



Standardization of method and time of grafting on pecan (*Carya illinoensis*) under intermediate agro-climatic conditions

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ABSTRACT

A study was conducted to standardize the method and time of grafting on pecan (*Carya illinoensis* Wangenh). Three grafting method, viz. Tongue grafting, Cleft grafting and Side grafting with four different timings, viz. 4th week of February, 1st week of March, 2nd week of March and 3rd week of March were used. The results indicated that among all the grafting methods, tongue grafting performed during 1st week of March showed highest grafting success (69.16 %) and maximum survival percentage (47.33 %), maximum number of leaves (24.55), plant height (118.38 cm), diameter of rootstock (2.40 cm), diameter of scion (2.19 cm), plant biomass (131.37 g) and leaf area (193.66 cm²). Hence, the grafting performed during the 1st week of March showed better performance as compared to other dates of grafting.

Key words: *Carya illinoensis*, Grafting methods, Time of propagation

The pecan (*Carya illinoensis* Wangenh) belonging to family Juglandaceae was originated from the south east of USA. It is considered as the “queen of nuts” in USA because of its value both as wild and cultivated nut (Woodroof 1979). Their nuts have high nutritional and calorific value. So, pecan is more acceptable in comparison to other nuts. Pecans are good source of protein and unsaturated fats like walnuts, pecans are rich in omega-6 fatty acids, although pecans contain about half as much omega-6 fatty acids as in walnuts. The antioxidants and plant sterols found in pecans reduce high cholesterol by reducing the “bad” cholesterol (low-density lipoproteins) levels. Seedling pecan trees often produce small, thick-shelled nuts while trees grafted with improved cultivars produce large, thin-shelled nuts. In the home landscape, these long-lived and sturdy trees provide ample shade and bright yellow fall colour and finally, pecans are a low-input orchard tree. Woody tree seed often does not breed true due to uncontrolled pollination and favourable characteristics of the parent tree cannot be reliably transferred via seed. However, by grafting a scion

of known production quality onto a rootstock with known features, the identical tree can be reproduced with ensured fruit quality (Onay 2000). A variety of grafting methods are used in commercial orchard nurseries. The most common grafting techniques are cleft and side grafting which are used when trunk diameter of rootstock arranged between 4-6 cm. The main constraints in commercialization of this crop in J&K include non-availability of standardized techniques of vegetative propagation, non-availability of quality plant material and late fruit bearing. The sexually reproduced plants come to bearing in 11-12 years in comparison to vegetative propagated plants which come into bearing in 4-7 years. Most plantations of pecan nuts are of seedling origin in scattered form and produce nuts of variable quality. Pecan nut cultivation suffers from lack of suitable methods of propagation, inadequate vegetatively propagated plants, lack of standard rootstocks and cultivars, problems of re-establishment of nursery plants in the orchard, pollination behaviour, and lack of suitable pollinizers, long juvenile period and lack of appropriate harvesting techniques. Therefore, standardization of method and time of propagation (grafting) is very important to get the highest success and good plant growth. Keeping in view the importance of time and method of grafting, this study was initiated to find out the most appropriate method and time of budding for pecan nut.

MATERIALS AND METHODS

The present investigation entitled “Standardization of

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method and time of grafting in pecan under intermediate agro-climatic zones of Jammu and Kashmir” was carried out at Regional Agriculture Research Station (RARS), Rajouri, SKUAST-Jammu during 2015-16. Rajouri is classified as warm and temperate zone at an altitude of 33.38° North and longitude of 74.3° East. The altitude of the place is 915 m above mean sea level. The climate of Rajouri is somewhat cooler than the other areas of Duggardesh plains. Summers are short and pleasant. The summer temperature generally does not exceed 41° C. Winters are cool and chilly characterized with rainfall due to western disturbance and the lowest average temperatures in the year occur in January, when it is around 9.2° C. Snowfall is scanty but may occur in cool months. Average rainfall is 769 mm (26.3 inch) in the wettest month. The average annual temperature in Rajouri is 20.3° C. The greatest amount of precipitation occurs in July, with an average of 140 mm. The experiment was carried out with different grafting methods, viz. tongue grafting (T₁), cleft grafting (T₂) and side grafting (T₃) with different timing, viz. 4th week of February 2016 (D₁), 1st week of March 2016 (D₂), 2nd week of March 2016 (D₃) and 3rd week of March 2016 (D₄). The experiment was laid in a Factorial Randomized Block Design with three replications. The seedlings for propagation studies were raised in the field at RARS, Rajouri from locally (desi) available pecan seeds. The seedlings were about two years old of pencil thickness at the time of propagation. Seedlings of healthy appearance were used for propagation studies. They were used as rootstock after attaining a stem diameter of 0.5 to 1.0 cm. The bud-wood for the scion was collected from CSKHPKV, Palampur. The bud-woods were kept moist by wrapping in moist gunny bags to avoid desiccation of buds due to hot weather until the time of grafting operation. Bud sticks with at least 3-4 buds were used for grafting. The biometrical observations were recorded on three randomly selected plants of each replication to assess the vegetative characters, viz. grafting success (%), survival percent (%), number of leaves/plant, number of days taken to sprout, scion and stock diameter (cm) of grafted plants, average leaf area (cm²) and plant height (cm). The number of successful grafts in each treatment was recorded at the end of growing season. The shoot with the opened leaves from the terminal bud of scion was considered as the success of a graft. Results were calculated and expressed in percentage basis. Percentage of successful grafts of individual treatment was calculated by using the following formula.

