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INFLUENCE OF SEASON ON GRAFT COMPATIBILITY IN PAPAYA CVS. CO.2 AND 9-1(D)

S. Senthilkumar *et al.,*

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S. SENTHILKUMAR[2]*, N. KUMAR[1] AND K. SOORIANATHASUNDARAM[1]
[1]Department of Fruit Crops, Tamil Nadu Agricultural University, Coimbatore - 641 003 (INDIA)
[2]Department of Horticulture, Lovely Professional University, Phagwara - 144411 (INDIA)
e-mail: senthilshanmugam87@gmail.com

ABSTRACT

An experiment was conducted to investigate the influence of season on graft compatibility in papaya cvs. Co.2 and 9-1(D**).** The results revealed that the variety Co.2 exhibited the highest survival percentage (80.00 per cent) while cleft grafting 'G_1' recorded the maximum survival percentage (87.20 per cent) during the experimental period. The other trait like increment in girth of the rootstock and number of leaves per graft showed significant differences due to method of grafting alone. It was found the cleft grafting 'G_1' (0.85 cm) and those performed during March registered the higher girth (0.92 cm), whereas, the cleft grafting 'G_1' produced more number of leaves per graft (1.48) and those performed during December recorded the maximum number of leaves (1.79). From the analyzed data, it was evident that cleft grafting performed with the cultivar Co.2 as a scionic material during January month registered higher survival percentage (96.00 per cent). So, it has been proposed to be a standardized technique with a specified month of suitability, highlights the influence of grafting method, prevailing environment, including the genotypic effect acts as a contributing factor in successfulness for papaya grafts.

***Corresponding author**

INTRODUCTION

Horticultural practices are usually correlated with seasonal changes, in which the success of every propagated plant also correlated strongly with seasonal cycles. The prevalence of favourable microclimate would favour the better performance of plant grafts (Pampanna and Sulikeri, 1994). Papaya (*Carica papaya* L.), regarded as one among the most important '*Wonder fruit of tropics and sub tropics*', belongs to Caricaceae family. The importance of papaya to agriculture and the world's economy is demonstrated by its wide distribution, substantial production in the tropical countries, besides its high nutritive value. Moreover, the potentiality in the sense of continuous flowering and fruiting throughout the year, pays a vital role in rendering quick returns to the growers.

Commercial method of propagation of papaya fruit is through seeds, exhibits high variability due to heterozygosity, cross pollination and existence of different sex forms. Especially for dioecious types, equal probability of male and female plant population poses the problem of rouging excess male plants. Hence, propagation by vegetative means could be an alternative to overcome these constraints.

In asexual propagation by means of grafting, season plays a critical role on the graft success in many fruit crops. Attempts have been made in this direction in other papaya growing countries like South Africa (Allan, 1990), Brazil (Lima de *et al.,* 2010) and USA (Lange, 1969). Season of grafting largely decides the success of grafting as reported in several other horticultural crops like jack (Selvi, 2005), sapota (Pampanna and Sulikeri, 1994), cashew (Swamy *et al.,* 1990), moringa (Punithaveni, 2010) and brinjal (Sherly, 2010). In this line, the detailed information regarding the impact of season on successful grafting with papaya under Indian conditions is unknown.

Growth and development after union of scion and rootstock of any grafted plant greatly found to be influenced with certain abiotic factors *viz.,* temperature, temperature range, relative humidity, sunshine and rainfall (Battey, 2000). The present scenario of unconditional seasonal changes over a period of time made it necessity for predicting suitability of season for papaya propagation. Such facts are found to be a mandatory one in boosting up the growing industrial sector for papaya, most especially with dioecious types. Hence, the present investigation was carried with the objective to access the efficacy of suitable season on graft compatibility, performance and success in relation to weather fluctuations.

