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Full Length Research Paper

Effect of growing media on the germination and seedling growth of Borneo sour eggplant

Ainnie Shaherah Ahmad Sabri[1] and Fauziah Abu Bakar[1,2]*

[1]Department of Crop Science, Faculty of Agricultural Science and Forestry, Universiti Putra Malaysia Bintulu Sarawak Campus, 97008 Bintulu, Sarawak, Malaysia.
[2]Institut Ekosains Borneo (IEB), Universiti Putra Malaysia Bintulu Sarawak Campus, 97008 Bintulu, Sarawak, Malaysia.

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ABSTRACT

Borneo sour eggplant, a popular indigenous fruit vegetable in Borneo, has become an important fruit not only to local people, but also to tourists who visit Borneo. One of the challenges in planting this crop is lacking information, particularly in finding suitable media for its growth, eventually inhibiting local farmers from growing the crop commercially. This study was conducted to investigate the effects of 4 growing media compositions (M1: topsoil, M2: topsoil and compost, M3: topsoil and cocopeat and M4: topsoil, compost and cocopeat) on the germination and growth performance of sour eggplant seedlings. The experiment was tested in a randomized complete block design (RCBD) with 10 replicates. At the end of germination period, seeds planted in M4 medium produced the highest germination rate of 96.67% and was significantly different ($P < 0.05$) from those sown in other growing media. However, the performance of the seedlings in terms of height, stem diameter, number of leaves and length of leaves showed significant increase ($P < 0.05$) in M2 medium. This study has demonstrated that M2 medium could improve the growth performance of the seedlings and therefore is recommended as suitable growing media for planting sour eggplant.

Keywords: Growth performance, growing medium, indigenous fruit, sour eggplant.

*Corresponding author. Email: ab_fauziah@upm.edu.my. Tel: (60) 86855839.

INTRODUCTION

Sour eggplant (*Solanum lasiocarpum*) or popularly known as terung asam by the local people, is a well-liked indigenous fruit vegetable in Borneo due to its high nutritive values such as Vitamin C and fiber, unique sour taste as well as its vibrant golden yellow color on the fruit (Razili et al., 2015). Since then, it has become an economically important fruit not only to local people in Borneo, but also to tourists who come to Borneo. As a popular indigenous crop, it is always a challenge in cultivating the crop commercially due to insufficient knowledge particularly in finding suitable growing media for its growth, eventually inhibiting local farmers from successfully growing the crop. Nowadays, cultivation of sour eggplant has been limited because the local farmers are using solely soil as a growing media. It is known that using soil alone especially in germination resulted in slow growth and hence the yield is low and the quality is poor. Hence, a detailed understanding on the characteristics of growing media required by sour eggplant, which greatly affect its growth, could provide more insight for our local farmers to cultivate this crop successfully in the future.

Many studies have explored the effect of using a range of growing media constituents as alternative to commercial soil media on plant growth. For example, Vivek and Duraisamy (2017) reported that combined application of coir pith and vermicompost was found to be the most optimum growth media that could enhance the germination and growth parameters of tomato seedlings. Some of the growth parameters observed and showed significant effects in this study were shoot and root length, stem diameter and number of leaves formed in each plant. Similarly, a study carried out by Bhardwaj et al. (2019) found that the use of cocopeat and vermicompost along with various organic constituents increased the growth performance of the eggplants (*Solanum melongena*) as compared to those eggplants that were grown in traditional soil. Other than these two examples, the effect of growing media has also been

studied in many ornamental plants. For instance, growth and flowering of gerbera daisy (*Gerbera jamesonii* H. Bolus) were improved when grown in the presence of coir pith and vermicompost based media combination (Rajan et al., 2020). Recently, studies on more flowering tropical plants have been conducted on their growth performance affected by various growing media. Fazeli Kakhki et al., (2020) reported that peace lily's (*Spathiphyllum wallisii)* morphological traits were significantly increased when grown in mixed growing medium containing peat moss and cocopeat along with application of perlite as mineral source. Similar results were obtained by Soltani and Naderi (2016) whereby carnation plants grown in combination with organic materials such as perlite produced better carnation growth, when compared to the soil alone.

