Volume: 1, Issue: 1, (August, 2019), pp 16-22
www.rjt.ac.lk/agri/sljae

SRI LANKAN JOURNAL OF AGRICULTURE AND ECOSYSTEMS ISSN: 2673-1401

SLJAE

ORIGINAL ARTICLE

Stem Cuttings of Different Maturity Classes of Tomato: A Viable Option for Seedlings

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Abstract

Although the tomatoes (*Solanum lycopersicum* L.) are propagated widely using seeds, propagation through stem cuttings could be a viable option to address the problems of seed propagation including genetic variations, poor quality, and high cost. This study was conducted during 2018 *Yala* season, to identify the suitability of stem cuttings as a promising propagule for tomato. Herbaceous, semi-mature and mature stem cuttings of tomato from variety *Thilina* (open-pollinated), and three F1 hybrids Padma, Ceres, and Big beef were evaluated for growth and yield in a Completely Randomized Design with three replicates. The study was carried out in a poly-house conditions at the HayleysAgro Farms (Pvt). Ltd, *Divithotawela*. Effect of variety, maturity class, and variety and maturity class interaction were not significant ($p>0.05$) for root length, and root and shoot dry weights of plants originated from cuttings. Days to first flower cluster and tomato yield were not significantly different among three types of cuttings. Hence, all three maturity classes of stem cuttings of tested varieties can be used for vegetative propagation of tomatoes. Flowering was hastened by five days in plants raised by cuttings (24 ±0.41 days) than in the plants raised by seeds (29 ± 0.67 days) in variety *Thilina*. Moreover, the yield of 2.2 ± 0.22 kg/plant in plants raised by cuttings was comparable to the yield of 2.17 ± 0.08 kg/plant in plants raised by seeds. In conclusion, stem cuttings can be considered as a good option for propagation of tomatoes without affecting to the fruit yield.

Keywords: *Maturity class, Propagation, Stem cutting, Tomato*

Date of Submission: 02-05-2019 Date of Acceptance: 17-07-2019

1. Introduction

Tomato (*Solanumlycopersicum* L.) is widely cultivated fruit vegetables in Sri Lanka (Horticultural Crop Research and Development Institute 2006). Although tomatoes can be propagated either through seed or vegetative means, it is widely propagated by seeds. The seed requirement to meet the present production target of tomato in Sri Lanka is estimated to be 0.3kg-0.4 kg/ha (Horticultural Crop Research and Development Institute 2006).

Plate 1: Cuttings at the propagation period

High cost of seeds has been identified as one of the major constraints for propagation of tomatoes by seeds. In addition to unavailability of quality seeds, genetic variations in plants of seed origin have also been identified as one of the problems faced by the farmers (Jack et al. 2017).

Propagation through stem cuttings is an option to obtain the true-to-type plants by alleviating issues relates to seed propagation. It is also gives an opportunity for generating more plants from a single mother plant and minimizes the imported hybrid seed cost (Panda et al. 2018). Use of vegetative parts of the tomato plants are economically feasible for farmers, since it reduces the juvenile phase, lead to early flowering and fruiting, and maintains genetic purity and uniformity (Kathiravan et al. 2007). Therefore, this study was formulated to assess the comparative advantage of propagation of tomatoes by stem cuttings and seedling with respect to plant and yield.

2. Materials and Methods

The experiment was conducted under poly-house conditions at Hayley's Agro Farms Company Ltd, *Divithotawela, Welimada*, Sri Lanka during February - September, 2018. Four tomato varieties including Thilina, Padma, Ceres and Big beef were propagated using three maturity classes of stem cuttings *i.e*; mature cuttings (MC), semi-mature cuttings (SMC) and herbaceous cuttings (HC).

The treatments were arranged in Complete Randomized Design in the poly-house. The stem cuttings were obtained from lateral branches of already established plants of the age between 65–75 days after the first harvest. Lengths of the cuttings were 10-12 cm at the time of extraction. Cuttings (Plate 1) were planted in cell plug trays filled using coir dust and recycled black soil in 9:1 ratios for rooting.

After three weeks of rooting, destructive sampling was done to measure the root length, root dry weight and shoot dry weight by using randomly selected three cuttings (replicates) from each treatment. Root length was measured by a scale ruler (cm) and shoot and root dry weight (g) was measured using the balance.

