

**Ministry of Education  
Department of Higher Education  
Yangon University of Distance Education**

**Yangon University of  
Distance Education  
Research Journal**

Vol. 10, No. 1

December, 2019

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## The Comparison of the Yield from Non-Grafted and Grafted of Five Plants of Family Solanaceae

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### ABSTRACT

The family solanaceae is one of the most important vegetable families in most regions of the world as the tropical and temperate regions. They were cultivated as grafted tomato (*Lycopersicon esculentum* Mill.) and eggplant (*Solanum melongena* L. cvs.) in field of Vegetable and Fruits Research Development Center (VFRDC), Hlegu Township, Yangon Division. In this study the four selected plants of the scions plants, three varieties of eggplants as khayay-nyo-shay, htaw-putt-khayay and khayay-padaetha and tomato as *Lycopersicon lycopersicum* L. with the stock plants (local varieties of eggplants as *Solanum melongena* L. cvs. khayay-gyut,) were grafted. The grafted plant and non-grafted plants of rootstock, and scions were cultivated with the comparison of one by one roll in the field and conducted. The microscocial studies were carried out at 21 days after grafted in the microscocial examination. The transverse section of grafted layer of stock and scion of five plants were observed that rootstock and scion were graft union successfully. The survived plants were early fruit in then non-grafted plants of rootstock and scions. The yield of total number and weight of fruits from the grafted plants were also greater than that of non-grafted plants. This paper was conducted by pilot scale production of strongly quality fruits for commercially.

**Keyword:** *Lycopersicon esculentum* Mill., *Solanum melongena* L. cvs.

### INTRODUCTION

The commercial production of horticultural plants is being attempted in the worldwide especially tropics and temperate regions. Vegetable crops are also grown for commercial production in Myanmar. The family Solanaceae (Nightshade family) consists of about 90 genera and 2,000–3,000 species. (Heywood, 1978).

Important vegetable plants in this family are eggplant (*Solanum melongena* L.), tomato (*Lycopersicon esculentum* Mill.), pepper (*Capsicum* spp.) and potato (*Solanum tuberosum* L.). Other important medicinal plants are tobacco and petunia etc. They are warm-season crops. Eggplants are produced in worldwide but to a lesser extent than other Solanaceous vegetable crops such as corn, pepper and tomato (Acquaah, 2002).

To study the morphological characters and germination test, the genus *Solanum* and *Lycopersicon* were selected from the family Solanaceae (Purse-glove, 1974). The genus *Solanum* has been known that twenty four species of this genus are growing wild in Myanmar (Hundley, 1978).

The distinctive characters of *Solanum melongena* L. and *Lycopersicon esculentum* Mill. are persistent calyx, the anthers dehisced by terminal pores but lateral slit dehiscence in *Lycopersicon esculentum* Mill., oblique ovary and the fruits are pendent berries (Acquaah, 2002).

Nowadays, grafting technique is a popular technique in the production of nursery plants by using more resistant rootstocks. (Hartmann and Kester, 1983; Grzyb and Starek, 1998; Kankaya *et al.*, 1999).

In successful grafting, a complete union or graft compatibility of grafting plants depend between the stock and scion. The ability of two different plants grafted. They are produce a successful union and develop satisfactorily into one composite plant is called compatibility (Hartmann *et al.*, 1990). If the grafting is successful, formation of callus will be slowly appear during the graft union. For a successful callus formation, very tight contact of rootstock and scion is crucial (Seferoglu *et al.*, 2004). The callus is formed by a proliferation of parenchyma was tissues from both components of the graft. The callus may also produced by cells of the cambial zone and by the other living cells of the vascular region (Kuster, 1925).

