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STANDARDIZATION OF ENVIRONMENTAL CONDITION FOR ENHANCED PROPAGATION OF RED PULP GUAVA (*PSIDIUM GUAJAVA* L.) HYBRIDS

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ABSTRACT

Guava (*Psidium guajava* L.) is a tropical fruit widely cultivated for its nutritional value, rich flavor and versatility in food products. Among its various cultivars, red pulp guavas like Arka Kiran, Punjab Pink and Punjab Bold are gaining attention due to their distinct color, taste and high antioxidant content. Successful propagation of these hybrids is crucial for enhancing their yield and quality. The present study aimed to standardize propagation environmental conditions for softwood grafting in red pulp guava hybrids, including Arka Kiran, Punjab Pink, and Punjab Bold under three different environmental conditions: polyhouse, shadenet and open field. The experiment was conducted using a two-factorial completely randomized design with nine treatments replicated three times. The results indicated that Arka Kiran, when placed under polyhouse conditions, exhibited the best performance, with the shortest number of days for first sprouting (8.34 days), the highest number of sprouts per graft (4.40), the longest length of sprouted shoot (7.43 cm), the maximum number of leaves per graft (18.27), and the highest graft success (94.10%) and survivability (89.92%). Whereas, Arka Kiran under open condition resulted in the highest total chlorophyll content (63.00 SCMR) and stomatal conductance (391.80 mmol m^2s^{-2}), followed by Punjab Pink under similar conditions. These findings suggest that the polyhouse environment is most favourable for the propagation of red pulp guava hybrids.

Keywords: Red pulp guava, softwood grafting, propagation environment, polyhouse conditions

Introduction

Guava (*Psidium guajava* L.) known as the "Apple of tropics" belongs to the family Myrtaceae which comprises of about 3,000 species under 80 genera. It is well-distributed in the tropical and subtropical regions of the world, especially in South America, Asia and Australia. The genus *Psidium* has about 150 shrubs and *P. guajava* is well-known species grown worldwide and is one of the most promising fruit crops of India (Paull and Bittenbender, 2006).

The area under the crop is 265.00 thousand ha with a production of 4054.00 thousand MT after

banana, mango, citrus and papaya. It shares 4.1% of total fruit production in India. Whereas, Uttar Pradesh leads in area and production under guava cultivation (49.53 thousand ha and 928.44 thousand MT respectively) (Anon, 2018).

Propagation of guava typically involves methods such as seed propagation, cutting, and grafting. Among these, grafting is the most preferred method for propagating hybrid guava varieties, as it ensures the maintenance of desirable traits such as fruit quality, disease resistance and high yield. Softwood grafting is a common method used for propagation, but environmental conditions play a crucial role in determining the success of the grafting process. The objective of this study was to standardize the propagation environmental conditions, specifically for softwood grafting, by evaluating the effects of polyhouse, shadenet and open field conditions on the growth and success of grafted red pulp guava hybrids.

Material and Methods

The present investigation was carried out at Main Horticulture Research and Extension Centre (MHREC), University of Horticultural Science, Bagalkot, during the year 2020-21, which comes under northern dry zone of Karnataka (zone -3) and this location is situated at $16^0 10'$ north latitude and $17^0 42'$ east longitude and elevation of 542 m above mean sea level. The scion material was collected from the identified elite types of red pulp guava hybrids plants of variety Arka Kiran, Punjab Pink and Punjab Bold from mother block of University of Horticultural Sciences, Bagalkot.

Ten days prior to grafting, curing was done (removing of leaves with the help of secateurs leaving the bud intact) on the selected scion shoots. The optimum sized one-year old local cultivar of guava seedlings was used as a rootstock for grafting and grafting was carried out on 2nd February 2021. Immediately after grafting, all three hybrids were shifted to mist house, shade house and open field (30 plants to each condition) to scrutinize the performance of these grafted hybrids to different growing condition. The observations were recorded on various parameters *viz*., number of days taken for sprouting, number of sprouts per graft, sprouting percentage, length of sprouted shoot, number of leaves per graft, grafts success, grafts survivability, total chlorophyll content and stomatal conductance. After grafting operation, grafts were observed regularly for its greening till it was sprouted or dried and after that mean was computed.