While the research advancement on the effect of growth parameters in different growing media has been performed extensively in many other plants, very limited information is available on growth performance of sour eggplant in suitable media. As a popular indigenous crop of Borneo, the challenge in finding cost-effective and locally produced material as growing media for its cultivation has hindered its production at large scale. Hence, the identification of suitable growing media for cultivating sour eggplant needs to be identified as well as the effect of its germination and growth performance.

At present, there has yet been any study on the effect of sour eggplant's growth performance grown in different growing media. The current study aimed to test four different combination of growing media on the germination rate and growth parameters of sour eggplant. The findings obtained in this study could be documented to provide basic knowledge to our local farmers in the future.

MATERIALS AND METHODS

Plant material and experimental design

The experiments were conducted at the nursery of University Agriculture Park, located in Universiti Putra Malaysia Bintulu Campus Sarawak. Disease-free and clean seeds of Borneo sour eggplant purchased from the local nursery were used in this study and grown in respective media under a controlled environment, in a net house. For germination, the seeds were treated overnight for 12 hours by soaking in distilled water to break seed coat. In the following day, the seeds were uniformly sown in potting trays filled with respective media and placed in a net house. The experiments were laid out in a randomized complete block design (RCBD) where each treatment was replicated three times and ten seedlings were used for each replication. All media containing the seeds were watered twice per day, each in the morning and evening. The watering was done by sprinkling and carried out in the morning by 7.00 am and in the evening by 6.30 pm. At 40 days of post-planting, the seedlings were transplanted to polybag (size 12 × 14 inch) (one seedling per polybag) to allow for better growth.

Preparation of trays and growth media

Seedling trays were filled with 4 types of media with 1 inch depth: (M1) topsoil alone; (M2) topsoil and organic compost (1:1) (*v/v*); (M3) topsoil and cocopeat (1:1) (*v/v*) and (M4) topsoil and organic mixture containing compost and cocopeat (1:1:1) (*v/v/v*). M1 serves as the control medium. There were 10 replicates for each media used in this study. Equal amount of Nitrogen Phosphate Potassium (NPK) fertilizer was applied after 80 days post-germination, with 2 weeks interval. The fertilizer was dissolved in distilled water prior treatment.

Data collection on seed germination, seedling growth and phenotypic analysis

To measure the seed germination percentage for each media tested, the total number of seeds that germinated under each growing medium was recorded at 7 days after sowing. Data was collected every day at 24-hour interval, started upon the emergence of radicle, and continued until the germination completed. Seed germination percentage was calculated according to formula:

$$\%\ Germination\ (\%) = \frac{Number\ of\ seeds\ germinated}{Total\ number\ of\ seeds\ sown} \times 100$$

The seedlings were allowed to grow for another eight weeks until the shoots achieved their maximum length. Phenotypic measurements of these seedlings were recorded after the plants reached 5 months old. Measurement of other growth parameters (n = 10 for each media), including plant height, length of shoots, diameter of stems, number of leaves and length of leaves were, taken after seedling emergence and this process continued on weekly basis for 20 weeks. The above ground part seedling heights were measured as the length from the soil to the top of each seedlings, using a measuring tape. Diameter of stems was measured using a vernier caliper. For leaves size, the length of leaves was measured from one end of the leaf to the petiole at the other end, using a ruler, whereas the number of leaves was determined by counting every visible leaf on the plant, including the tips of new leaves just beginning to emerge.

Statistical analysis

Data was analyzed using Statistical Analysis Software (SAS) 9.4 version. Significant difference from the control value(s) was determined at $P < 0.05$ levels. All reported data represent the mean ± SD of at least 3 independent experiments.

RESULTS AND DISCUSSION

The germination percentage of sour eggplant seeds in four different media was calculated on seven days post planting (Table 1). There was a slight delay in germination due to several environmental factors such as light, moisture, temperature, and nutrients, which could possibly delay the germination rate. Similar result was also seen in a study carried out by Daddario et al. (2017) who reported that these environmental factors affected the germination of common teasel seeds (*Dipsacus fullonum*). In this study, seed germination of sour eggplant was significantly affected by growing media ($P < 0.05$). At the end of germination period, germination percentages for each medium were 46.7% (M1), 80% (M2), 86.67% (M3) and 96.67% (M4). These results

Table 1. Average germination percentage of sour eggplant in different growing media. M1: topsoil (control plant); M2: topsoil and compost; M3: topsoil and cocopeat and M4: topsoil, compost and cocopeat.

