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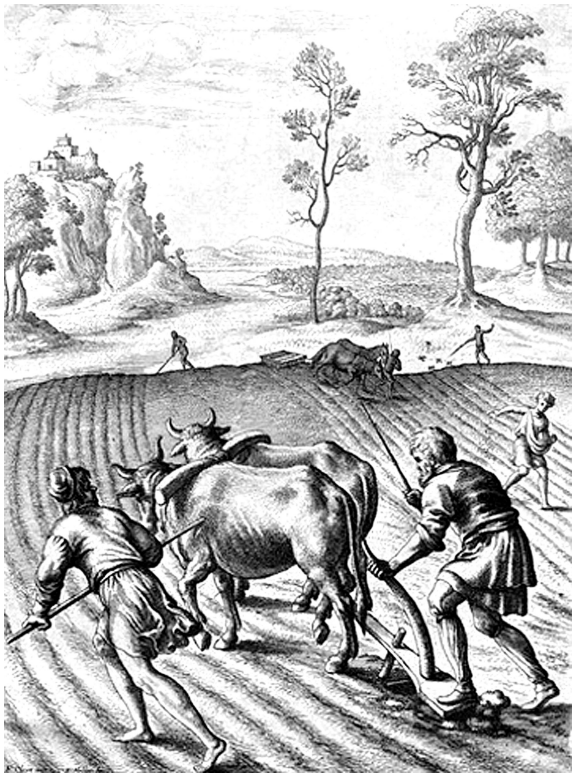

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Research Article
Different Growing Media Effect on the Cutting Quality of Two Dragon Fruit Species (*Hylocerues* sp.)

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Abstract

Background and Objective: Plant propagation is one the important factors in plant and fruit production. Many problems have been arisen in dragon fruit propagation, such as the yellowing and the rooting inability of cuttings. To solve this problem, the understanding how to choose suitable growing media is needed. This study was conducted to investigate the effects of different growing media compositions on dragon fruit propagation. **Materials and Methods:** The experiment was conducted in Green House, Faculty of Agriculture, Universitas Padjadjaran from June to September, 2017. Six growing media compositions were used for two species of dragon fruit (*H. undatus* and *H. polyrhizus*): soil (v), soil+sand (1:1/v:v), soil+compost (1:1/v:v), soil+vermicompost (1:1/v:v), soil+sand+compost (1:1:1/v:v:v) and soil+sand+vermicompost (1:1:1/v:v:v). **Results:** The results showed that soil+vermicompost (1:1/v:v) and soil+sand+compost (1:1:1/v:v:v) gave the best growth results for the two dragon fruit species by increasing the number of shoots and the lengths of the shoots. **Conclusion:** It was concluded that vermicompost was better growing media than compost for propagating dragon fruit by cuttings.

Key words: Compost, dragon fruit, growing media, vermicompost, propagation

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Dragon fruit (*Hylocereus* sp.) is a horticultural crop. This tropical, drought-resistant fruit originated in Mexico[1]. It has been widely cultivated throughout the world because it has many advantages such as being high in economic value and health benefits. Plant propagation is an important step for dragon fruit cultivation to support the availability of plant materials. The problem with dragon fruit cultivation is obtaining high-quality cuttings. Availability can be enhanced by vegetative propagation such as by cutting. One alternative to obtaining uniform seeds in large quantities is to propagate stem cuttings. Propagating stem cuttings is also known to produce a derivative that is identical to the parent; beneficial properties can be ensured as a result. Lakitan found that propagation by cutting has benefits because it cuttings can be obtained quickly and easily[2]. Stem cuttings must be healthy, green in the color and ideally be between 20 and 30 cm in length. The ability of stem cuttings to form roots is influenced by physical factors such as the length and diameter of the cuttings[3,4].

The growing medium plays an important role in the successful propagation and cultivation of dragon fruit. The choice of growing medium depends on availability, production cost, suitability for dragon fruit growth and appropriateness in physical, chemical and biological properties[5,6]. The use of media types is a matter of concern in treating cuttings. A topsoil layer is a fertile soil layer commonly used in agricultural sectors (e.g., nurseries). The increasing demand for topsoil is requiring that nurseries use marginal land as a substitute medium for topsoil. In addition, topsoil removal on a large scale has a negative impact on ecosystems in the area. Moreover, many farmers use soil for a medium for propagating dragon fruit despite it having a negative impact on the reducing the success of the cutting and rooting quality because of a loss of soil fertility. One of the materials that can be used to improve the availability of nutrients in soil is organic fertilizer[7]. Organic fertilizer is made of natural materials such as animal manure, compost, vermicompost, etc.