$$\text{Per cent success} = \frac{\text{Number of plant sprouted}}{\text{Number of plants propagated}} \times 100$$

The number of survival grafts in each treatment was recorded at the end of growing season. Results were calculated and expressed in percentage basis. Percentage of successful survival grafts of individual treatment was calculated by using the following formula.

$$\text{Per cent survival} = \frac{\text{Number of plant survived}}{\text{Number of plants propagated}} \times 100$$

The data regarding the number of days taken to

sprouting were calculated by observing the plants on alternate days from the day of planting grafted plants and their mean was used to calculate the days taken for first bud burst. All cultural practices like manuring, hoeing, weeding and irrigation were uniformly carried out during the research study. The data generated during the investigations were subjected to statistical analysis as prescribed by Panse and Sukhatme (2000) under factorial randomized block design with three replications.

RESULTS AND DISCUSSION

Grafting success

Among different methods of grafting, tongue grafting showed highest grafting success (69.16%) as compared to cleft and side grafting performed during 1st week of March (Table 1). Highest success in tongue grafting is in accordance with the findings of Bhardwaj and Awasthi (1983). Superiority of tongue grafting over other methods might be because of favorable temperature and relative humidity prevailing during the period following grafting and rapid sap flow in stock and scion which might have favoured the healing process and established the continuity of cambial

Table 1 Effect of method and time of grafting in grafting success (%), survival percent (%), plant height (cm) and days taken for bud burst in pecan

Method of grafting	Time of grafting	Grafting success (%)	Survival percent (%)	Plant height (cm)	Days taken for bud burst
Tongue grafting	4 th week of February	60.88	41.00	112.75	31.77
Tongue grafting	1 st week of March	69.16	47.33	118.38	25.00
Tongue grafting	2 nd week of March	63.33	44.33	114.53	30.11
Tongue grafting	3 rd week of March	48.00	38.66	109.93	35.66
Cleft grafting	4 th week of February	51.00	37.33	108.70	34.33
Cleft grafting	1 st week of March	59.33	43.66	114.51	31.00
Cleft grafting	2 nd week of March	54.44	40.33	110.10	32.77
Cleft grafting	3 rd week of March	44.00	34.33	107.06	37.11
Side grafting	4 th week of February	42.33	33.66	106.70	37.00
Side grafting	1 st week of March	52.66	39.33	112.36	35.10
Side grafting	2 nd week of March	46.33	36.33	108.13	36.11
Side grafting	3 rd week of March	36.33	29.33	104.90	38.33
CD (P=0.05)		3.78	2.16	1.98	1.96

and vascular tissue for bud take. Tongue grafting done on 3rd March had highest bud bursting (39.55%) followed by 15th February (29.75%). These findings are in conformity with those of Joolka and Rindhe (2000).