Well-grown of three weeks old cuttings were transplanted in to poly bags, filled using coir fiber: recycled black soil: paddy husk in 7:2:1

ratio. Standard management practices were done during the crop production period.

Plate 2: Measuring root length of softwood cuttings in Big beef

When the plants at their reproductive stage number of days to appear the first flower cluster was recorded and at the harvesting stage yield per plant was measured by using three replicates from each treatment. In addition, a comparison of days to appear the first flower cluster and yield in plants raised by seedlings (three seedlings from each variety) and cuttings was done using *Thilina* and *Padma* varieties.

Parametric data were analyzed using ANOVA procedure and count data were analyzed using CATMOD procedure in statistical package 'SAS'. Duncan's New Multiple Range Test (DNMRT) was used in mean separation when the treatment effect was significant at 5% level.

3. Results and Discussion

The interaction effect variety and maturity class for root length, root and shoot dry weight, days to first flower cluster and yield in tested tomato varieties was not statistically significant.

3.1 Root length

The root length (Plate 2) of mature (15.08 ± 1.76 cm), semi-mature (15.13 ± 1.2 cm) and herbaceous cuttings (14.63 ± 1.04 cm) were not significantly different among maturity classes of tested tomato varieties (Fig.1). The root lengths variations among maturity class of tomato cuttings were not reported in previous studies.

Rooting potential of stem cuttings can be affected by different factors such as; type of cutting, cutting size, condition of stock plant and growing conditions (Hartmann et al. 2002). Therefore, it is showed that the all maturity classes including mature, semi-mature and herbaceous can be placed under uniform conditions in a poly-house for better rooting in tomatoes.

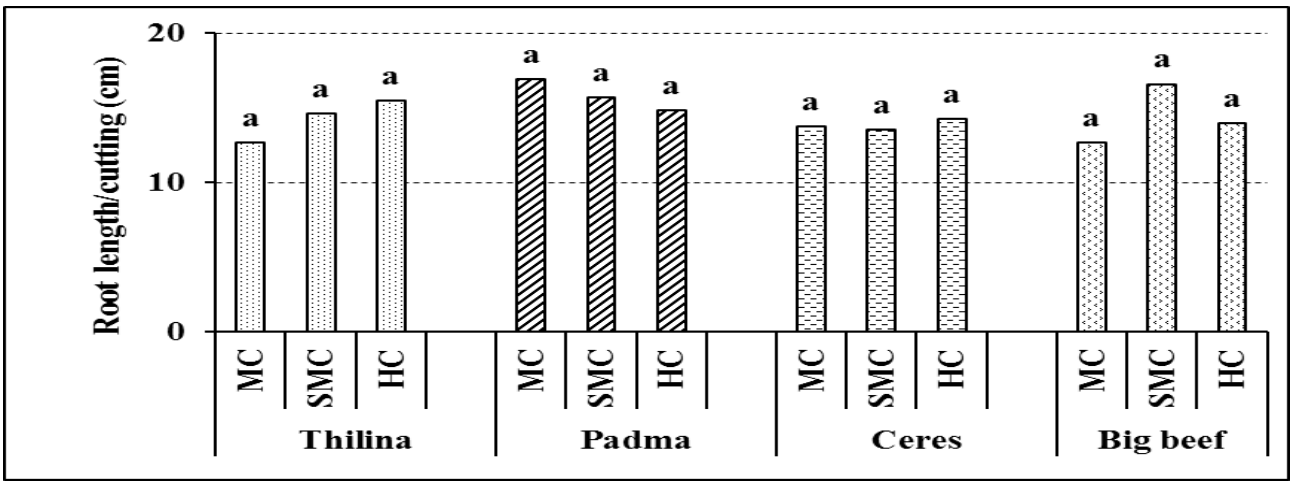

Figure 1: Root length as affected by maturity stage of stem cuttings of different tomato varieties.
Means with same letter in columns are not significantly differed at $p<0.05$.

3.2 Root and shoot dry weight

Root and shoot dry weight of mature, semi-mature and herbaceous cuttings of tested varieties are shown in Table 1. Root and shoot dry weights were not significantly different among maturity classes of four tomato varieties. However, according to results, the highest root dry weight (0.14 ± 0.02 g) was recorded in plants originated from semi-mature cuttings in *Thilina* variety. Highest shoot dry weight (0.68 ± 0.13 g) was recorded in plants raised by herbaceous cuttings in Big beef variety.