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**MATERIALS AND METHODS**

The experiments of non-grafted and grafted plants were collected from the farm of Vegetable and Fruit Research Development Center (VFRDC), Yemon village, Hlegu Township, Yangon Division from 2006 to 2007. The grafted plants of each variety were cultivated by peg and tube grafting methods (Oda, 1995, AVRDC, 2003, Bersi, 2002). Plant identification was done by the references of the (Backer et.al. 1965, Cronquist, 1981, Radford, 1986, Rendle, 1967). The microscopical characters of non-grafted and grafted plants were studied with the help of reference such as Esau (1953), Trease and Evans (1966) and Melcalfe and Chalk (1950). The microscopical studies were carried at 21 days after grafted in the microscopical examination, the transverse section of grafted layer of stock and scion of six plants were observed that rootstock and scion were graft union successfully.

**RESULTS**





















**Morphological characters of *Solanum melongena* L.**

An annual small trees, stem profusely branched, stout, stellate hairs present; leaves simple, alternate, softly stellate hairs on both sides, unequal-sided at the base, petiolate, exstipulate; inflorescences supra-axillary helicoid cymes, terminal, 1-4 flowered; pedicellate, actinomorphic, bisexual, complete, 5-merous, hypogynous; campanulate densely stellate-pubescent, valvate, sepaloïd, petals (5), corolla tubes short and lobes ovate, imbricate, petaloïd (purplish blue or white); stamens 5, equal, free, inserted at the throat of the corolla lobe; filaments very short, anther dithecous, basifixed, dehiscing by lateral slits stigma simple; axile placentation, fruit berries, greenish-white or dark purplish, seeds numerous, circular-reniform, pale yellow or brown smooth.

**Morphological characters of *Lycopersicon esculentum* L.**

An annual herbs, stem and branches fistular cylindrical green, hispid, tomentoses; leaves imparipinnate compound, alternate, pubescent, the leaflets elliptic-lanceolate, the bases oblique, both surfaces pubescent; inflorescence terminal and axillary helicoids cymes, 5-13 flowered, actinomorphic, pedicellate bisexual, complete, 5-merous, hypogynous; sepals (5), campanulate, persistent and often much enlarge in fruit, petal (5), rotate to tubular, corolla tubes short and lobes ovate, petaloïd (yellow); stamens 5, equal, attached near the corolla throat; anther elongated, adnate to each other, longitudinal dehiscence; axile placentation, stigma capitate; fruit berry, green to red; seeds many, discoid and smooth.

**Study on the Morphological Character and Grafting Methods of Some Species of Family *Solanaceae***

Characters	Inflorescence	Flower	TS of ovary	Fruit
<i>Lycopersicon esculentum</i> Mill.				
<i>Solanum melongena</i> L. cvs. (Khayau-nyo-shay, Local)				
<i>Solanum melongena</i> L. cvs. (Htaw-putt-ichayau, Local)				
<i>Solanum melongena</i> L. cvs. (Khayau-padaetha, Local)				
<i>Solanum melongena</i> L. cvs. (Khayau-lyut, Local)				

The results from tube grafting experiment showed that the highest survival rate of the grafted plants had 82% in T<sub>5</sub> and followed by 64% in T<sub>1</sub>, 62% in T<sub>2</sub>, 54% in T<sub>4</sub> and 52% in T<sub>3</sub> respectively. The results from cleft grafting experiment observed that the highest survival rate of T<sub>1</sub> and T<sub>3</sub> was 70%, T<sub>2</sub> and T<sub>4</sub> 72% and T<sub>5</sub> 6% (Table 1). According to the results of this experiment, the lowest survival rate (6%) was observed in T<sub>5</sub> (F<sub>1</sub> tomato).

Table (1) **Survival rate of grafted *Solanum melongena* L. cvs. and *Lycopersicon esculentum* Mill.**