Media	Component	Number of seeds sown	Average germination percentage (%)
M1	Topsoil	30	46.7
M2	Topsoil and compost	30	80.0
M3	Topsoil and cocopeat	30	86.7
M4	Topsoil, compost, and cocopeat	30	96.7

indicated that M4 medium could provide highest germination rate compared to other three media due to its good physical properties and holding water capacity. While the combination of compost and cocopeat improved the ability of soil to retain water, the mixture of these components in M4 medium helped to improve nutrient soil availability and eventually increased the amount of nutrients absorbed by the seedlings. These criteria directly affected the seedling development during germination as well as the seedling quality when it matured. This finding coincided with Meena et al. (2017) who reported the combination of vermicompost, sand and pond soil along with cocopeat was found to be the best medium for the growth of papaya seedlings.

Data presented in Figure 1 shows growth and development of sour eggplant seedlings were significantly affected by mixture of growing media tested in this study. While M4 medium was proved to provide the highest germination rate in sour eggplant seedlings, the growth performance in terms of height, stem diameter, length of leaves and number of leaves showed significant increase ($p < 0.05$) in M2 medium.

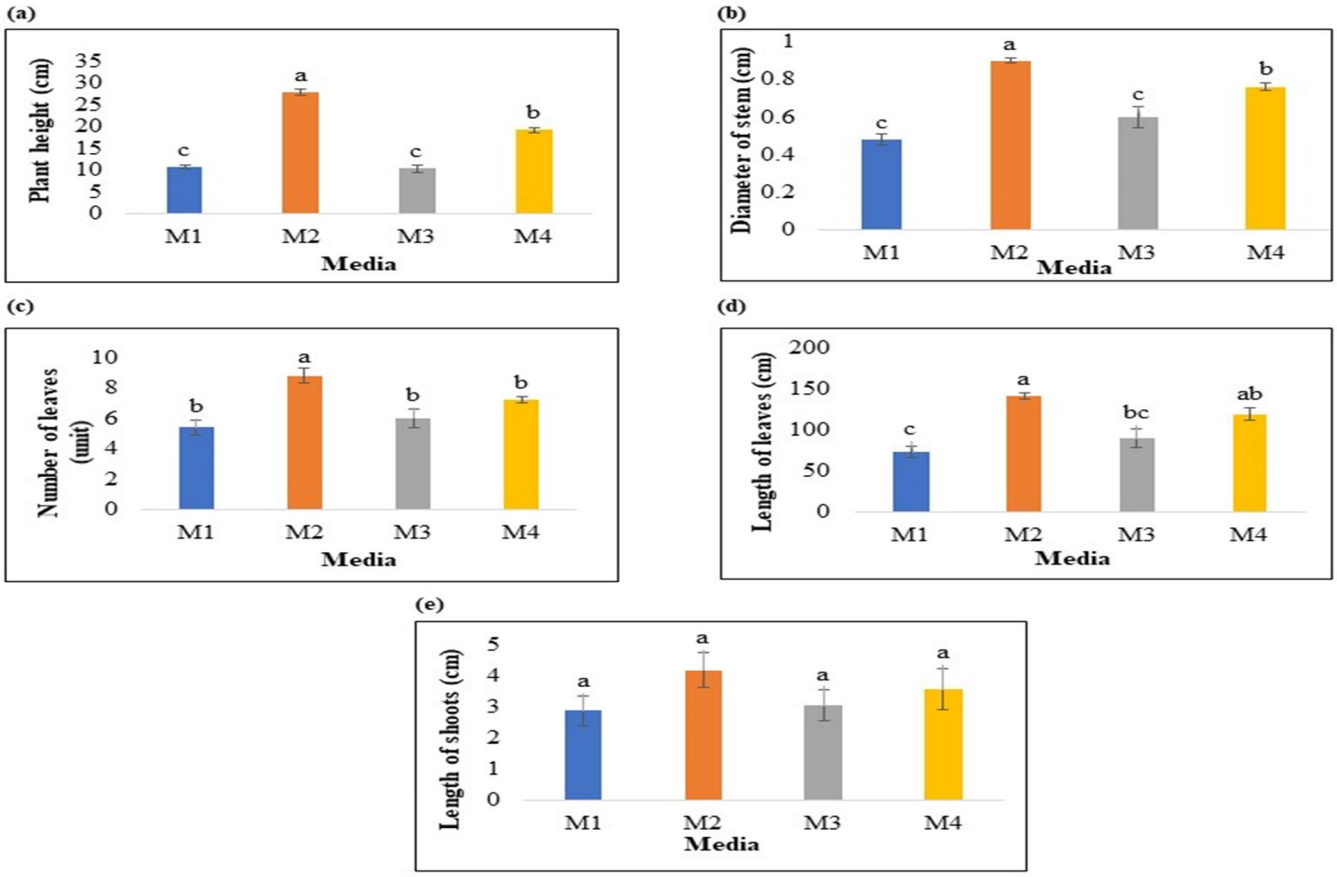

Figure 1. Effect of different growing media on growth parameters of sour eggplant at 5 months post-planting. (a) Total height for each plant measured from the soil to the top of the plant; (b) Diameter of stem for each plant; (c) Number of leaves formed in each plant; (d) Length of the largest leaves for each plant; (e) Length of shoot for each plant. The data in (a-e) are shown as the mean ± standard deviation (n = 10) from three biological replicates which were chosen randomly for each parameter measurements. Different letters above the bars indicate significantly different means [$P < 0.05$ as analyzed by SAS]. M1: topsoil (control plant); M2: topsoil and compost; M3: topsoil and cocopeat and M4: topsoil, compost and cocopeat.

In all growth parameters recorded, the plants showed increased growth in terms of height, diameter of stems, number of leaves as well as size of leaves at maturity (Figures 1a – d and 2). Increased in all these parameters particularly in M2 medium could be due to the presence of high phosphorus content, one of the most important nutrients for plant growth. In this study, the compost in M2 medium was obtained from commercially available in the form of chicken manure, one of the sources of phosphorus. At 5 months post-planting, the differences in the length of shoots were, however, not significant (Figure 1e).

