www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; SP-11(3): 88-92

www.thepharmajournal.com
Received: 13-01-2022
Accepted: 16-02-2022

Ashika Parveen K
PG Scholar, Department of Floriculture and Landscape Architecture, TNAU, Coimbatore, Tamil Nadu, India

Padmapriya S
Assistant Professor, (Horticulture), Controllerate of Examination, TNAU, Coimbatore, Tamil Nadu, India

Rajamani K
Professor, Department of Floriculture and Landscape Architecture, TNAU, Coimbatore, Tamil Nadu, India

Vetrivelkalai P
Assistant Professor, (Nematology), Department of Fruit Science, TNAU, Coimbatore, Tamil Nadu, India

Corresponding Author
Ashika Parveen K
PG Scholar, Department of Floriculture and Landscape Architecture, TNAU, Coimbatore, Tamil Nadu, India

Effect of different wild rootstock and various grafting methods on Crossandra (*Crossandra infundibuliformis*)

Ashika Parveen K, Padmapriya S, Rajamani K and Vetrivelkalai P

Abstract
The present investigation was carried out to find out the graft compatibility of Crossandra infundibuliformis with different rootstocks and to confirm the suitability of the type of grafting method. The experiment consisted of 6 different rootstocks viz., *Adathoda vasica*, Delhi Crossandra, *Crossandra infundibuliformis*, *Barleria cristata Ecbolium viride* and *Barleria prionitis* along with 3 grafting methods *i.e.* wedge, splice, and saddle grafting, it was laid out in factorial randomized block design (FRBD) with 3 replications. The results indicated earlier days taken for sprouting in T_1G_1 (wedge grafting in Adhatoda) – 13.61 days, while an increased number of sprouts per graft (4.30), increased graft success percentage (82.22), graft survival percentage (61.72), in T2G1 (Delhi Crossandra + wedge grafting). Concerning the sprout length and graft height recorded at 30, 60, 90, and 120 days after grafting, increased sprout length and graft height was recorded in T_1G_2 (Adathoda + wedge grafting) at 30 and 60 DAG, later during 90 and 120 DAG, T_3G_1 (Crossandra seedling+ wedge grafting) registered increased values. The lowest values were observed in *Barleria cristata* + wedge grafting combination.

Keywords: Crosssandra, rootstocks, wedge, saddle and splice grafting, graft success, and survival percentage

Introduction
Crossandra infundibuliformis is one of the important traditional flowers which is being cultivated for its bright colored flowers. The word crossandra is derived from the Greek word krossos + andros, krossos meaning fringed and andros represents the anthers. It is commonly known as kanakamaram in Tamil. The firecracker flower is the native of India, Srilanka, Madagascar, and Africa. Crossandra is placed in the family Acanthaceae which consists of nearly 20-25 species. In Tamilnadu, crossandra is cultivated in an area of 888 ha with a production of 2664 tonnes and a productivity of 3 tonnes/ ha (tn.data.gov.in).
Crossandra is an erect evergreen shrub that grows up to 1-3 ft. The leaves are ovate to lanceolate shaped with a glossy appearance and wavy at the margins. Their flowers are tiny fan-shaped, 3-4 asymmetrical petals with flower colors ranging from orange to salmon-orange, apricot, coral, red, yellow, and even turquoise. They bloom on four-spliced spike inflorescence throughout the year with prominent bracts. These flowers lack fragrance and are used in hair adornment, garland, either alone or along with jasmine flowers. An average of 2000 kg/ha/yr. is harvested in tetraploid, 2800 kg/ha/yr. from Delhi Crossandra (TNAU Agritech Portal). There has been a gradual increase in demand for these flowers due to their brightly colored flowers and year-round flowering. Though the habit of these plants is perennial in nature, they are cultivated as biennial due to their decreased flowering and sensitivity of the plant to soil-borne pathogens. Khan & Reddy (1994) reported that root-knot nematode is one of the major nematodes affecting Crossandra grown in India. This study aimed to find a suitable rootstock to eliminate the dangers of the soil-borne pathogens, extend the plant's lifecycle, and standardize a proper grafting method for *Crossandra infundibuliformis*.

