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Response of Rooting Attributes of Peppermint (*Mentha piperita* L.) Stem Cuttings to Natural Rooting Stimulators

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Abstract: *Mentha piperita* L is a hybrid plant derived from the crossing of *Mentha aquatic* and *Mentha spicata*. The plant is not able to reproduce seeds. The present study was aimed to determine the most suitable liquid medium for better rooting and survival. Healthy immature stem cuttings of peppermint with two pairs of leaf were placed in 5% vermiwash, 5% honey, 5% coconut water and pure water. The results revealed that there was a significant difference ($P<0.01$) in rooting percentage of stem cuttings among the tested treatments. The stem cuttings of peppermint plant dipped in 5% vermiwash showed remarkably higher rooting percentage and lower rooting percentage was observed in pure water after 72 hours. Further, experiment was done to optimize the concentration of vermiwash liquid medium for better rooting and survival of peppermint stem cuttings Healthy stem cuttings were placed in liquid media of different concentrations (5%, 10%, 15% and 20%) of vermiwash. The result indicated that the stem cuttings dipped in 10% vermiwash had higher rooting percentage (98%) and growth of shoots within a week of period. Furthermore, an experiment was done to determine the rooting of stem cuttings on sand medium by applying the different concentrations (0%, 3%, 4%, 5%) of vermiwash instead of watering. Results recorded the growth performance of peppermint stem cuttings ie; number of suckers, shoot length, root length, fresh shoot and root weight were increased gradually with increase in vermiwash concentration from 3% to 5%. The vermiwash has a significant effect on rooting of peppermint cuttings.

Key words: Coconut water, Honey, Peppermint, Stem cutting, Vermiwash,

INTRODUCTION

Mint plant is belonging the family Lamiaceae (Mint Family). The family includes about 65 genera (Harley et al., 2004). Mints are aromatic herbs and plants have large spreading underground and over ground stolons (Aflatuni et al., 2005). *Mentha* genus is widely distributed in various environments. Peppermint (*Mentha x piperita* L.) is a hybrid plant derived from the crossing of *Mentha aquatic* (water mint) and *Mentha spicata* (spearmint). The leaves of peppermint have aromatic and sweet flavor. The fresh and dried leaves are the cooking source of mint (Baban, 2016). Peppermint essential oil and menthol are widely used as flavourings. Mint was initially used as a medicinal herb to cure stomach ache and chest pains (Misra et al., 2014).

Menthol from mint essential oil is an ingredient of many cosmetics and some perfumes. Menthol and mint essential oil are utilized in aromatherapy (Hunt et al., 2013). *Mentha piperita* L. is an aromatic plant which is not competent to reproduce seeds. On the contrary, it can be propagated by using stem cuttings. Buta et al. (2014) studied on the vegetative propagation through cuttings of *Mentha x piperita* hybrid using various rooting substrates. Vegetative propagation is the most commonly used method in commercial production of many plants. In many species, it is the only method for clonal propagation of plants (Hartmann et al., 2002). Production of adventitious

roots is a process induced and regulated by external and internal factors (Salas et al., 2012). The effectiveness of the natural rooting stimulants is an important for successful propagation. Therefore, this study was aimed to evaluate the rooting responses of peppermint stem cuttings as influenced by different natural rooting stimulators and also to determine the best rooting medium for the propagation of peppermint.

MATERIALS AND METHOD

This study was carried out in 2017 at a shade house in a home garden, Palugamam, Portivu pattu pradesha sabha, Eastern region of Sri Lanka. The experiments were laid out in a Complete Randomized Design with three replicates for each treatment.

Experiment 1

This experiment was done to select the most suitable liquid medium for better rooting and survival of stem cuttings of pepper mint plants where the different liquid media such as pure water, 5% coconut water, 5% honey and 5% vermiwash were used as rooting liquid media (Table 1).

Table 1: Liquid rooting media used in this experiment.

Treatment codes	Liquid media
L1	Pure water
L2	5% Coconut water
L3	5% Honey
L4	5% Vermiwash

Preparation of Liquid Rooting Media

Coconut water, honey and vermiwash at a rate of 5% were used as rooting stimulators. In this experiment, different liquid rooting media (Table 1) were separately prepared by adding proper amount of each stimulator and pure water. The media were separately poured into the plastic transparent vessels in which each solution was filled upto about two third of the vessels. In addition, pure water alone was also used as a control treatment.

Collection of Stem Cuttings

Young stem cuttings from healthy mother plants of peppermint (Figure 1) were carefully cut off approximately 10 cm long with a sharp single edge razor blade. Two pairs of leaves from the base of the cutting were removed. The stem cuttings having 5 nodes were taken from new growth of plants. Base of the stem cutting was cut slanted below the final node.