Figure 2. Morphology of the sour eggplants at 5 months post-planting grown in different growing media. M1: topsoil (control plant); M2: topsoil and compost; M3: topsoil and cocopeat and M4: topsoil, compost and cocopeat.

Choosing the right growing media is necessary to ensure enough physical support provided to the plants as well as to obtain sufficient nutrients, water and gaseous exchange for plant growth and development. Some of the essential physical characteristics of suitable growing media include lightweight, well-drained and resistant to decomposition (Latshaw et al., 2009). In this study, combination of topsoil and compost in M2 was found to be the most suitable medium for the growth and development of sour eggplant. The presence of compost in M2 increased the nutrient content of the plant, proven by improved in its growth performance in this media. Similar results have also been reported by several previous studies. Massa et al. (2018) showed an enhancement in plant performance in soils treated with compost, compared with untreated soil. Furthermore, Shahin and Dergham (2018) indicated that combined application of compost to the growing medium of *Pelargonium zonale* increased nutrient content in the leaves, compared to those plants grown in peat alone. In this study, blending compost into a growing medium also allows good water retention particularly on hot days when plant transpiration rate is high. Due to its fine particles, it allows more water to pass through, ensuring plants to obtain sufficient water.

While the growth of sour eggplant seedlings was increased in M2, the seedlings that were grown in M4 medium was similarly showing significant effect on their growth performance. The growth of the seedlings in M4 may not be as good as in M2, but M4 medium could also be used as an alternative growing medium to M2. Several studies have been conducted in earlier studies and showed similar findings. Marjenah et al. (2016) reported that the growth of two dipterocarps (*Dryobalanops aromaticaand* and *Shorea balangeran*) seedlings were significantly improved when grown in combined application of cocopeat and compost along with biochar in growing media. Ghoreishy et al. (2018) also reported that all growth parameters tested on tomatoes grown in compost- and coco peat-based growing medium were

significantly higher than the other media.

Conclusions

This study has demonstrated that combined application of topsoil and compost along with cocopeat increased the germination rate and growth performance of Borneo sour eggplant, compared to topsoil alone. Although the present findings are considered preliminary, they provide intriguing evidence on the enhanced plant growth and this could be an attractive motivation to continue research along this line for potential agricultural application.

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