The highest root dry weight in semi-mature cuttings could be due to presence of both food reserves and endogenous hormones at optimum levels (Ranawana and Eeswara 2008). The higher levels of endogenous hormone in herbaceous cuttings can responsible for the production of higher shoot dry weight in herbaceous cuttings (Kouakou et al. 2016).

Table 1: Root and shoot dry weights of plants raised by stem cuttings of different maturity levels of selected tomato varieties

Root dry weight (g)				
Type of cutting	Thilina	Padma	Ceres	Big beef
MC	0.12[a]	0.08[a]	0.1[a]	0.10[a]
SMC	0.14[a]	0.07[a]	0.06[a]	0.13[a]
HC	0.09[a]	0.06[a]	0.09[a]	0.08[a]
CV%	60.52	82.90	56.92	50.74
Shoot dry weight (g)				
	Thilina	Padma	Ceres	Big beef
MC	0.39[a]	0.31[a]	0.58[a]	0.38[a]
SMC	0.42[a]	0.27[a]	0.53[a]	0.56[a]
HC	0.51[a]	0.61[a]	0.39[a]	0.68[a]
CV%	42.02	61.93	68.20	47.16

MC, mature cuttings; SMC, semi-mature cuttings; HC, herbaceous cuttings

Means with same letter in columns are not significantly differed at $p<0.05$

3.3 Days to first flower cluster

Days to appear the first flower cluster were not significantly different among mature (23.16 ± 0.4 days), semi-mature (23.5 ± 0.26 days) and herbaceous (23.5 ± 0.26 days) cuttings of four varieties (Fig.2). Days to flowering were not significantly different among maturity classes of tested tomato varieties as well.

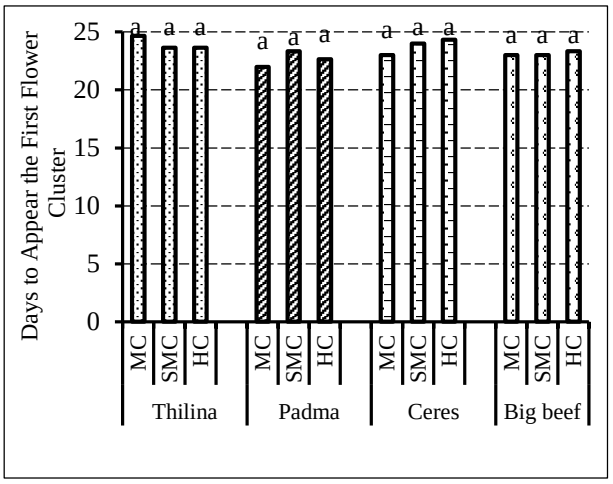

Figure 2: Days to appear the first flower cluster as affected maturity classes of the stem cuttings of different tomato varieties

MC, mature cuttings; SMC, semi-mature cuttings; HC, herbaceous cuttings

Means with same letter in columns are not significantly differed at $p<0.05$

3.4 Total yield/Plant

Total tomato yield in the plants raised by mature (1.89 ± 0.17 kg), semi-mature (1.99 ± 0.18 kg) and herbaceous (2.05 ± 0.17 kg) cuttings of tested varieties were not significantly different among maturity class of the stem cuttings (Table 2). The plants originated using herbaceous cutting showed a higher yield in *Thilina*, *Padma*, and Ceres varieties than in the Big beef variety. In variety Big beef, the highest yield was recorded in plants raised by semi-mature cuttings.

Table 2: Yield (kg) as affected by different maturity classes

Type of cutting	Thilina	Padma	Ceres	Big beef
MC	1.82[a]	1.55[a]	1.95[a]	2.17[a]
SMC	2.3[a]	1.49[a]	1.67[a]	2.55[a]
HC	2.48[a]	1.88[a]	2.07[a]	1.79[a]
V%	31.2	18.92	20.05	34.26

3.5 Comparison of number of days for first flower cluster in plants raised by cuttings and seedlings

Number of days to appear the first flower cluster was advanced by five days (24 ± 0.41 days) in plants raised by stem cuttings than in the plants of seedling origin (29±0.67 days) in *Thilina* variety (Fig.3). Hence, it indicated clearly that the plants raised by stem cuttings came to flowering early by reducing the juvenile stage (Low and Hackett 1981; Kathiravan et al. 2007) than that in the plants propagated by seeds in open-pollinated variety of *Thilina*.