The composition of growing medium for plant propagation can be one alternative to obtain high-quality cuttings (e.g., mixing sand with organic matter). Organic materials used as a planting medium can provide nutrients for plants. In addition, organic materials also have macro and micro pores that are almost balanced with the air and water[8]. One of the organic materials that is used is compost. This study was conducted to investigate the effect of different compositions of growing media on dragon fruit propagation.

MATERIALS AND METHODS

Plant material and media preparation: The experiment was conducted in Green House, Faculty of Agriculture, Universitas Padjadjaran from June, to September, 2017. Thirty-centimeter stem cuttings of two dragon fruit species (*H. undatus* and *H. polyrhizus*) were used in this experiment. Six different growing media were used: soil, soil+sand (1:1/v:v), soil+compost (1:1/v:v), soil+vermicompost (1:1/v:v), soil+sand+compost (1:1:1/v:v:v), soil+sand+vermicompost (1:1:1/v:v:v). Prior to planting, the stem cuttings were immersed in fungicide and then planted in a 15 cm-diameter polybag with the new selected growing medium. The plants were then placed in a green house held at 26.5°C and 85% relative humidity (RH). Watering, fertilizing and pest and disease control were conducted during the experimental period.

Plant growth analysis: Plant growth assessments were measured 60 weeks after replanting before the plants were re-planted in bigger pots. Plant height (cm) was measured from the stem base to the tip of the highest leaves. Other parameter were investigated namely the number of shoots, the root length and the number of roots.

Statistical data analysis: A completely randomized design with four replicates was used for this experiment. For the statistical data analysis, the data were tested for normality. One factor analysis of variance (ANOVA) was performed to analyze the data and followed with Duncan's Multiple Range Test (DMRT) at $p<0.05$ to compare differences among the growing media.

RESULTS

The effect of growing medium on the quality of cuttings of dragon fruit was investigated. Data showed that more than 80% of investigated cuttings both of species, *H. undatus* and *H. polyrhizus*, can grow normally in different combinations of growing media. The cutting of *H. undatus* yielded the largest growth rates. All of the plants survived in all growing media with a growth rate of 100%. On the other hand, 100% plant survival was observed for only some growing media for *H. polyrhizus*; two kinds of growing media, namely soil and soil+sand+compost resulted in an 80% growth rate (Fig. 1).

The quality of the growing medium directly affects the growth and the development of the cuttings, particularly their shoot and root growth. The number of shoots, the length of

the shoots, the number of roots and the length of the roots can be used as indicators of cutting growth quality. This study demonstrated that the response of two dragon fruit species were similar to all investigated growing media. *Hylocereus undatus* and *H. polyrhizus* exhibited the same response to six types of growing media in terms of the number of shoots per plant. Statistical data analysis revealed that for *H. polyrhizus* the combination of the soil+vermicompost and also soil+sand+vermicompost media yielded the largest number of shoots. The average number of shoots produced from both types of media was 2.6-fold greater than the number of shoot obtained from cutting potted in soil (Fig. 2a).

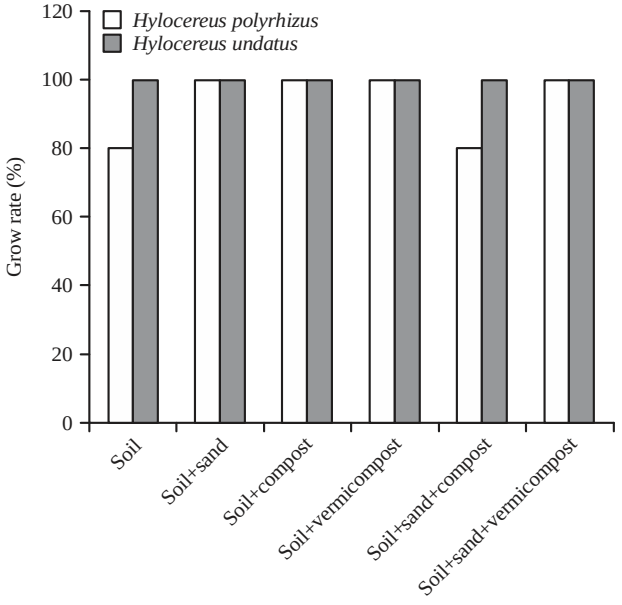

Fig. 1: Growth rate of the cutting of two species of dragon fruit, *H. undatus* and *H. polyrhizus* at 15 weeks after cutting (15 WAC)