Figure 1: Peppermint plant for taking stem cuttings

Planting of Cuttings in Liquid Media

The prepared stem cuttings were directly placed in the different liquid rooting media in which two end nodes of the stem cuttings were dipped (Figure 2). Each liquid medium was aerated manually thrice a day by using thin plastic tube. This experiment was repeated thrice. Rooting attributes were observed daily.

Experiment 2

In the previous experiment, vermiwash medium was shown better for rooting of stem cuttings than that of the other liquid media. Therefore, vermiwash was used in this trial to select the most suitable concentration of vermiwash liquid medium for better rooting and survival of peppermint stem cuttings. Healthy stem cuttings were placed in liquid media of different concentrations (5%, 10%, 15% and 20%) of vermiwash. This experiment was repeated thrice. Rooting attributes were observed daily and data were recorded.

Figure 2: Peppermint stem cutting dipped in liquid medium

Experiment 3

This study was done to determine the rooting of stem cuttings on sand medium by applying the different concentrations (0%, 3%, 4%, 5%) of vermiwash instead of watering. Healthy semimatured stem cuttings of peppermint plants were excised with two nodes. The stem cuttings were planted on the medium about one node inserted into the sand. The growth parameters were measured and recorded daily.

Statistical analysis

The data obtained were subjected to Analysis of variance (ANOVA) using SAS 9.1.3 portable version. The treatment means were compared using Tukey's Test at 5% significant level.

RESULTS AND DISCUSSION

Mentha piperita L. (*Mentha x piperita* L.) is a herbaceous plant with aroma and it is a hybrid plant derived from the crossing of *Mentha aquatic* (water mint) and *Mentha spicata* (spearmint). The some plants are not competent to produce viable seeds. Those plants can be reproduced by using their vegetative plant parts for clonal propagation. The commercial mint varieties are propagated vegetatively as they are sterile hybrids (Broertjes and Van Harten 1988). Stem cuttings are commonly used to propagate *Mentha x piperita* L under favourable environmental conditions.

Plant growth regulator, auxin is used for cell elongation and root initiation from stem cuttings. Root tip cells are considerably sensitive to auxin (Salisbury and Ross, 1992) and they are essential to absorb water and nutrients from rooting medium for better growth of stem cuttings. Natural rooting stimulators can be used to stimulate the roots in stem cutting of peppermint plants. This study was therefore aimed to find out the most suitable natural rooting stimulator for selection of the best rooting medium to propagate peppermint plants.

Experiment 1

This experiment was done to determine the most suitable liquid medium for better rooting and survival of peppermint stem cuttings. The healthy stem cuttings were placed in different liquid rooting media such as pure water (control), 5% coconut water, 5% honey and 5% vermiwash. The results revealed that the stem cuttings showed the considerable difference ($P<0.01$) in rooting percentage among the tested treatments (Table 2). Mean rooting percentage of stem cuttings in different rooting media ranged from 60.2% to 88.5%.

The stem cuttings of peppermint plant placed in 5% vermiwash exhibited significantly higher rooting percentage (88.5%). after 72 hours and lower rooting percentage (60.2%) was observed in pure water. Roots were initiated within 18 hours in about 25% of the stem cuttings after dipping in 5% vermiwash. Meanwhile the rooting responses were noted in the peppermint stem cuttings positioned in the other liquid media after 24 hours of duration. Among the treatments, vermiwash medium showed rapid and better rooting response in peppermint stem cuttings. This was supported by Abesekara et al. (2007) stated that vermiwash extracts had equal or greater effect on bean and radish root tip length increase than the synthetic auxin IBA.

Table 2: Rooting responses of peppermint stem cuttings in different liquid rooting media.

Liquid media	Rooting % of peppermint stem cuttings	
	At 48 hrs	At 72 hrs
L1	40.0	60.2 ± 3.1c
L2	47.0	70.2 ± 1.6b
L3	55.0	72.5 ± 3.2b
L4	82.0	88.5 ± 0.6a
F test	-	P<0.01

L1- pure water; L2 - 5% coconut water; L3 - 5% honey; L4 –5% vermiwash.
The rooting % values are means± standard error of three replicates. Means followed by the same letter are not significantly different from each other at 5% significant level according to the Tukey's Test.