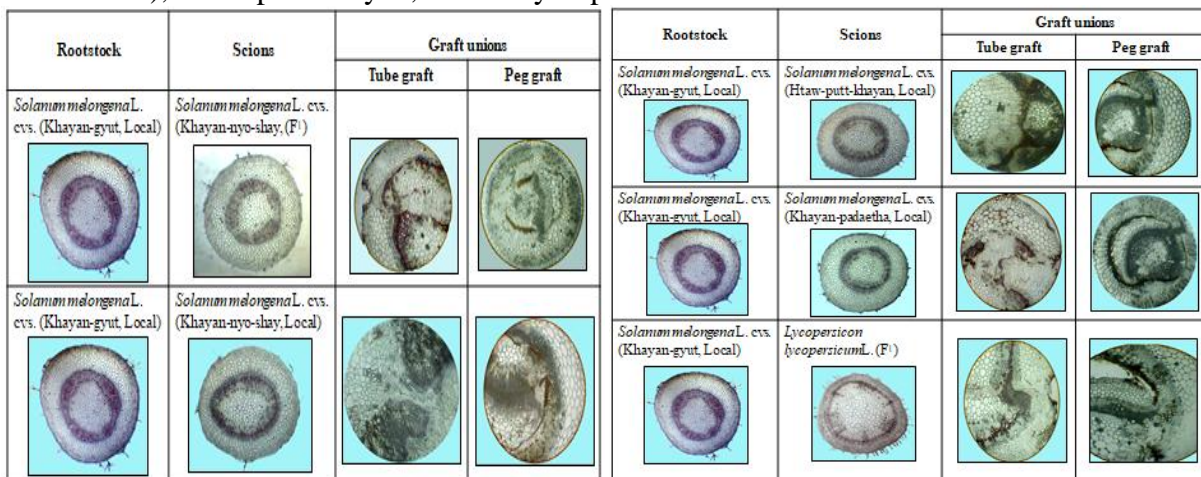
Treatment	Survival rate (%)	
	Tube grafting	Peg grafting
T <sub>1</sub> (khayan-nyo-shay F <sub>1</sub> )	64%	70%
T <sub>2</sub> (khayan-nyo-shay local)	62%	72%
T <sub>3</sub> (htaw-putt-khayan local)	52%	72%
T <sub>4</sub> (khayan-padaetha local)	54%	72%
T <sub>5</sub> (tomato F <sub>1</sub> )	82%	6%

**Microscopical characters of five grafted plants**

The microscopically studies of the graft unions of khayan-gyut (rootstock) and *Lycopersicon esculentum*(L.) Karsten.(scion) from peg grafting methods observed that the two components could not connect with each other. The callus was not formed between the rootstock and scion. It was also observed a free space between the graft components except the graft unions using tube grafting method of *Lycopersicon esculentum*(L.) Karsten.

The microscope was determined the callus layers of five scion of khayan, tomato and rootstock of khayan gyut were found under the microscope and it thickness of callus layers from all graft unions of *Solanum melongena* L. were about 0.0108 μ. The cambial differentiation of callus tissues was also observed in the graft unions of *Solanum melongena* L. It was observed that the cambial differentiation of the graft union by peg grafting method was more than that of tube grafting method. The grafting of *Solanum melongena* L. khayangyut and *Lycopersicon esculentum* L.by tube grafting method was more achieved than peg method (Fig.1).

Fig.1. Study on the Graft Union Regions of Tomato and Eggplant cvs. Nyo-shay (F<sub>1</sub> and Local), Htaw-putt-khayan, and Khayan-padaetha



### Yield and Yield Components of eggplant

Table (2) Comparison of number and weight of total fruits per plot/per acre of non-grafted stock and scion and grafted plants selected *Solanum melongena* L. cvs.

Treatment	Yield of <i>Solanum melongena</i> L.					
	cv. Nnyo shay		cv. Htaw-putt		cv. padaetha	
	Number	Weight (kg)	Number	Weight (kg)	Number	Weight (kg)
T <sub>1</sub> (Stock control)	104.0/27506.0	4.0/1049.1	105.0/27770.5	4.0/1049.1	107.0/28299.4	4.21/119.6
T <sub>2</sub> (Scion control)	87.0/23009.8	6.9/1824.9	67.7/17896.6	9.6/2547.8	96.7/25566.5	3.8/996.2
T <sub>3</sub> (Grafted plant)	103.3/27770.5	9.9/2212.8	78.0/20629.5	12.6/3332.5	113.7/30062.7	4.7/1234.2
F-test	**/**	**/ns	**/**	**/**	*/ns	ns/**
5% LSD	6.1747/1692.94	1.3324/1154.91	3.1557/834.662	0.6662/176.172	12.7239/3365.240	0.8700/230.082
cv%	2.8%/6.3%	8.5%/30.1%	1.7% 1.7%/	3.4%/3.4%	5.3%/5.3%	9.1%/9.1%