MATERIALS AND METHODS

The present investigation was conducted at College Orchard, Horticultural College and Research Institute, TNAU, Coimbatore located at an altitude of 426.6 m above mean sea level with latitude of 9.19°N and longitude of 77.88°E. The experiment was carried out during the period of December, 2010 to April, 2011. Fifty seedlings were grafted per treatment and thus 200 plants were grafted per month. The scions of Co.2 and 9-1(D) variety were utilized for grafting. The experimental design adopted was FCRD with five replications. Scions of two varieties *viz.,* Co.2 and 9-1(D) were compared along with two methods of grafting *viz.,* cleft and side grafting. The

description of the experiment was given as follows,

Varieties	Method of Grafting
V_1 - Co.2	G_1 - Cleft
V_2 - 9-1(D)	G2 - Side
Age of the rootstock: Three months old seedlings	

Treatment Combination	Scion Variety (V)	Method of Grafting (G)
V_1G_1	Co.2	Cleft
V_1G_2	Co.2	Side
V_2G_1	9-1(D)	Cleft
V_2G_2	9-1(D)	Side

Treatment combination

The methodology in grafting was performed as per the method outlined by Ramkhelawan and Baksh (1998) and Chong *et al.* (2008) in every month. Healthy lateral shoots (5-6 cm) were taken from elite trees of Co.2 and 9-1(D), in the morning hours on the day of grafting and defoliated with sharp knife. The scions so prepared were further used for grafting on the same day. The size of the scion was about the size of the rootstock selected. The base of the scion was trimmed to a sharp wedge for cleft grafting and trimmed across for side grafting to 2-3 cm using a sharp and clean knife. The leaves were trimmed to reduce transpiration loss. Healthy and vigorous papaya seedlings of about 2, 3, 4 and 5 months old were selected as rootstocks. The seedling rootstock was topped-off at about 10 cm from soil level in poly bag and a slit of about 2-3 cm was made at the middle of the stem. In case of side grafts, one side of the stem was slantingly trimmed to about 2-3 cm. The prepared scion was then inserted into the rootstock in a manner to ensure that both cambiums were aligned and then grafted portion was wrapped firmly with polythene strip to ensure good contact. The grafted plants were transferred immediately to the mist chamber and maintained for 20 days. Later, they were shifted to shade net house and maintained for 90 days period. The observations on survival percentage of grafts including other traits like increment in girth of the rootstocks, height of the graft, number of leaves per graft were observed. Statistical analysis of the data was carried out as per the FCRD method outlined by Panse and Sukhatme (1995).

RESULTS AND DISCUSSION

The results on survival percentage of grafts performed during December, 2010 to April, 2011 presented in Table 1. The results revealed that the values did not exhibit any significant differences with variety and method of grafting including their interaction at all stages of observation. However, the variety Co.2 exhibited the highest survival percentage (80.00 per cent) while cleft grafting 'G_1' recorded the maximum survival percentage (87.20 per cent) during the experimental period. The cleft grafts of Co.2 performed during January exhibited higher survival percentage (96.00 per cent). The method of grafting and prevailing environment is an important key factor deciding the success of grafting in any fruit crops. Similarly, the genotype decides the success with any specific rootstock. In this present study, with regard to method of grafting, cleft grafting demonstrated from December to April retained its superiority to side grafting throughout the experimental period. This finding corroborates the earlier results of Ramkhelawan *et al.* (1999) and Chong *et al.* (2008) in papaya. The variation may be attributed to the increased rate of division of cambial cells, their differentiation and consequent development in healing of stock scion union. The fact was agreed with Dar (2003) who observed that the environmental factors greatly influenced the success of grafting and growth related parameters in walnut, when cleft grafting was performed. Similarly, according to Qian and Qian (2000), the higher survival percentage in walnut is due to cleft grafting which were performed in pre-summer.

The higher in survival rate during January month may be attributed to better the impact of relative humidity along with appropriate minimum and minimum temperature levels congenial for increased cell activity. Lower the survival rate of

Table 1: Effect of variety, method and months of grafting on survival percentage of grafts at 90 DAG in papaya