Materials and Methods
The experiment was performed in Botanical Garden, TNAU, Coimbatore. During the month of October 2019 (monsoon) using different rootstocks and types of grafting methods viz., wedge grafting, splice grafting, and saddle grafting. The experiment was laid out in Factorial Randomised Block Design (FRBD) and a total of 18 treatment combinations consisting of 3 replications per combination with 5 plants in each replication calculating 270 plants grafted. The treatment combinations are listed below

The treatment combinations are listed below

No. of treatments	Treatment combinations
T_1G_1	*Adathoda vasica* + Wedge grafting
T_1G_2	*Adathoda vasica* +Splice grafting
T_1G_3	*Adathoda vasica* + Saddle grafting
T_2G_1	Delhi Crossandra + Wedge grafting
T_2G_2	Delhi Crossandra + Splice grafting
T_2G_3	Delhi Crossandra + Saddle grafting
T_3G_1	*Crossandra infundibuliformis* + Wedge grafting
T_3G_2	*Crossandra infundibuliformis* + Splice grafting
T_3G_3	*Crossandra infundibuliformis* + Saddle grafting
T_4G_1	*Barleria cristata* + Wedge grafting
T_4G_2	*Barleria cristata* + Splice grafting
T_4G_3	*Barleria cristata* + Saddle grafting
T_5G_1	*Ecbolium viride* + Wedge grafting
T_5G_2	*Ecbolium viride* + Splice grafting
T_5G_3	*Ecbolium viride* + Saddle grafting
T_6G_1	*Barleria prionitis* + Wedge grafting
T_6G_2	*Barleria prionitis* + Splice grafting
T_6G_3	*Barleria prionitis* + Saddle grafting

Plant material

The scions were collected from the farmer's field in the Nilakottai district. Ahead of grafting, the scion sticks were pre-cured wherein, the leaves were defoliated and the petiole alone was left. This practice was carried out 5 days before grafting by which the dormant buds gt activated. The scions of pencil size thickness and 15- 20 cm length were cut using secateurs and kept in a thermacol icebox containing polymer ice gel packs to prevent drying out of scions.

The rootstocks which were healthy and free of pests and diseases were selected carefully. The crossandra seedlings raised from the seeds were collected from the Nilakottai region whereas *Adathoda vasica* and *Ecbolium viride* are procured from the nursery in Tamilnadu Agricultural University Coimbatore. *Barleria cristata* and *Barleria prionitis* were purchased from a nursery in Pondicherry and Delhi crossandra cuttings were taken from Coimbatore private nursery.

The observations on days taken for the sprouting of bud, number of sprouts/graft, sprout length (cm), graft height (cm), graft success percentage and graft survival percentage were recorded and statistically compared and analyzed mean comparisons with Least Significance Difference (LSD) values with $p<0.05$.

Results and Discussion

Number of days taken for sprouting

The data on the average number of days taken for the sprout emergence varied significantly for various treatment combinations which were represented in Table 1. Among rootstocks, the lowest number of days taken for sprout emergence (14.02) was observed in T_2 (delhi crossandra) which was on par with T_1 (Adhatoda) (14.03) followed by T_3 (Crossandra seedlings) (14.08). The maximum number of days taken for sprouting was noted on splice grafting G_2 – 16.26 and the lowest no. of days was recorded in G_1 (wedge grafting) – 14.97. Regarding the interaction between the various rootstocks and grafting methods the minimum days taken for sprouting T_1G_1 (wedge grafting in Adhatoda) – 13.61 followed by T_2G_1 (Wedge grafting in Delhi crossandra) *i.e.* 13.75 and a maximum of 31.83 had been recorded in T_6G_2 - *B. prionitis.* Pre-curing of scion sticks would have activated the dormant buds present in the nodal region by diversion of conserved food material to sink into the dormant bud, causing an increase in sucrose content. Higher meristematic activity leads to early sprouting and leaf emergence. The variation in sprouting days may be due to the presence of stored food material in the scion, which has facilitated early bud sprout.