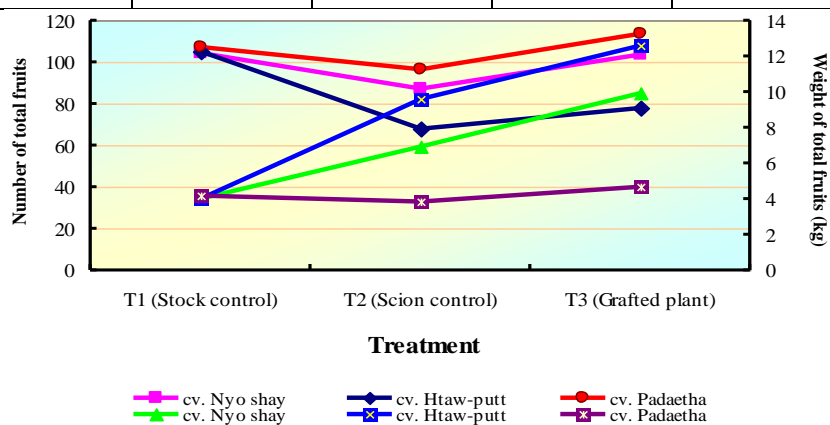


Fig.2. Total number and weight of total fruits per plot of non-grafted stock and scion and grafted plants selected *Solanum melongena* L.

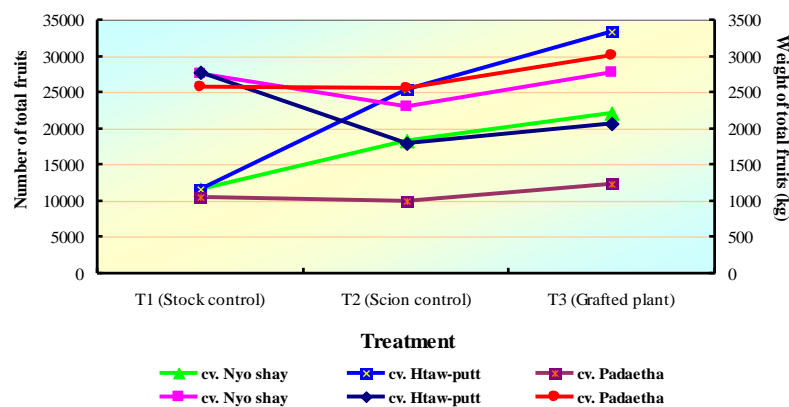


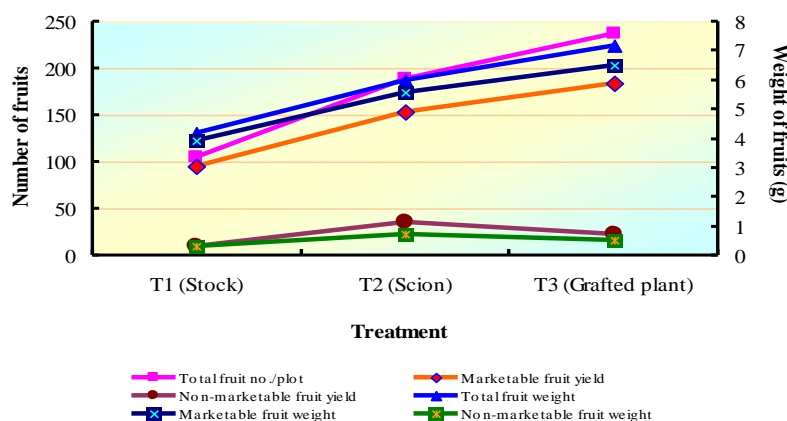
Fig.3. Total number and weight of total fruits per acre of non-grafted stock and scion and grafted plants selected *Solanum melongena* L. cvs.