Experiment 2

In the Experiment 1, vermiwash medium showed better for rooting of stem cuttings than that of the other liquid media. The present study was attempted to optimize the concentration of vermiwash liquid medium for better rooting and survival of peppermint stem cuttings. Healthy stem cuttings of peppermint plant were placed in liquid media of different concentrations (5%, 10%, 15% and 20%) of vermiwash. Selection of optimum concentration of liquid medium for rooting of stem cuttings and their subsequent growth is an important step in successful plant propagation. Vermiwash contains ample amounts of soluble macro and micronutrients, natural growth hormones and beneficial microbes (Ismail, 1997).

Better rooting performance were observed in all tested treatments within a week. During this period, better rooting and survival were observed. The result in the stem cuttings of peppermint plant clearly showed remarkable difference in rooting response ($P<0.001$) among the treatments (Table 3). Mean rooting percentage ranged from 67.0% to 98.0%. Peppermint stem cuttings dipped in 10% vermiwash significantly differed from the others by the higher rooting percentage, root hair development and shoot growth after 72 hours of planting.

The root tip length increase may be attributed mainly due plant growth regulating compound present in vermiwash and root tip cells are highly sensitive to auxins than the other compounds (Abesekara et al., 2007). Quaik et al. (2012) stated that the highest length of root and shoot may be due to the results of high potassium content in vermiwash. In the present study, stem cuttings placed in 20% vermiwash showed browning and decay of roots. This was supported by Gutiérrez et al. (2017) who stated that vermicomposting leachate is diluted to avoid plant damage such as scorching of leaves. The peppermint stem cuttings placed in 5% vermiwash and 15%

vermiwash showed lower rooting responses compared to 10% vermiwash. Liquid medium containing 10% vermiwash showed the better survival and rooting of peppermint stem cuttings (Figure 3&4).

Table 3: Rooting responses of stem cuttings of peppermint plant in different concentrations of vermiwash media after 72 hours of planting.

Liquid media	Response	Response %
V_1	Better rooting and new shoot growth	86.0 ± 1.8b
V_2	Better rooting, root hair development and new shoot growth	98.0 ± 0.9a
V_3	Better rooting and browning of roots	75.0 ± 0.9c
V_4	New shoot growth and decay	67.0 ± 2.3d
F test		P < 0.001

V_1 - 5% vermiwash; V_2 - 10% vermiwash; V_3 - 15% vermiwash; V_4 – 20% vermiwash
The response % values are means± standard error of three replicates. Means followed by the same letter are not significantly different from each other at 5% significant level according to Tukey,s test.

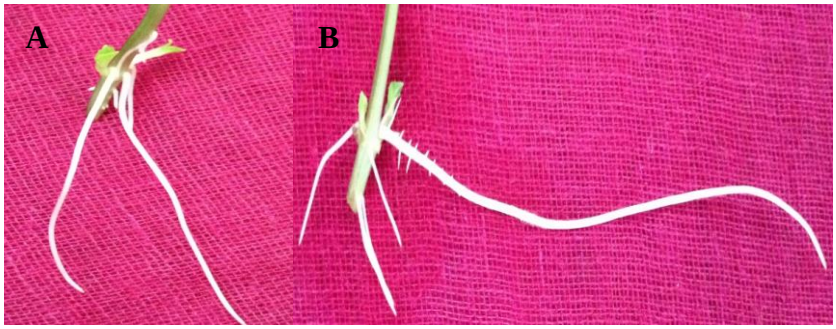

Figure 3: Rooting responses of stem cuttings of peppermint in different concentrations of vermiwash after 72 hours of planting.
A - 5% vermiwash; B - 10% vermiwash

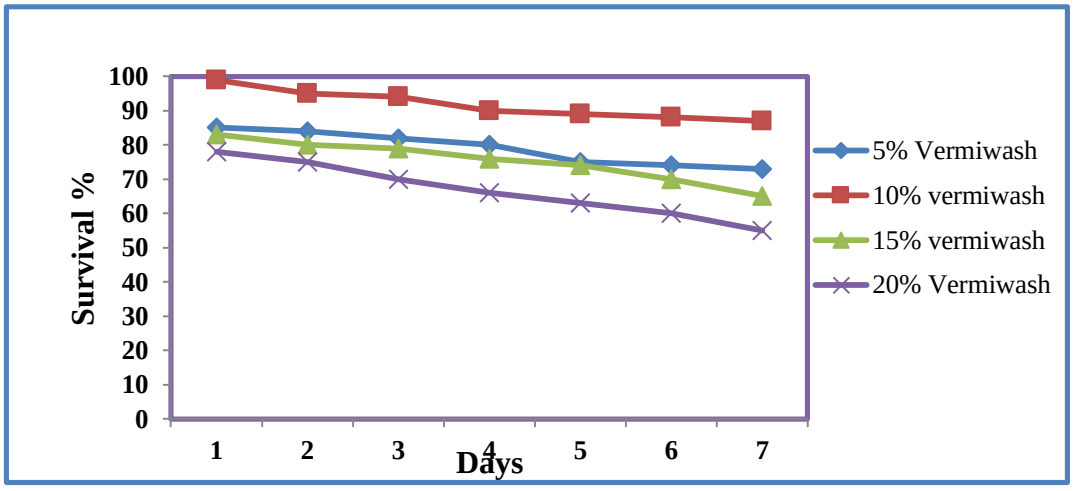

Figure 4: The survival % of peppermint stem cuttings in different concentrations of vermiwash.