Number of sprouts per graft

The number of bud sprouts was significantly influenced by different grafting methods and various rootstocks (Table 1). The mean for highest number of sprouts were recorded in T_2 (Delhi crossandra) *i.e.* 3.90 and a lowest of 2.37 were noted on T_4 (*B. cristata*). Among different grafting methods, the maximum number of sprouts was observed on wedge grafting G_1 – 3.40 and a least of 2.60 had been recorded in G_3 (splice grafting). In an interaction between different rootstock and grafting methods, the highest number of sprouts has been recorded in T_2G_1 (wedge grafting of Delhi crossandra rootstock) which was 4.30 followed by T_3G_1 (wedge grafting of Crossandra seedling) (4.10) and the least number of sprouts (2.10) were noted in T_4G_2 and T_6G_2 (splice grafting of *B.cristata* and *B. prionitis*). A maximum number of sprouts were observed in the axial region of leaves which indicates the availability of food material from the scion to the bud which was observed by Ahire *et al.*, (2016). The growth of cambial tissue between scion and rootstock causes early sprouting and helps in better establishment of the grafts. This aids in the uptake of more water and nutrients from the soil, as well as the production of more photosynthates and auxins in the leaves, resulting in greater transport of water, nutrients, photosynthates, and hormones to the newly created scion shoot. These results are in agreement with the findings of Palanikumar *et al.*, (2020) [10] in tomato.

Table 1: Effect of different rootstock and grafting methods on days taken for sprouting and Number of sprouts per graft in Crossandra

Treatments	Days taken for sprouting				Number of sprouts/ graft			
	G_1 Wedge grafting	G_2 Splice grafting	G_3 Saddle grafting	Mean	G_1 Wedge grafting	G_2 Splice grafting	G_3 Saddle grafting	Mean
T_1 *Adathoda vasica*	13.61	14.50	13.98	14.03	3.90	2.60	3.40	3.30
T_2 Delhi Crossandra	13.75	14.30	14.02	14.02	4.30	2.70	3.60	3.90
T_3 *Crossandra infundibuliformis*	13.91	14.25	14.08	14.08	4.10	3.80	3.60	3.47
T_4 *Barleria cristata*	15.02	15.40	15.38	15.27	2.60	2.10	2.40	2.37
T_5 *Ecbolium viride*	14.7	15.30	14.8	14.93	2.80	2.30	2.70	2.60
T_6 *Barleria prionitis*	18.83	23.83	21.66	21.44	2.70	2.10	2.40	2.40
Mean	14.97	16.26	15.65		3.40	2.60	3.02	
Source	S.Ed		C.D (0.05%)		S.Ed		C.D (0.05%)	
T	0.36		0.74		0.07		0.13	
G	0.26		0.52		0.05		0.09	
T x G	0.63		1.28		0.11		0.23	

Graft success percentage and graft survival percentage

A significant difference was observed among the different combinations of various grafting methods and rootstocks for graft success and survival percentage (Table 2). The graft success percentage was noted 30 days after grafting in which a maximum success percentage (83.09) was recorded by T_2 – Delhi Crossandra rootstock followed by T_3 (Crossandra seedlings) *i.e.* 77.34% and a least was noted in *B. cristata* (21.95%). Regarding grafting methods, a high graft success (68.56%) was noted on wedge grafting (G_1) method and a least was recorded in splice grafting (G_2) (41.30%). As for both grafting methods and different rootstocks, a maximum success rate was found in wedge grafting of Delhi crossandra (T_2G_1) which (89.26%) and a least (10.46%) was recorded in splice grafting of *B. cristata* (T_4G_2). For a successful graft union, the cambium of the rootstock and scion must be well aligned and in contact with each other. The results are in agreement with high graft success on wedge grafting of King chilli scion on Mem and Moni Jolokia rootstocks which were 80% and 75% respectively (Phukon *et al.* 2020) [11].

