, P and K played a significant role in supporting the growth of mint plants which are expressed in the shoots length. This was evidenced by the application of chicken manure or OPEFB compost (K6 and K7), which significantly increases the length of the shoot.

3.4. N uptake of shoot
Based on Figure 1. it can be seen that N uptake of shoot in K3-K6 increases compared to K1, K2 and K7. N uptake in K4 treatment (top soil + OPEFB compost = 3 : 1) was the highest because of the high of N total content in the OPEFB compost (2.48%) compared to other sources of organic matter and the increase in plant canopy dry weight.

The growing media composition of K2 and K7 resulted in the low N uptake, presumably due to biochar used, resulting in the increased of growing media porosity, so that the growing media was not able to bind water for a long time, as a result the growing media will dry quickly and cause drought. In addition, the nutrient content of N in biochar is low, so that N uptake is also low. In accordance with Supriyadi’s [11] statement, that increasing the N nutrient in organic matter used will increase the N content in plants because of the improvement of soil physical properties and the availability of N nutrients so that the contact of root hair to absorb nutrients are more quickly.

Mint plants require relatively large amounts of N nutrients for leaf growth and plant metabolism such as photosynthesis. N becomes the main macronutrient which is the main component of the plant body. Growing plants need N to form new cells, protein formation and are an integral part of chlorophyll [12]. Plants that have a higher N content have greener leaves, so photosynthesis works better. The photosynthetic produced is used for plant growth, including increasing the number of shoots and the length of shoots.
Figure 1. The effect of growing media composition on the N uptake of the shoot in mint

4. Conclusion
The growing media composition of top soil + OPEFB compost = 3 : 1 was the best composition of the growing medium because it produced higher sprouting age, shoot length, number of shoots and N nutrient uptake of shoot than other growing media composition.

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