Among these treatments, the total yield of T<sub>3</sub> grafted plants per plot/acre had the superior results than the other treatment (T<sub>1</sub> and T<sub>2</sub>). According to the statistical results, these treatments of two eggplants were highly significant different to each cultivated plants except the Khayan-padaetha (Table 2, Fig.2 and 3).



**Table (3) Number and weight of total fruits, marketable and non-marketable fruits per plot/acre of grafted and non-grafted *Lycopersicon esculentum* Mill.**

Treatment	Total fruit yield	Marketable fruit yield	Non-marketable fruit yield	Weight of total fruit(kg)	Weight of Marketable fruit(kg)	Weight of Non-marketable fruit(kg)
T <sub>1</sub> (Stock)	104.7	95.3	9.3	4.2	3.9	0.3
T <sub>2</sub> (Scion )	189.3	154.0	35.3	6.0	5.6	0.7
<b>T<sub>3</sub> (Grafted plants)</b>	<b>237.0</b>	<b>183.3</b>	<b>22.7</b>	<b>7.2</b>	<b>6.5</b>	<b>0.5</b>
F-test	**	**	**	*	*	*
5% LSD	22.9305	19.5917	10.4799	1.3971	1.3314	0.2066
cv%	5.7	6.0	14.3	10.6	11.0	18.3

**Fig. 4.** Number and weight of total fruits, marketable and non-marketable fruits of grafted and non-grafted *Lycopersicon esculentum* Mill.**Yield and Yield Components tomato (F<sub>1</sub>)****Number and weight of total marketable and non-marketable fruits**

The results of the experiment were observed the yield of shown in table (3), fig. (4) the T<sub>1</sub>, control (stock) treatment had 104.7 fruits/plot. T<sub>2</sub>, control (scion) non-grafted plants produced 189.3 fruits/plot. The grafted plants, T<sub>3</sub> gave 237.0 fruits/plot. Then, the marketable fruit yield in T<sub>1</sub> had 95.3 fruits/plot, and 154.0 fruits/plot in T<sub>2</sub>, 183.3 fruits/plot in T<sub>3</sub>. The observation of non-marketable fruit number in T<sub>1</sub> had 9.3 fruits/ plot, 35.3 fruits/ plot in T<sub>2</sub> and 22.7 fruits/ plot respectively. According to the statistical results, they were highly significant different to each other.

**Table (4) Comparison of number and weight of total fruits and marketable fruits per acre from stock and scion (non-grafted) and grafted plants of *Lycopersicon esculentum* Mill.**

Treatment	Total no. of fruit per acre	of marketable fruit per acre	Weight of total fruit per acre (kg)	Weight of Marketable fruit per acre (kg)
T <sub>1</sub> (Stock control)	27682.3	25213.8	1154.9	1040.3
T <sub>2</sub> (Scion control)	45315.2	26925.9	1444.0	1332.3
T <sub>3</sub> (Grafted plant)	56723.7	43879.1	1747.1	1563.7
F-test	**	ns	*	*
5% LSD	5423.490	21055.90	424.407	334.712
cv%	5.5%	29.1%	12.9%	11.3%

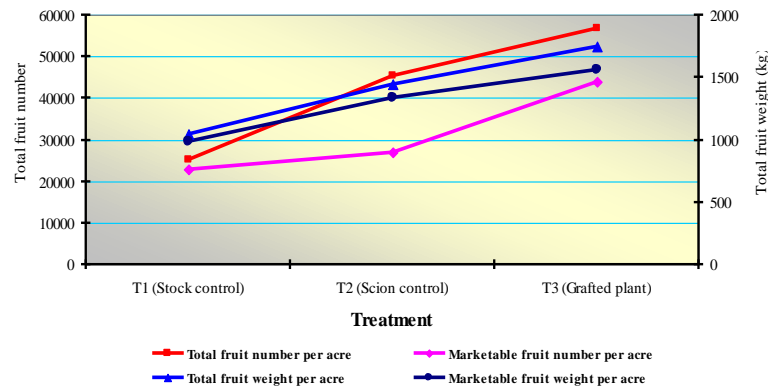


Fig. 5. Total number and weight of fruit yield per acre from stock and scion (non-grafted) and grafted plants of *Lycopersicon esculentum* Mill.