The experiment was conducted using a two-factorial completely randomized design (CRD) to evaluate the performance of red pulp guava hybrids under different propagation environments. The study included three environmental conditions: poly house, shade house, and open field. Each treatment, representing a combination of hybrid and environmental condition, was replicated three times to ensure reliability and accuracy of the results. A total of 30 plants were allocated to each environmental condition for grafting, providing a robust sample size to assess the impact of the growing environment on the grafting success and growth parameters of the guava hybrids. Data from the observations were subjected to analysis of variance (ANOVA) to compare the means of the different environmental conditions and hybrids for each parameter. Statistical significance was determined at a 5% level ($p \leq 0.05$).

Results and Discussion

Number of days taken for first sprouting

The data presented in the Table 1 showed that significantly very early sprouting was observed in polyhouse condition (8.39 days) and in case of hybrids, Arka Kiran (8.85) found to sprout quicker compared to other of varieties. Interaction effect showed that Arka Kiran grafted plants raised under polyhouse took significantly minimum number of days for first sprouting (8.34). It might be due to the presence of favourable meteorological conditions, such as mean maximum (32.30°C) and mean minimum (24.68°C) temperatures, along with mean maximum (85.00 %) and mean minimum (45.00 %) humidity. The early sprouting of grafts was mediated by auxin production at the wounding site, which facilitated the differentiation of mature parenchymatous cells into cambial tissue between stock and scion. Similar findings were observed in Ramirez *et al.* (1999), Singh and Singh (2007), Visen *et al.* (2010), Joshi *et al*. (2016), Mamta *et al.* (2016), Nanditha *et al*. (2017) in guava, Sivudu *et al.* (2014) in mango, Gurjar and Singh (2012) in aonla and Raghavendra *et al.* (2011) in wood apple.

Number of sprouts per graft

The data presented in Table 1 indicated that maximum number of sprouts per graft at 90 DAG was noticed in the plants kept under polyhouse (4.36) and among hybrids, Arka Kiran recorded significantly maximum sprouts per graft (3.90). Maximum number of sprouts in interaction was observed in Arka Kiran kept under polyhouse condition (4.40). As earlier sprouting recorded in polyhouse condition it produced more number of sprouts per graft. The callus tissue that

emerges from the cambial area is made up of thin-walled turgid cells that are readily dehydrated and die off, but relative humidity can protect such cells in the cambial region of the graft union of plants grown in a polyhouse. These results are in concurrence with the research carried out by Syamal *et al*. (2012) in guava, Sivudu *et al*. (2014) in mango and Shinde *et al*. (2010) in jamun.

Sprouting percentage (%)

The perusal of the data revealed that significantly maximum sprouting percentage was recorded in plants kept under polyhouse condition (98.88%), whereas, Arka Kiran (97.73%) had recorded more sprouting percentage among hybrids. The earlier formation of cambial tissue between stock and scion in Arka Kiran grafts increases the percentage of graft sprouting and development of new flushes on the sprout. Our results are similar to the findings of Mamta *et al*. (2016) in guava, Gurjar and Singh (2012) in aonla, Raghavendra *et a*l. (2011) in wood apple, Shinde *et al*. (2010) in jamun and Nair *et al*. (2002) in mango.

Number of leaves per graft

In this existing analysis, maximum number of leaves per graft at 90 DAG was recorded in grafts kept under polyhouse (17.82) and among different hybrids Arka Kiran has been recorded with maximum number of leaves (16.82). With reference to interaction effect Arka Kiran kept under polyhouse condition (18.27) shown more leaves per graft. The increase in leaf count might be due to strong stock and scion development, early sprouting, where a greater number of sprouts per graft promotes more leaves per grafts followed by favourable environmental conditions. Similar results have been reported by Syamal *et al.* (2012), Nanditha *et al*. (2017) in guava, Sivudu *et al.* (2014) in mango, Uchoi *et al*. (2012) in jamun and Raghavendra *et al.* (2011) in wood apple.