The same response to the use of soil+vermicompost and soil+sand+vermicompost was noted in *H. undatus*. The combination of soil+vermicompost and soil+sand+ vermicompost significantly increased the average number of shoots to 2.4 and 3.0, respectively; the average number of shoots in the control (soil) was 1 (Fig. 2b). Based on these observations, one can conclude that vermicompost is very good for new shoot development of dragon fruit cuttings.

The data showed that the combination of soil+vermicompost and soil+sand+vermicompost improved the shoot length in two dragon fruit species. In *H. polyrhizus*, the combination of soil+vermicompost yielded the longest shoots. This shoot growth was better than that of other cuttings in other growing media without vermicompost. The average shoot length of cuttings grown in soil+vermicompost was 25.53 cm, comparable to the shoot length of cuttings grown soil+sand+vermicompot (average shoot length: 23.92 cm). The shortest average shoot length was obtained from cuttings grown in soil+sand: 12.57 cm (Fig. 3a). The same plant growth response was shown in *H. undatus*. The use of soil+vermicompost and soil+sand+vermicompost resulted in the longest shoot length compared with the other growing media: shoot lengths of 24.80 and 26.26 cm, respectively (Fig. 3b).

Besides shoot length, root length was another parameter used to determine the quality of the growing medium. Both species of dragon fruit exhibited the same response to the use

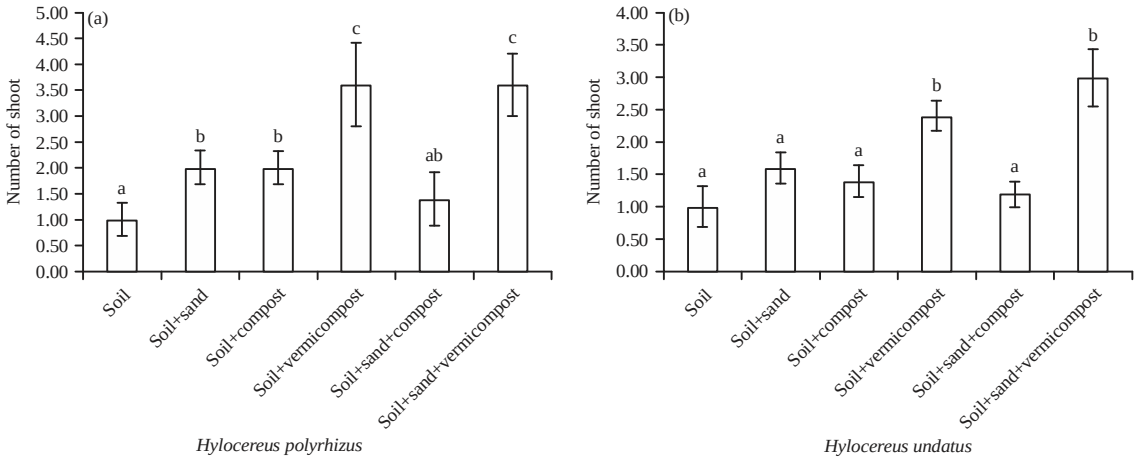

Fig. 2(a-b): Number of shoot of two dragon fruits species as a response of different composition of growing medium, (a) *Hylocereus polyrhizus* and (b) *Hylocereus undatus*. Mean values followed by the same letters are not significantly different according to the Duncan's multiple range test at $p<0.05$