Although the flowering was advanced in variety *Thilina*, the same trend was not observed in the hybrid variety of Padma. Number of days to appear the first flower cluster was not significantly different in plants propagated by cuttings (22.67 ± 0.37 days) and seedlings (22.67 ± 0.67 days) of Padma (Fig.4).

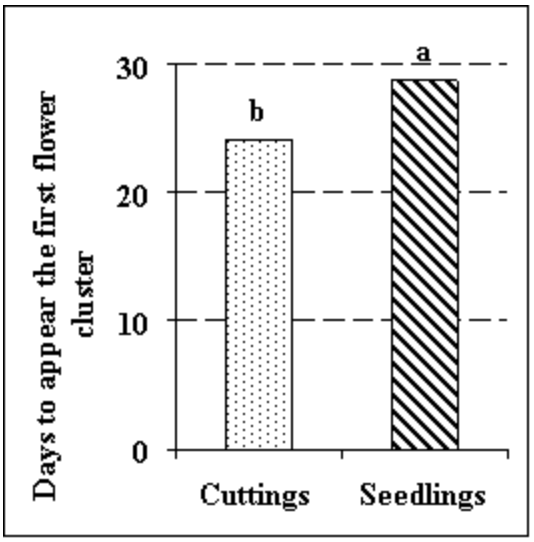

Figure 3: Days to appear the first flower cluster of plants raised using cuttings and seedling of variety *Thilina*. Means with different letters in columns are significantly differed at $p<0.05$

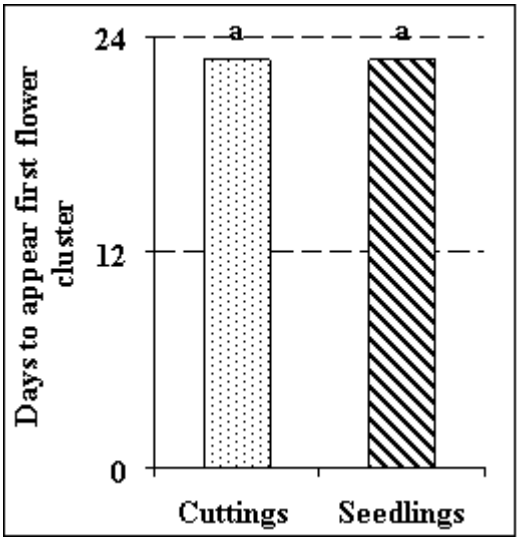

Figure 4: Days to appear the first flower cluster in cuttings and seedling plants of variety *Padma*. Means with same letter in columns are not significantly differed at $p<0.05$

3.6 Yield comparison of plants raised by cuttings and seedlings

Method of propagation, either the propagation using stem cuttings or seedlings were not significantly affected on yield in tomato plants in tested verities of *Thilina* and Padma. The per plant yield of 2.2 ± 0.2 kg in plants raised by cuttings was comparable to the yield of 2.17 ± 0.08 kg in seedling origin of *Thilina* variety. Although the yield difference was insignificant, a yield reduction by 23% was observed in plants raised by stem cuttings (1.6 ± 0.3 kg) compared seedling (2.07 ± 0.32 kg) plants in variety Padma.

4. Conclusion

Any maturity classes of stem cuttings, including; mature, semi-mature and herbaceous can be used in propagation of tomatoes without affecting the final yield of the plant. The yield of plants raised by cuttings is comparable to the yield of the plants with a seedling origin. Moreover, flowering time was also advanced in plants propagated by cuttings. Therefore, it can conclude that the propagation of tomatoes using stem cuttings is a feasible method for farmers to get a comparable yield and it also addressed the issues related to availability of quality seeds and high cost of hybrid seeds.

5. Acknowledgements

The authors wish to acknowledge the institutional supports rendered by the Faculty of Agriculture, Rajarata University of Sri Lanka and Hayley's Agro-farms (Pvt). Ltd, Welimada, Sri Lanka.

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