The graft survival percentage was noted at 120 days after grafting. A significant difference was observed in the survival percentage which was greatly influenced by the different rootstock and various grafting methods. A high survival rate of 61.72% was recorded by Delhi crossandra rootstock (T_2) followed by Crossandra seedlings (T_3) *i.e.* 57%. In case of method of grafting, wedge grafting method (G_1) exhibited high success of 30.61% and a least of 20.46% was noted in splice grafting (G_2). Regarding the interaction between both rootstocks and various grafting methods, the highest survival percent was recorded in T_2G_1 (70.67%) *i.e.* wedge grafting of Delhi Crossandra rootstock and a least of 1.84% was noted on T_4G_3 (Saddle grafting of *B. cristata* rootstock). The same research finding of high survival percentage of 100% on wedge grafting of tomato with *C. annuum* rootstock was recorded by Bosland *et al.* (2010) [7]. The same was also noted by Rasool *et al.*, (2020) in which wedge graft had the best success rate, with a 100% survival rate. (Kacjan *et al.*, 2004) [5]. For grafting *Spondias tuberosa*, top wedge grafting is superior to whip and inverted T budding techniques (Araújo 2002).

From the data relating to graft success rate and survival percentage, the rootstock *Adhatoda vasica* (T_1) was noted to have high success percentage while the survival rate which was recorded 120 days after grafting was zero which might be due to delayed incompatibility, comparable to the findings of Herrero, (1951); Mosse,(1962) wherein incompatibility symptoms arise at a later level of development in which the presence of a few biochemical changes throughout the graft union may also result in slight and delayed incompatibility, as has been defined in cherry and peach/plum combinations (Treutter and Feucht, 1991; Salesses and Bonnet, 1992)

Table 2: Effect of different rootstock and grafting methods on graft success % and graft survival %

Treatments	Graft success %				Graft survival %			
	G_1 Wedge grafting	**G_2 Splice grafting**	**G_3 Saddle grafting**	**Mean**	**G_1 Wedge grafting**	**G_2 Splice grafting**	**G_3 Saddle grafting**	**Mean**
T_1 *Adathoda vasica*	88.96	48.95	76.65	71.52	0.00	0.00	0.00	0.00
T_2 Delhi Crossandra	89.26	73.33	86.67	83.09	70.67	49.47	65.01	61.72
T_3 *Crossandra infundibuliformis*	86.67	60.77	82.00	76.48	66.12	45.55	59.33	57.00
T_4 *Barleria cristata*	32.71	10.46	22.67	21.95	2.52	0.00	1.84	1.45
T_5 *Ecbolium viride*	67.43	34.87	49.99	50.76	34.51	21.66	29.54	28.57
T_6 *Barleria prionitis*	46.32	19.44	37.73	34.50	9.82	6.10	8.21	8.04
Mean	68.56	41.30	59.29		30.61	20.46	27.32	
Source	S.Ed		C.D (0.05%)		S.Ed		C.D (0.05%)	
T	1.25		2.55		0.96		1.96	
G	0.88		1.81		0.68		1.39	
T x G	2.17		4.42		1.67		3.40	

Sprout length

The sprout length of the grafted plants was recorded at 30, 60, 90 and 120 days after grafting which showed significant difference among the different rootstock and grafting methods (Fig 1). At 30 days after grafting, a higher sprout length (1.02cm) has been noted in the rootstock T_1 (Adhatoda) and T_3 (Crossandra seedlings) and least sprout length of 0.18 cm has been recorded in T_6 rootstock (*B. prionitis*). In case of grafting methods, wedge grafting (G_1) has highest sprout length *i.e.* 0.82 cm and a least of 0.75 cm was found to be recorded in G_2 – splice grafting. The result regarding the interaction between the various rootstock and different grafting methods, a maximum of 1.13 cm sprout length was recorded in T_1G_1 (wedge grafting of *Adhatoda vasica*) followed by T_2G_3 – saddle grafting of Delhi Crossandra (1.10) and a lowest of 0.15 was observed in T_6G_3 (*B.prionitis* + saddle grafting) .