The results revealed regarding the number of roots and root length of stem cutting were showed considerable differences (P<0.001) among the treatments (Table 4). Highest number of roots (10.3) and the longest root length (12.9 cm) were obtained in the 10% vermiwash treatment. Indian Borage in 10% vermiwash hydrophonic solution exhibited highest length of root and shoot as compared to other concentrations of vermiwash (Wani et al., 2017). Vermiwash has an effective rooting hormone (Weerasinghe et al., 2005).

Table 4: Effect of vermiwash on number of roots and root length of peppermint stems cuttings after 7 days of planting.

Media	Number of roots	Root length (cm)
V_1	05.1 ± 0.28b	05.1 ± 0.42b
V_2	10.3 ± 1.60a	12.9 ± 1.33a
V_3	1.5 ± 0.20c	2.5 ± 0.30c
V_4	1.3 ± 1.40c	1.3 ± 0.28c
F test	P<0.001	P<0.001

V_1 - 5% vermiwash; V_2 - 10% vermiwash; V_3 - 15% vermiwash; V_4 – 20% vermiwash.
The values are means ± standard error of three replicates. Means followed by the same letter are not significantly different from each other at 5% significant level according to the Tukey,s Test.

Experiment 3

This experiment was done to determine the rooting of stem cuttings on sand medium by applying the different concentrations (0%, 3%, 4% and 5%) of vermiwash. Results recorded the growth performance of peppermint stem cuttings ie. number of suckers, shoot length, root length, fresh shoot and root weight were increased gradually with increase in vermiwash concentration from 3% to 5% (Figure 5) after two weeks of planting in sand medium. The highest number of suckers (3), shoot length (12.5 cm), root length (10 cm), fresh shoot weight (17 g) and fresh root weight (10 g) observed on T_4 (5% vermiwash) while the control treatment (T_1) showed lowest growth performance after two weeks of planting. Manyuchi (2013) reported that the vermiwash had about neutral pH, particularly the electrical conductivity was higher in the vermicompost. Vermiwash is a very good plant tonic which can be used for foliar spray and rooting medium (Sundararasu, 2016).

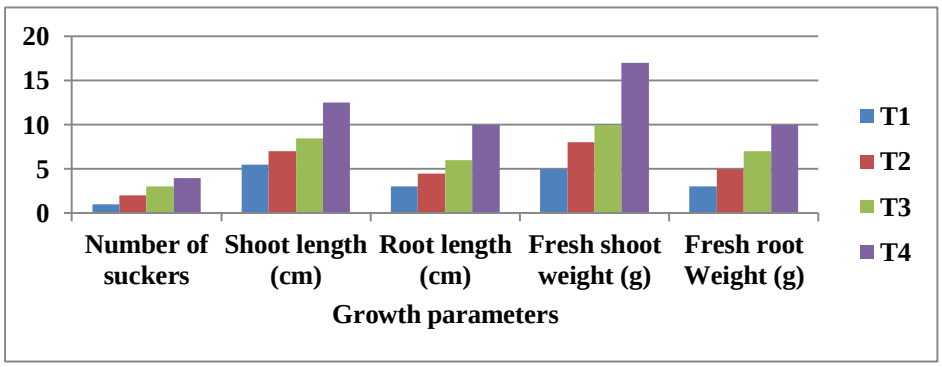

Figure 5: Growth parameters of peppermint stem cuttings in different concentrations (T_1- 0% vermiwash, T_2- 3% vermiwash, T_3- 4% vermiwash, T_4- 5% vermiwash) of vermiwash after two weeks of planting in sand medium.

CONCLUSIONS

In the present study, results revealed that the vermiwash liquid medium had better rooting response of peppermint stem cuttings. Optimum concentration of vermiwash liquid medium was 10% for higher rooting percentage, root hair development and shoots growth of peppermint stems cuttings. 5% of vermiwash application instead of watering is recommended for the best growth performance of the mature stem cuttings of peppermint in sand medium. Further study is necessary to evaluate the plant performance of peppermint plants in liquid and sand medium.

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