Survival per centage

After the end of growing season highest per cent survival (55.33%) was recorded in tongue grafting when performed during 1st week of March followed by the same method percent survival (51.66%) when performed during 2nd week of March. Higher survival is in accordance with the finding of Joolka *et al.* (2001). The results are in close agreement with those of Awasthi *et al.* (1982). Higher rate of survival in tongue grafting might be due to interlocking of stock and scion more securely, resulting in more intimate contact of cambial layers of the two components than other methods (Hartmann *et al.* 1990). The minimum survival (31.33%) was recorded in case of side grafting when performed during 4th week of March. Poor survival of plants grafted in February-March might be due to temperature (18.8 °C) and humidity (55%) whichever is quite low during April but temperature rose and humidity lowered during May and June. Since the variation was very high, the grafts could not get much time

Table 2 Effect of method and time of grafting on number of leaves, rootstock diameter (cm), scion diameter (cm) and leaf area (cm²)

Method of grafting	Time of grafting	Number of leaves	Rootstock diameter (cm)	Scion diameter (cm)	Leaf area (cm ²)
Tongue grafting	4 th week of February	20.66	2.12	1.89	168.58
Tongue grafting	1 st week of March	24.55	2.40	2.19	193.66
Tongue grafting	2 nd week of March	21.77	2.23	1.99	187.39
Tongue grafting	3 rd week of March	18.66	1.92	1.77	150.47
Cleft grafting	4 th week of February	17.66	1.92	1.74	144.33
Cleft grafting	1 st week of March	21.10	2.05	1.88	174.58
Cleft grafting	2 nd week of March	18.33	1.96	1.79	161.65
Cleft grafting	3 rd week of March	15.99	1.86	1.70	134.62
Side grafting	4 th week of February	16.55	1.72	1.62	137.88
Side grafting	1 st week of March	18.21	1.81	1.71	153.77
Side grafting	2 nd week of March	17.99	1.76	1.66	143.66
Side grafting	3 rd week of March	15.00	1.70	1.60	127.88
CD _(0.05)		0.81	0.09	0.09	5.68

to establish properly to fare high temperature, transpiration and water stress of summer months. These results are in agreement with those of Yates and Sparks (1992).

Days taken to bud burst and plant height (cm)

Minimum number of days (25.00) to bud burst and maximum plant height (118.38 cm) was observed in tongue grafting when performed during 1st week of March which was followed by the same method (30.11), days taken to bud burst and plant height (114.83 cm) when performed during 2nd week of March. The lesser time taken by the tongue grafting to sprout might be due to early contact of cambial layers of stock and scion, resulting in early callus formation and initiation of subsequent growth and the maximum increase in plant height in tongue grafting is due to the quick and strong union formation, greater nutrient uptake and ample growing period in tongue grafting method may have accounted for higher growth in these treatments (Pathak *et al.* 1996). The results are in accordance with Bohra *et al.* (2011) where they showed that tongue grafting took minimum days to bud burst ranges between 25-30 days when performed on 1st week of March. Pathak and Srivastava (1971) showed that tongue grafting when performed on 2nd week of March took 29-32 days to bud burst in walnut plants. The maximum height in tongue grafting is in accordance with the findings of Dwivedi *et al.* (2000).

Rootstock and scion diameter (cm)

Maximum rootstock diameter (2.40 cm) and scion diameter (2.19 cm) was observed in the tongue grafting when performed during 1st week of March followed by the same method rootstock diameter (2.23 cm) and scion diameter (2.19 cm) when grafting was performed during 2nd week of March. The maximum rootstock and scion diameter in tongue grafting may be attributed to greater nutrient uptake that showed faster (Skene *et al.* 1983) and uniform growth (Howard *et al.* 1974) as a result of quicker and stronger union formation during this period of grafting. These results are in accordance with Kim *et al.* (1989) wherein they reported that maximum scion diameter ranges between 2-2.3 cm when tongue grafting performed on 5th March. Pieniazek (1969) also showed maximum rootstock diameter in tongue grafting when performed on 1st week of March.

Number of leaves and leaf area (cm²)

Among all the grafting methods tongue grafting after the end of growing season was found to be best in terms of maximum number of leaves (24.55) and maximum leaf area (193.66 cm²) when grafting performed during 1st week of March. This might be due to strong plant and better root system therefore, food intake was good and hence after union growth was quite faster and also during rainy season well matured rootstock favoured with high atmospheric humidity along with fairly high temperature is found congenial for rapid callus production that ensure formation of an early and strong union between stock and scion (Gurjar *et al.* 2012). The results are in agreement with

the finding of Mir and Kumar (2011) where they resulted that tongue grafting during 1st week of March showed the leaf area ranged between 192-198 cm².

Conclusion

It can be concluded from the present investigation that the tongue grafting gave highest success (69.16%) as compared to cleft and side grafting when performed in 1st week of March. Tongue grafting took minimum days to bud burst (25 days) when performed on 1st week of March. The rootstock diameter and scion diameter was also maximum in tongue grafting as compared to cleft and side grafting. The survival percentage was highest in tongue grafting (55.33%) followed by cleft grafting (52.66%).

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