In the case of 60 days after grafting 3. 35 cm sprout length was noted in T_1 - *Adhatoda vasica* rootstock which was on par with T_3 (Crossandra seedlings) and the least of 0.61 cm was on T_4 (*B. cristata*). Among the grafting methods G_1 – wedge grafting has high sprout length (2.76 cm) with G_2 – splice grafting the lowest (1.89cm). On the 90th day after grafting, T_3G_1 – wedge grafting + crossandra seedlings recorded higher sprout length and the lowest (1.96 cm) was noted in T_6G_3 (splice grafting of *B. prionitis*). At 120 days after grafting, maximum sprout length was observed by T_3G_1 – wedge grafting in crossandra seedling (5.01cm) and the lowest (2.41cm) was in Splice grafting if *B. prionitis* (T_6G_2). Higher contact of cambial tissue between the scion and rootstock, leading to early bud sprout and an increase in sprout length. Similar results were reported by Fernandez *et al.*, (2004), Palanikumar *et al.*, (2020) [10] in tomato grafted plants. Defoliation of scion causes activation of dormant bud and occurrence of early sprouting and increased sprout length.

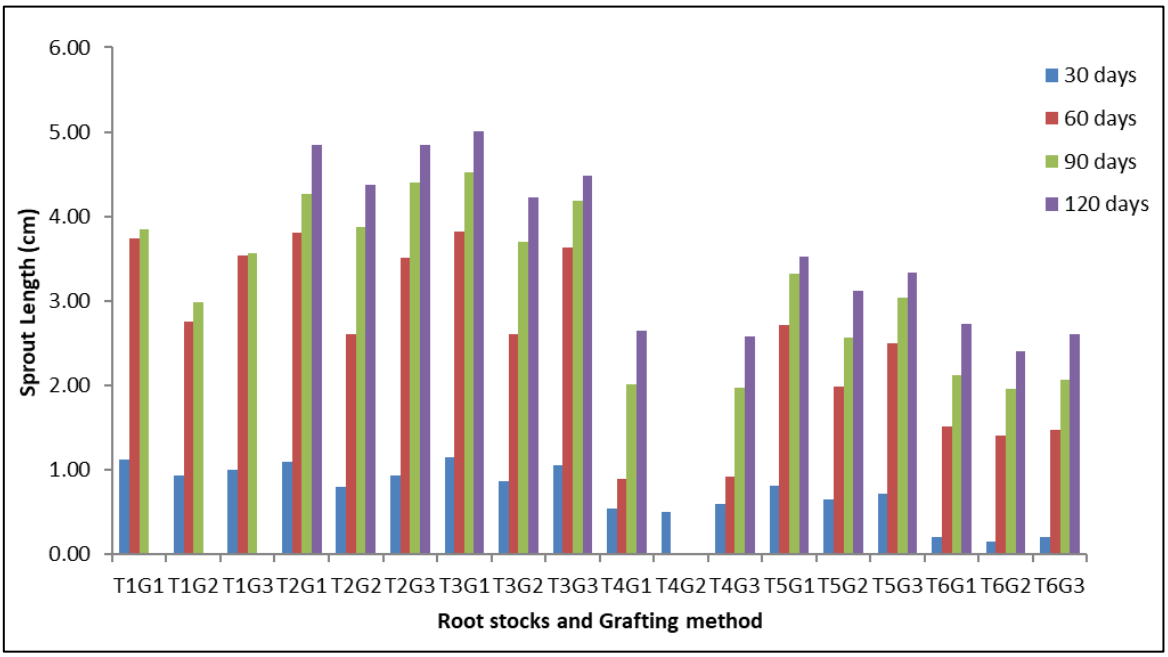

Fig 1: Effect of different rootstock and grafting methods on sprout length at 30, 60, 90, 120 days after grafting