Table 1 : Influence of propagation environment and guava hybrids on different growth parameter

Propagation environment	Number of days taken for first sprouting				Number of sprouts per graft				Sprouting percentage (%)				Number of leaves per graft			
	V_1	V_2	V_3	Mean	V_1	V_2	V_3	Mean	V_1	V_2	V_3	Mean	V_1	V_2	V_3	Mean
C_1	8.34	8.43	8.40	8.39	4.40	4.36	4.33	4.36	100.00	100.00	96.66	98.88	18.27	17.75	17.46	17.82
C_2	8.90	9.06	9.17	9.04	3.90	3.93	3.80	3.87	96.60	96.66	93.33	95.53	17.04	16.42	15.90	16.45
C_3	9.33	9.69	9.92	9.64	3.40	3.06	2.80	3.08	96.60	93.33	93.33	94.42	15.16	14.8	13.13	14.36
Mean	8.85	9.06	9.16		3.90	3.78	3.64		97.73	96.66	94.44		16.82	16.32	15.49	
	S.Em±		CD at 5%		S.Em±		CD at 5%		S.Em±		CD at 5%		S.Em±		CD at 5%	
C	0.04		0.12		0.06		0.19		0.64		1.92		0.11		0.34	
V	0.04		0.12		0.06		0.19		0.64		1.92		0.11		0.34	
C×V	0.06		0.20		0.08		0.24		1.11		NS		0.19		0.59	

C_1- Poly house, **C_2-** Shade net, **C_3-** Open field, **V_1 -**Arka Kiran, **V_2 –**Punjab Pink, **V_3 –**Punjab Bold
DAG – Days after grafting, **NS –** Non significant

Table 2 : Influence of propagation environment and guava hybrids on different growth parameter

Propagation environment	Length of sprouted shoot (cm)				Chlorophyll content (SCMR)				Stomatal conductance (m mol m^{-2} s^{-1})			
	V_1	V_2	V_3	Mean	V_1	V_2	V_3	Mean	V_1	V_2	V_3	Mean
C_1	7.43	7.23	6.40	7.02	53.26	53.10	52.30	52.88	263.00	224.86	209.33	232.40
C_2	6.20	5.80	5.50	5.83	54.40	53.33	50.33	52.68	307.30	291.40	277.80	292.16
C_3	5.06	4.79	4.60	4.81	63.00	62.33	59.30	61.54	391.80	339.66	324.00	351.82
Mean	6.23	5.94	5.50		56.88	56.25	53.97		320.70	285.31	270.37	
	S.Em±		CD at 5%		S.Em±		CD at 5%		S.Em±		CD at 5%	
C	0.05		0.15		0.28		0.86		1.87		5.62	
V	0.05		0.16		0.28		0.86		1.87		5.62	
C×V	0.10		0.31		0.50		1.50		3.25		9.75	

C_1- Poly house, **C_2-** Shade net, **C_3-** Open field, **V_1 -**Arka Kiran, **V_2 –**Punjab Pink, **V_3 –**Punjab Bold
DAG – Days after grafting, **NS –** Non significant

Sprout length (cm)

In the present study, maximum length of sprouted shoot at 90 DAG was recorded in polyhouse condition (7.02 cm) and in Arka Kiran (6.23cm). Among interaction effect Arka Kiran kept under polyhouse condition (7.43cm). It might be linked to variety's genetic performance as well as favourable microclimate within the polyhouse, which encouraged early sprouting, maximum number of sprouts and

leaves per graft with increased sprout length. Similar outcomes were found by Syamal *et al.* (2012) in guava, Sivudu *et al.* (2014) in mango and Shinde *et al.* (2010) in jamun.

Chlorophyll content of leaf and Stomatal conductance

In this study, at 90 DAG maximum amount of chlorophyll content (61.54 SCMR) recorded in grafts maintained under open condition and in hybrid Arka Kiran (56.88 SCMR). Interaction effect showed that maximum amount of chlorophyll content (63.00 SCMR) was noticed in Arka Kiran kept under open condition. The optimal temperature raises chlorophyll content and photosynthesis rate, leading in more food resources being produced to aid and encourage graft growth and development. This might be due to varietal genetic character, optimal temperature and relative humidity in open field condition, which aids in achieving maximum chlorophyll as compared to other growing environment, because stomata opening and closing are completely dependent on environmental conditions. The present result was also supported by the study conducted by Athani *et al.* (2005) in guava.