Variety	Method of grafting	Months of grafting					MEAN
		December	January	February	March	April	
Co.2	Cleft	86.00(68.32)	96.00(82.24)	88.00(71.88)	88.00(71.88)	84.00(66.99)	88.40(72.26)
Co.2	Side	64.00(53.35)	80.00(64.03)	70.00(56.92)	76.00(60.78)	68.00(55.71)	71.60(58.16)
Mean		75.00(60.84)	88.00(73.14)	79.00(64.40)	82.00(66.33)	76.00(61.35)	80.00(65.21)
9-1(D)	Cleft	82.00(65.36)	94.00(80.62)	86.00(70.55)	86.00(68.32)	82.00(65.36)	86.00(70.04)
9-1(D)	Side	60.00(50.87)	72.00(58.25)	66.00(54.38)	74.00(59.57)	70.00(56.92)	68.40(56.00)
Mean		71.00(58.12)	83.00(69.44)	76.00(62.47)	80.00(63.95)	76.00(61.14)	77.20(63.02)
G1 mean		84.00(66.84)	95.00(81.43)	87.00(71.22)	87.00(70.10)	83.00(66.18)	87.20(71.15)
G2 mean		62.00(52.11)	76.00(61.14)	68.00(55.65)	75.00(60.18)	69.00(56.32)	70.00(57.08)
Grand mean		73.00(59.48)	85.50(71.29)	77.50(63.43)	81.00(65.14)	76.00(61.25)	78.60(64.12)

	December		January		February		March		April	
Source	SEd	CD (P=0.05)	SEd	CD (P=0.05)	SEd	CD (P=0.05)	SEd	CD (P=0.05)	SEd	CD (P=0.05)
V	2.68	NS	4.06	NS	3.82	NS	2.98	NS	2.57	NS
G	2.68	NS	4.06	NS	3.82	NS	2.98	NS	2.57	NS
V x G	3.78	NS	5.74	NS	5.40	NS	4.22	NS	3.64	NS

(*Figures in parenthesis indicate the transformed values*); DAG: Days After Grafting; V: Variety G: Method of grafting NS: Non Significant

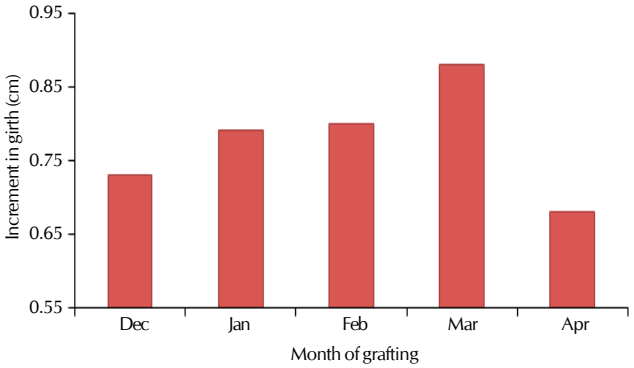

Figure 1: Effect of month of grafting on increment in girth of rootstock of grafts at 90 DAG

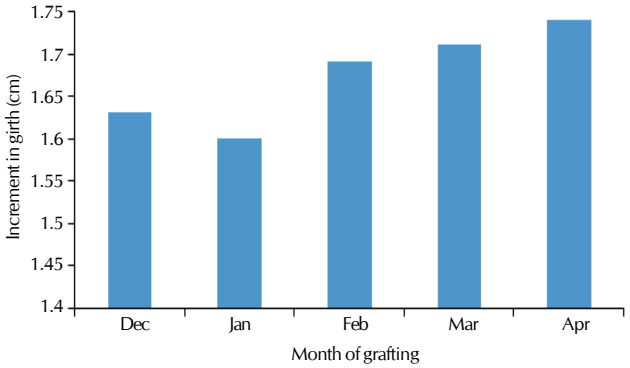

Figure 2: Effect of month of grafting on increment in height of grafts at 90 DAG

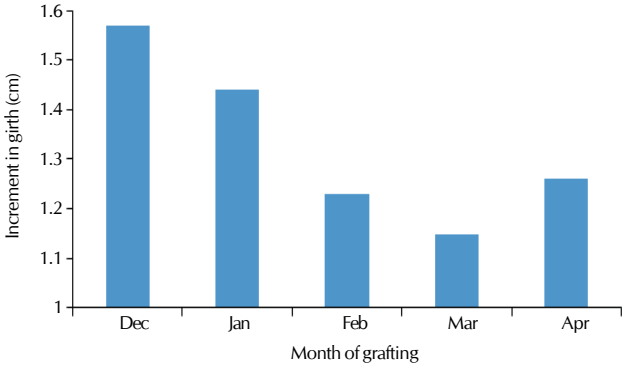

Figure 3: Effect of month of grafting on increment in number of leaves per graft at 90 DAG

grafted plants in other months are due to altered temperature and prevailed micro climatic conditions around grafted papaya plants, made unfit to perform during the initial growth phase of graft development (Dharmendra Kumar *et al.,* 2014).