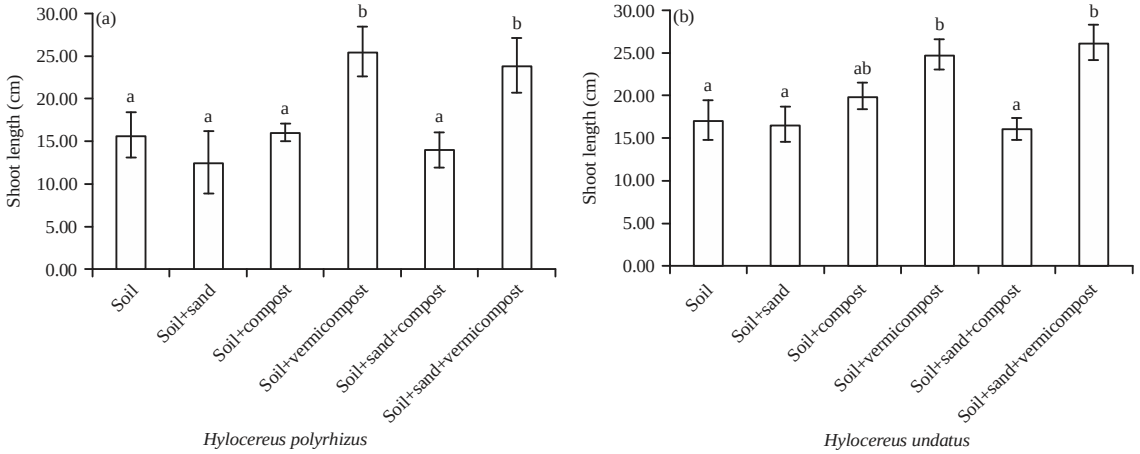

Fig. 3(a-b): Shoot length of two dragon fruits species as a response of different composition of growing media, (a) *Hylocereus polyrhizus* and (b) *Hylocereus undatus*. Mean values followed by the same letters are not significantly different according to the Duncan's multiple range test at $p<0.05$

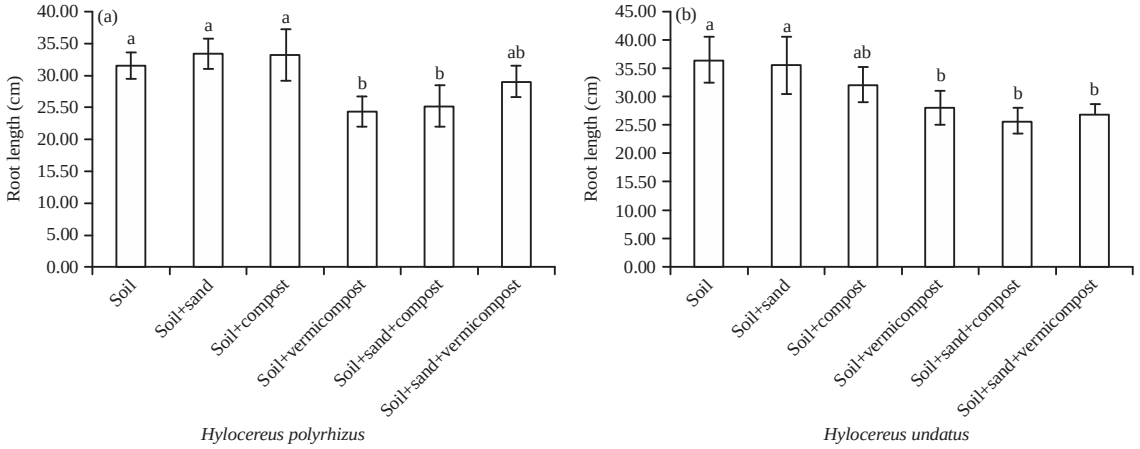

Fig. 4(a-b): Root length of two dragon fruits species as a response of different composition of growing media, (a) *Hylocereus polyrhizus* and (b) *Hylocereus undatus*. Mean values followed by the same letters are not significantly different according to the Duncan's Multiple Range test at $p<0.05$

of six kinds of growing media. Statistical data analysis showed that the combination of growing media of soil+vermicompost significantly affected root length and also the number of roots compared with the soil growing medium. The application of compost or vermicompost as the growing medium significantly decreased root length for both species. In *H. polyrhizus*, the shortest root length was observed for the soil+vermicompost medium with the value of 24.22 cm (Fig. 4a). In *H. undatus*, the cuttings grown in soil+sand+compost had a root length of 25.73 cm (Fig. 4b). On the other hand, the cuttings that used growing media without additional compost or vermicompost had the longest root lengths: 33.34 cm in *H. polyrhizus* (soil+sand) and 36.46 cm in *H. undatus* (soil) (Fig. 4a and b).