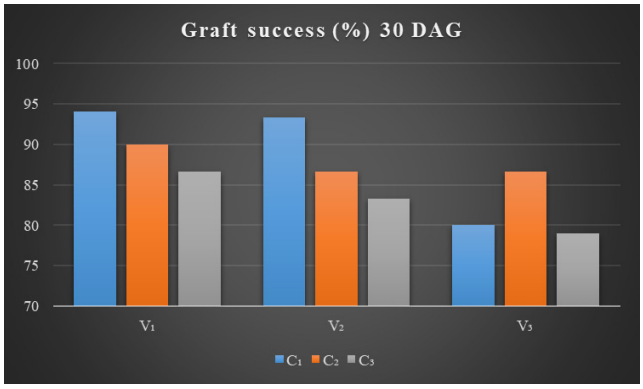
In this study, at 90 DAG maximum amount of Stomatal conductance (351.82 m mol m^2s^{-2}) recorded in grafts maintained under open condition and in hybrid Arka Kiran (320.70 m mol m^2s^{-2}). Interaction effect showed that maximum amount of Stomatal conductance (391.80 m mol m^2s^{-2}) was noticed in Arka Kiran kept under open condition. This could be directly attributable to the genetic composition of the scion variety, the right growing conditions and climatic factors for stomata opening and shutting, the compatibility of the scion and rootstock, which results in maximum leaf area production, which are all possible explanations for steadily increasing in stomatal conductance. The present result was also supported by the study conducted by Athani *et al.* (2005) in guava.

Graft success and survivability

At 30 and 90 DAG, polyhouse condition recorded significantly highest graft success and graft survivability (88.88% and 86.85%, respectively) and Arka Kiran had maximum (90.25% and 85.87%, respectively). With respect to interaction effect maximum graft success (Fig. 1) and graft survivability (Fig. 2) (94.10% and 89.92%, respectively) was noticed in hybrid Arka Kiran kept under polyhouse condition. In Arka Kiran, faster callus formation may aid in early healing of the grafted portion, as well as faster developmental processes like cell division and cell elongation, resulting in early emergence of leaves with more leaf area and increased sprout length which may have led to the production of more carbohydrates required for graft survival and prosperity. The present findings were supported by Ramirez *et al.* (1999), Singh and Singh (2007), Visen *et al.* (2010), Syamal *et al.* (2012), Mamta *et al.* (2016) in guava, Raghavendra *et al.* (2011) in wood apple, Mulla *et al.* (2011) in jamun.

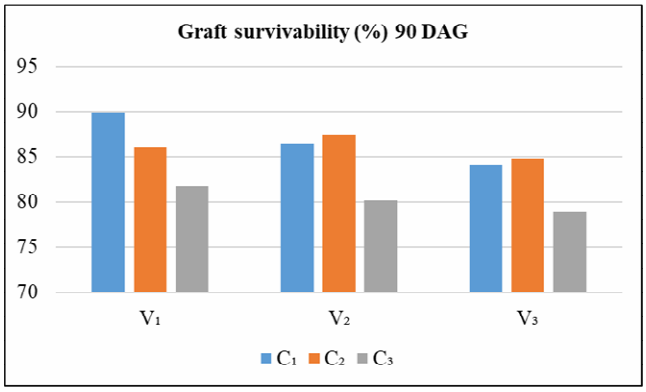
Conclusion

In the present investigation both the growth of the graft and survivability was found to be highest when the grafts of cultivar Arka Kiran kept under poly house condition followed by Punjab Pink kept under poly house. The congenial temperature and relative humidity in the poly house at the initial stage might have helped in better graft success and survivability. It can be concluded that grafts maintained under poly house condition during the initial days of grafting may be helpful in large scale and off-season production of grafts in red pulp guava hybrids to get vigorous and good quality seedlings in shorter period of time.



C_1- Poly house, **C_2**- Shade net, **C_3**- Open field, **V_1** -Arka Kiran, **V_2** –Punjab Pink, **V_3** –Punjab Bold

Fig. 1 : Influence of propagation environment and guava hybrids on different graft success



C_1- Poly house, **C_2**- Shade net, **C_3**- Open field, **V_1** -Arka Kiran, **V_2** –Punjab Pink, **V_3** –Punjab Bold

Fig. 2 : Influence of propagation environment and guava hybrids on different graft survivability (%).

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