The observations on girth of rootstock, height of graft and number of leaves produced per graft were also recorded. Among those observations, the increment in girth of the rootstock observed in two months between 30 days after grafting (DAG) and 90 DAG showed significant differences due to method of grafting alone except those during March. The increment in girth of the rootstock was found to be maximum with cleft grafting 'G_1' (0.85 cm) and those performed during March registered the higher girth (0.92 cm) (Fig. 1). Comparatively lower the rootstocks girth with side grafts upon cleft grafted plants might be due to the fact that side grafts found to have lower affinity for graft compatibility, as it fetches lesser tensile for union, under all seasonal conditions (Sharma *et al.,* 2003).

The increment in height of the graft observed in two months between 30 DAG and 90 DAG did not exhibit significant differences among the variety and method of grafting, including their interaction at all stages of observation. However, the variety Co.2 registered the maximum graft height (1.70 cm) while cleft grafting 'G_1' recorded taller grafts (1.77 cm) during the experimental period. Among all, cleft grafts of Co.2 performed during April exhibited the maximum graft height (1.89 cm) (Fig. 2). The observation for graft height in those grafts performed during April might be due to favourable condition for shooting under prevailed environmental condition. Similar findings are also in line with Iqbal *et al.* (2004) in walnut.

With regard to the increment in number of leaves per graft observed in two months between 30 DAG and 90 DAG exhibited significant differences due to method of grafting alone except those during April. Among the method of grafting, cleft grafting 'G_1' produced more number of leaves per graft (1.48) while those performed during December recorded the maximum number of leaves (1.79) (Fig. 3). The differences with regard to growth related traits among the varieties might be due to different growth characteristics, graft affinity and compatibility (Tamilselvi and Pugalendhi, 2015). Better the growth related traits in young grafts can be explained due to interaction of some or all of the several other phenomena that includes increased water and nutrient uptake with better the root activity with stocks, endogenous hormone production, enhanced scionic vigour. Addition to it, the other functional changes could also impart essential role in betterment for plant growth (Yetisir *et al.,* 2007; Muzaffar and Kumar, 2011). The results are in line with Rivero *et al.* (2003), reported that the effect of environment directly influenced in greater biomass production. The variation in relevance to that of vegetative growth parameters for both papaya varieties might be due to differences with genetic makeup. This was in line with the findings of Rajesh Singh *et al.* (2014) in mango.

So, for the above results it was found to clear that the growth related traits like increment in girth of the rootstocks and scions, height of the graft, number of leaves per graft were highly influenced by method of grafting and environment and it was of higher magnitude with cleft grafting than side grafting. This suggests that the uniform origin of callus tissues from xylem ray cells of both graft partners in graft union region initiated the new vascular elements and ensured good connection. Similar results were also reported by Abd El Zaher (2008) in jack. In many other horticultural crops like cashew, sapota, durian, mangosteen, soursop, watermelon, tomato and brinjal, cleft grafting is being commercially followed as it produces higher success (Oda, 2002; Lee and Oda, 2003; Sherly, 2010).

Season plays a vital role in influencing both the unconditional environment and also with biological components in plant propagation mediated by the prevailing environment. With

regard to season of grafting, the observation on survival of grafts ranged from 73.00 to 85.50 per cent. It is evident that Co.2/9-1(D) graft combinations, especially those performed during January recorded the highest survival percentage of 88.00 per cent at 90 days after grafting highlighting the role of season in influencing the grafting success. The success of grafting is solely dependent upon weather conditions and thus may vary from region to region within a season. The decline in survival percentage during February, 2011 and April, 2011 may be due to the increasing temperature under Coimbatore condition signifying the influence of temperature on graft success. With higher temperature, the callus production is retarded and the cell injury becomes more apparent and leads to death of cells. The prevalence of optimum humidity would have favoured better success in graft, which could be related to moisture relationship of exposed callus layers of both graft partners forming bridge between them. Similar results were well documented in brinjal by Sherly (2010). With regard to variety the Co.2/9-1(D) combination performed better by recording higher survival percentage and also other growth related traits. The results are in confirmation with Nhat Hang and Chau, 2000 in papaya.

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