Graft height

The graft height at 30, 60, 90, and 120 days after grafting were observed which showed variations among the different treatment combinations (Fig 2). At 30 days after grafting, T_1- Adhatoda had high graft height (15.57cm) followed by T_3 – crossandra seedlings (15.45 cm) and a least of 11.72 cm was observed in *B.* cristata. Regarding grafting methods saddle grafting – G_3 (14.46cm) was on par with wedge grafting – G_1 (14.35cm). and the interaction between various rootstock and grafting methods, indicated a maximum graft height of 16.25cm in T_3G_1 (wedge grafting of Crossandra seedlings) and a lowest of 11.50cm was noted in splice grafting of *B.cristata* rootstock at 30 days after grafting.

At 60 days after grafting, the maximum graft height in rootstock was noted in T_1 – Adhatoda (18.91 cm) on par with T_3 – crossandra seedlings and a least of 8.49 cm was observed in T_4 – *B.cristata.* Among type of grafting methods, G_1 – wedge grafting has maximum graft height and a least of 13.73 cm was noted in G_2 – splice grafting. A maximum height of 19.58 cm was observed in T_3 – crossandra seedling and a minimum of 9.21 has been noted on T_4 – *B. cristata* rootstock at 90 days after grafting. In case of grafting methods, a high value was observed in G_1 – wedge grafting (17.70 cm) and lowest of 14.35 cm of G_2 – splice grafting. At 120 DAG, T_3G_1 – wedge grafting of Crossandra seedlings exhibited maximum graft height and a lowest of 14.23 cm was noted in T_4G_1 – wedge grafting of *B.cristata* rootstock. Days taken for sprouting, sprout length had a direct effect on graft height. Defoliation of leaves leads to early sprouting of buds and increase in sprout length causing an increase in graft height. This result agrees with the findings of Lee (1994) and Ioannou *et al.*, (2002) that grafted plants were taller and more vigorous than self-rooted ones.