The results of the experiment were observed the yield of the T<sub>1</sub>, control (stock) treatment had 27682.3 fruits/acre. T<sub>2</sub>, control (scion) non-grafted plants produced 45315.2 fruits/acre. The grafted plants, T<sub>3</sub> gave 56723.7 fruits/acre. Then, the marketable fruit yield in T<sub>1</sub> (stock, control) had 25213.8 fruits/acre, 26925.9 fruit/acre in T<sub>2</sub> (scion, control) and 43879.1 fruits/acre in T<sub>3</sub> (grafted plants). According to the statistical results, they were highly significant different to each other except the number of marketable fruits per acre, it had non-significant. The yield of tomato (F<sub>1</sub>) was shown in (Table 4 and Fig.5).

### DISCUSSION AND CONCLUSION

During grafting the cells from the cut areas were damaged due to the cut wound and hence, the cells from these areas become turn brown and finally die. The above observations were in agreement with Polat (1990) who reported that the callus formation was produced by living cells, located behind the dead cells during the grafting process, in a response to injury.

The contact between rootstock and scions was supplied by the bridge that formed from callus tissues in both grafting techniques; it was the first step for the success union of the grafting. The above observation was in consistent with Mosse (1962) and Moore (1984) who reported that the callus tissues were produced at both side of the graft union and then they combined to make connection between rootstock and scion.

In both graft techniques, it was observed that the callus tissues from the rootstock had more appearance than that of the scions. The above findings was in agreement with Tekintas (1988), Polat and Kaska (1992) who showed that the callus tissues of the stock had higher density at the rootstock than at the scion.

The better development of callus between rootstock and scions was formed level in tube graft than peg graft of *Lycopersicon esculentum* L. Karsten at 21 days after grafting. It was concluded that the callus of tissues produced more regular structure (*Solanum melongena* L.). They are agreement Mosse (1962), Moore (1984), Tekintas (1988), Polat and Kaska (1992).

The observation of, 21 days after grafting revealed that the cambial differentiation were observed at graft samples in both graft methods of *Solanum melongena* L. The cambial differentiation began to form the cells of existing cambiums, later on the callus cells were formed between graft components. This formation was the second stage of successful grafting. This finding was agreed with Hartmann and Kester (1983), and Errea *et al.* (1994).

Later on, the continuous cambium formation and vascular connection were observed in this investigation. The findings were in consistent with Seferoglu *et al.* (2004).

Therefore, the graft unions from khay-an-gyut (rootsock) and *Lycopersicon esculentum*(L.) Karsten. (scion) using peg grafting method were failed and that of tube grafting method had successful graft compatibility. The microscopically studies approved that the graft unions of *Solanum melongena* L. khay-an-gyut (stock) and khay-an-nyo-shay, htaw-

putt-khayan and khayan padaetha (scions), using peg and tube grafting methods had been successful due to the graft compatibility.

The successful graft union was obtained by the union of cambial cells of in the contact of rootstock and scions, and the consequence of the formation of callus tissues. Finally this experiment revealed that grafted plants have significant effect on plant growth, fruit yield and the fruit quality for cultivars.

### ACKNOWLEDGEMENTS

I am most grateful to the Rector Dr. Tin Maung Hla, Pro-Rector, Dr. Khin Thant Sin Yangon University of Distance Education for his kind permission to conduct this research paper. I would like to express my special thanks Professor Dr. Nu Nu Swe Head of Department of Botany, Yangon University of Distance Education for her encouragement and support.

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