The cuttings that had long root lengths had small numbers of roots and vice versa. A decrease in root length and an increase in the number of roots was observed for all of the investigated cuttings. The combination of soil+vermicompost resulted in the largest average number of roots in both dragon fruit species (4.2 and 3.8 for *H. polyrhizus* and *H. undatus*, respectively) (Fig. 5a and b). These root numbers were comparable to the average number of roots in cuttings grown in soil+sand+vermicompost (3.8 for both dragon fruit species) (Fig. 5a and b).

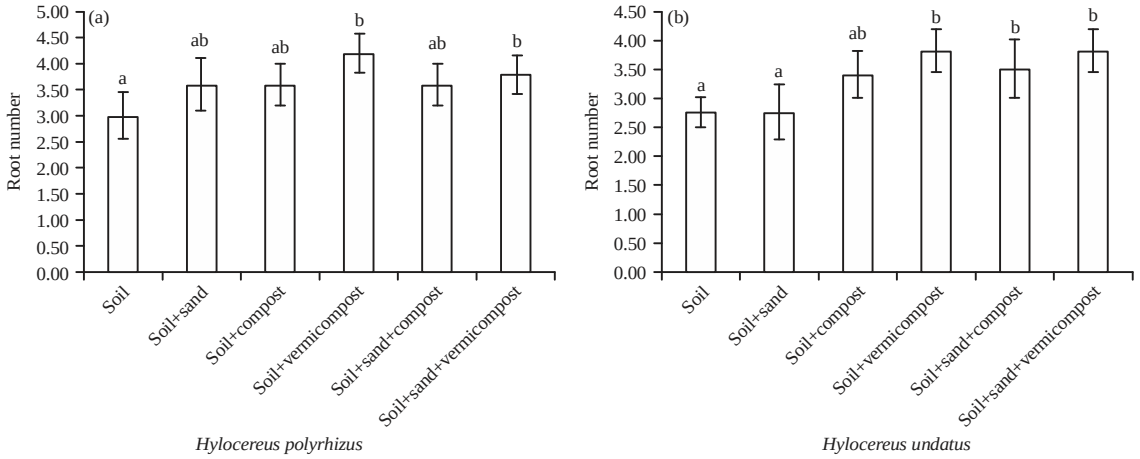

Fig. 5(a-b): Root number of two dragon fruits species as a response of different composition of growing media, (a) *Hylocereus polyrhizus* and (b) *Hylocereus undatus*. Mean values followed by the same letters are not significantly different according to the Duncan's multiple range test at $p<0.05$

DISCUSSION

Cuttings are one kind of plant-propagation method for dragon fruit. Several factors influence the success of this kind of plant propagation (e.g., choosing an appropriate growing medium for the cuttings). A growing medium can be useful for plant propagation if the plant exhibits good plant growth and development. Hwang and Jeong stated that an indicator for evaluating a growing medium and plant growth is changes in plant structure. Therefore, several vegetative parameters such as plant height, number of leaves, number of shoots, etc. can be used as plant growth indicators[9].

In this study, the effect of different combinations of growing media on the growth and the success of dragon fruit cutting propagation was investigated. Soil with the addition of organic matter such as compost and vermicompost was used for this experiment. The additional of organic matter can increase nutrient content in soil and also improve its physical properties. An increase in organic compounds in soil can help to improve plant growth and development. Tisdale stated that plant growth is also influenced by nutrients such as nitrogen, an essential macronutrient for plants[10].

This study showed that the application of vermicompost resulted better cutting growth and development for both dragon fruit species compared with compost. The cuttings from the soil+vermicompost medium exhibited the largest number of shoots and roots, significantly more so than the cuttings grown in soil alone. Based on these data, there can conclude that vermicompost was better than compost in terms of increasing the physical and chemical properties of the soil. Good-condition cuttings accordingly resulted. Vermicompost is a type of organic fertilizer and one material that can augment chemical nutrients in soil. Organic fertilizer is made from natural materials such as animal manure, plant, trash, or other waste; vermicompost is made from worm manure that has been decomposed.

The application of vermicopost as a growing medium is preferred because it can improve the chemical properties of the soil, rendering the chemical and physical properties of the growing medium suitable for cutting growth and development. Plant growth and development are affected by the availably of the nutrients from the soil. Moreover, the availability of nutrients in the soil affects fruit flavor[11]. Therefore, choosing a suitable medium for propagating cuttings is necessary to obtain high-quality cuttings. An appropriate growing medium, which has good chemical and physical properties, is needed for plant growth and development.