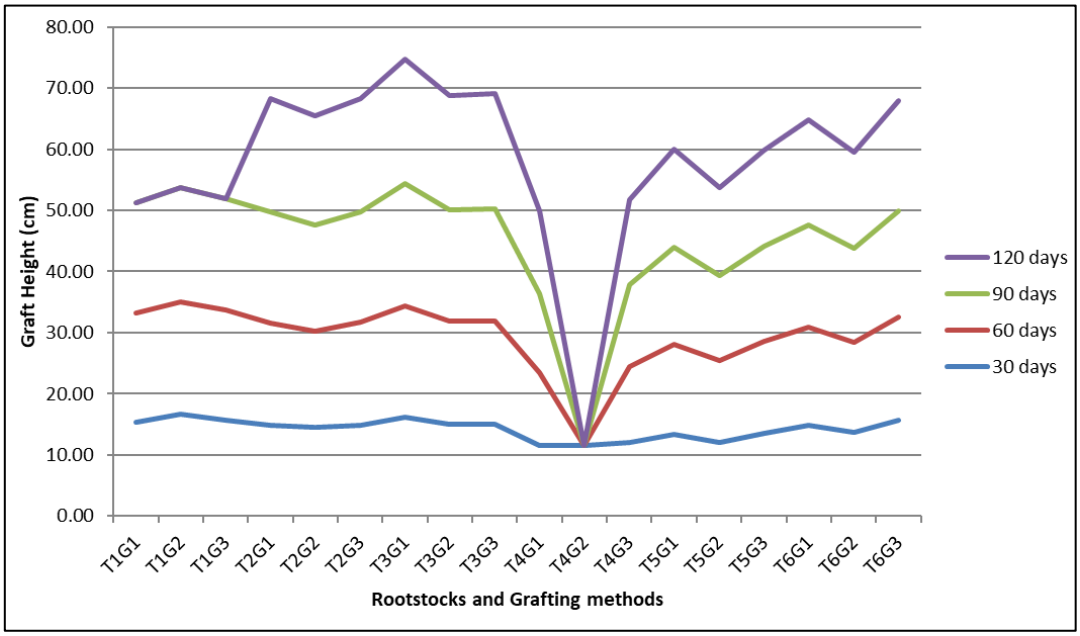

Fig 2: Effect of different rootstock and grafting methods on graft height at 30, 60, 90, 120 days after grafting

Conclusion

From the above study it can be concluded that wedge grafting of Delhi Crossandra and Crossandra seedlings resulted in increased graft success percentage, higher graft survival percentage, improved sprouting length and graft height among the different rootstocks used which can be further exploited as potential rootstocks for grafting in crossandra.

References

1. Andrew Petran, Emily Hoover. *Solanum torvum* as a Compatible Rootstock in Interspecific Tomato Grafting. Journal of Horticulture. 2014;1:1.
2. Black L, Wu D, Wang J, Kalb T, Abbass D. Grafting tomatoes for production in the hot-wet season. Asian Vegetable Research & Development Center. AVRDC Publication. 2003;3:551.
3. Colla G, Rouphaell Y, Cardarelli1 M, Temperini1 O, Rea E, Salerno A *et al*. Influence of Grafting on Yield and Fruit Quality of Pepper (*Capsicum annum* L.) Grown under Greenhouse Conditions. Acta Horticulturae, 2008.
4. Fernandez GV, Martinez A, Cerda, Carvajal M. Fruit quality of grafted tomato plants grown under saline conditions. J Hort. Sci. Biotechnol. 2004;79:995-1001.
5. Kacjan *et al.* The influence of grafting on yield of two tomato cultivars (*Lycopersicon esculentum* Mill.) grown in a plastic house. Acta agriculturae, slovenica, 2004, 83-2.
6. Leonardi C, Romano D. Recent issues on vegetable grafting. Acta Horticulturae. 2004;631:163-174.
7. Maria Maribel Rodriquez, Paul Bosland W. Grafting capsicum to tomato rootstocks. The Journal of investigtators. 2010;152-159:20(2)
8. Nanditha GC, Patil DR, Kulapati Hipparagi, Ambresh, Patil SN, Venkateshalu *et al*. Study the Survivability of Grafts in Different Varieties of Guava (*Psidium guajava* L.) by Softwood Grafting under Different Growing Conditions. Int. J Curr. Microbiol. App. Sci. 2017;6(12):3017-30223017.
9. Palada MC, Wu DL. Grafting Sweet Peppers for Production in the Hot-Wet Season. AVRDC, Shanhua, Taiwan. 2008;9:722.
10. Palanikumar M, Thiripurasundhari S, Vinothini R, Ajitha V. Grafting compatibility of tomato (*Solanum lycopersicum*), brinjal (*Solanum melongena*) and chilli (*Capsicum annum*) through cleft graft method. International Journal of Current Research. 2020;12(12):15061-15065.
11. Rinku Moni Phukon, Sarat Saikia, Borah P, Sibani Das, Seema Bhagowati, Ranjita Bezbaruah. Vegetable Grafting for Enhancing Yield and Combating Biotic Stress in Bhut Jolokia (*Capsicum chinense*) under Protected Condition. Int. J Curr. Microbiol. App. Sci. 2020;9(9):3051-3055
12. Vuruskan MA, Yanmaz R. Effects of different grafting methods on the success of grafting and yield of eggplant/tomato graft combination. Acta Horticulturae. 1990;287:405-409.