The quality of a growing medium can be estimated based on root growth (e.g., the number of roots). This study showed that the combination of organic matter (compost+vermicompost) resulted in a larger number of roots than soil by itself (Fig. 5). The addition of organic matter can increase soil porosity, which can enable roots to grow easily. Similar results have also been demonstrated by a previous study, which found that root growth was inhibited in low-porosity conditions, an effect the authors attributed to difficulty with root movement in the growing medium that inhibited plant growth[12]. The ability of plants to respond appropriately to nutrient availability is of fundamental importance for their adaptation to their environment[13]. High nutrient levels in soils will accelerate plant growth rate by

increasing the number and length of shoots, which will affect changes in the plant phenotype. Changes of in phenotype characteristics are regulated by interactions between genotype and the environment[14]. Many environmental factors affect changes in plant phenotype (e.g., soil or growing medium quality). The application organic matter such as compost and vermicompost as growing media will be a potential ways to improve soil fertility and also improve the plant growth and development especially for plant propagation. However, the availability of these materials still has limitation especially for vermicompost.

CONCLUSION

In conclusion, the quality of a growing medium directly affects the success and growth of cuttings. Vermicompost suitable to be used as a growth medium for cuttings. It can be mixed into soil to improve soil quality. The application of vermicompost into soil and/or sand can improve and increase shoot growth and shoot length.

SIGNIFICANCE STATEMENT

Many organic matter are used to improve biological properties of the soil and also the plant phenotype which is affected by genetic and environmental factors. This study discovered the modification of environmental condition of soil (growing media) of compost and vermicompost as a mixed soil media. This study showed that vermicompost is more effective than compost to be used as a combination of soil in dragon fruit cuttings propagation. This study will help the researcher and also the practical in dragon fruit nursery that the vermicompost is better than compost for plant propagation and also as growing media.

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REFERENCES

1. Le Bellec, F., F. Vaillant and E. Imbert, 2006. Pitahaya (*Hylocereus* spp.): A new fruit crop, a market with a future. Fruits, 61: 237-250.
2. Lakitan, B., 1996. Fundamental of Plant Physiology. Grafindo Persada, Jakarta, (In Indonesian).
3. Hartmann, H.T., D.E. Kester, F.T. Davis Jr. and R.L. Geneve, 2002. Plant Propagation: Principles and Practices. 1st Edn., Prentice Hall, New Jersey.
4. El Obeidy, A.A., 2006. Mass propagation of pitaya (Dragon fruit). Fruits, 61: 313-319.
5. Lemaire, F., 1994. Physical, chemical and biological properties of growing medium. Hydroponics Transplant Prod., 396: 273-284.
6. Barrett, G.E., P.D. Alexander, J.S. Robinson and N.C. Bragg, 2016. Achieving environmentally sustainable growing media for soilless plant cultivation systems-A review. Sci. Hortic., 212: 220-234.
7. Mubarok, S., K. Kusumiyati, I. Muhardiono, A. Yuniarti, S. Rosniawati and E. Suminar, 2017. Improvement of soil chemical properties of typic hapludult after application of organic and inorganic fertilizers. J. Trop. Soils, 22: 131-137.
8. Yuliarti, N., 2012. Business of Dragon Fruit. IPB Press, Bogor, (In Indonesian).
9. Hwang, S.J. and B.R. Jeong, 2007. Growth of Phalaenopsis plants in five different potting media. J. Jap. Soc. Hortic. Sci., 76: 319-326.
10. Tisdale, S.L., W.L. Nelson and J.D. Beaton, 1990. Soil Fertility and Fertilizers. 4th Edn., MacMilan Publishing Co., New York, USA.
11. Raffo, A., I. Baiamonte, R. Bucci, A. D'Aloise and M. Kelderer *et al*., 2014. Effects of different organic and conventional fertilisers on flavour related quality attributes of cv. Golden Delicious apples. LWT-Food Sci. Technol., 59: 964-972.
12. Aisyah, S. and D. Nasrun, 2006. To Know Ornamental Plants. Andi Press, Jakarta, (In Indonesian).
13. Lopez-Bucio, J., A. Cruz-Ramirez and L. Herrera-Estrella, 2003. The role of nutrient availability in regulating root architecture. Curr. Opin. Plant Biol., 6: 280-287.
14. Via, S. and R. Lande, 1985. Genotype-environment interaction and the evolution of phenotypic plasticity. Evolution, 39: 505-522.