



E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2019; 8(4): 2657-2659
Received: 04-05-2019
Accepted: 06-06-2019

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Studies on success rate of grafting methods on walnut (*Juglans regia* L.) at different time under polyhouse condition

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Abstract

Two factors of different grafting methods tongue and cleft grafting with four different time 1st week of January, 3rd week of January, 1st week of February and 3rd week of February were find out the best method of grafting, and appropriate grafting time under polyhouse condition at Fruit nursery, department of Fruit Science, VCSG Uttarakhand University of Horticulture and Forestry, Bharsar, Pauri Garhwal, Uttarakhand, India. The results showed significant effects on number of days to first sprout, length of new shoot, diameter of shoot, number of branches, number of leaves, leaf area, survival of grafted plants (%) and total saleable plants (%). Minimum days taken to sprouting (45.57 days), maximum shoot length (52.40 cm), diameter of shoot (0.87cm), number of branches (17.56), number of leaves (85.59), leaf area (30.55), survival of grafted plants (46%), and total saleable plants (93.77%) were observed in cleft grafted plants on 1st week of February. Cleft grafting showed significant results among most of the parameters observed. Hence for better success rate of grafting methods in walnut through cleft grafting on 1st week February is recommended under polyhouse.

Keywords: Methods, time, walnut, grafting, polyhouse

Introduction

The walnut (*Juglans regia* L.) belongs to the family Juglandaceae with the chromosome number ($2X = 2n = 32$) and is native to Persia and Northern western Himalayas. It is a very nutritious nut fruit. Its kernels contain 64.5% fat, 14.8% proteins, 15.85g carbohydrates and 631 calories of energy per 100 gram (watt and Merrill, 1963). The kernels are consumed fresh, used in confectionary and for extracting edible oil. The tree yields valuable timber which is most suitable for carving, making furniture and the butt of guns.

Walnut is very popular nut fruit of the world, cultivated mostly in semi cold region. It is grown extensively in USA, China, France, Italy, Turkey, Poland, Yugoslavia, Romania, Ukraine, Japan, Austria and India. In India it is found in all part of Himalayan region between the elevations of 1200-2150m above mean sea level. The area under walnut cultivation in India is 121.87 thousand hectare with an annual production of 240.63 thousand tones (NHB, 2015). In Uttarakhand walnut is one of the important fruit crop grown over an area of 19.64 thousand hectare with an annual production of 21.81 thousand tones. The major walnut producing districts in Uttarakhand are, Almora, Dehradun, Chamoli, Pauri, Tehri and Uttarkashi. The important varieties of walnut grown in Uttarakhand are Chakrata selections and Govind. However, its commercial cultivation is confined mainly to the state of Jammu and Kashmir, Himanchal Pradesh and Uttarakhand.

Grafting in walnuts is more difficult than in other fruit trees. Temperature and humidity have major effects on the process of walnut graft union. Specially changing in temperature among the uniting period has direct effect on callus development and successful grafting. Best temperature for walnut grafting is 27 °C. In this temperature, callus formation occurs five days after grafting but at 22 °C callus formation begins in seven days after grafting, and at temperatures lower than 20 °C, no callus formation occurs. Low temperature in winters is the most important limiting factor for walnut grafting. To avoid low temperature in winter in walnut, 27 °C condition has to be provided for 3-4 weeks for successful grafting. Also high environmental moisture is needed for winter grafting, because the parenchymal cells of callus have soft walls and they lose their moisture in dry places. Covering the graft point with moist sawdust might increase graft success up to 93.3%, but in dry condition as occurs in the cleft method, the graft success was zero. So only the environments having with proper moisture, is required for callus formation and growth. Grafting method also influences graft success. Comparison of different grafting methods showed that modified bark grafting had 100% graft Success and 85% survival while, other grafting (whip and cleft) resulted in poor success and survival.

Although walnut is a very popular nut fruit crop, yet its cultivation in our country has remained continued in few states or in neglected state. The non-availability of the quality planting materials (rootstock and scion) and lack of efficient propagation techniques and other information on the performance of cultivars under different agro-climatic condition of temperate hilly region are the major constraints in the expansion of walnut cultivation in India. In walnut no systematic work has so far been done on their survivability and morphological performance in relation to propagation method (grafting) with suitable time of propagation under the hilly conditions of Uttarakhand.

Therefore, keeping in view the above points into consideration, the present investigation was under taken on "Studies on Success Rate of Grafting Methods on Walnut (*Juglans regia* L.) At Different Time under Polyhouse Condition" has to be carried out with the following objectives;

- To standardize suitable time of grafting under polyhouse condition.
- To evaluate appropriate grafting method for walnut cv. Govind under polyhouse condition.

Materials and Methods

The materials used in this experiment were uniform sized rootstock of walnut seedling rootstocks and scion material used was taken from Govind variety of Walnut. The seedlings were grafted at height of 20 cm from the soil level. 100 graft per treatment combinations were inserted in walnut seedling rootstocks with replicated five times, one replicates with 20 number of plants. Thus the total 800 graft were inserted for two methods and four different time. The experiment was carried out in Randomized Complete Block Design (RCBD) with two factors (different grafting methods and grafting times), factorial arrangement replicated five times. There were eight treatment combinations in each replication. Experiment was based upon following two factors i.e. grafting methods and grafting times.

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Factor- A	Factor-B
Grafting Methods	Grafting Times
a. Tongue grafting	a. 1 st week of January
b. Cleft grafting	b. 3 rd week of January
	c. 1 st week of February
	d. 3 rd week of February

Observations

Data was recorded on different parameters and subjected to the statistical procedure given below i.e. days to first sprout, length of new shoot (cm), diameter of shoot(mm), number of

branches, number of leaves and leaf area (cm²) while survival of grafted plants (%) and total saleable plants (%) was determined using the following procedure.

- % Survival = Number of plants survived / total number of grafted plants x 100
- % Saleable = Total number of saleable plants / total number of survived plants x 100

Statistical Procedure

All the data noted on plant growth parameters was subjected to analysis of variance (ANOVA) techniques to confirm differences among different treatments as well as interactions. Least Significant Difference (LSD) test was used for mean differences where the results were significant. Computer statistical software OPSTAT, STPR and GRAPH PAD were applied for calculating both ANOVA and LSD (Steel and Torrie, 1980).

Results and Discussions

Data recorded on the above parameters is presented in Table 1. The results are briefly described as under;

Days taken to sprout (Days)

The statistical analysis of data showed a significance variation of different grafting methods and time for days taken to sprouting (Table.1) The minimum number of days taken to first sprouts was recorded with cleft grafting 1st week of February (45.57 days) G₂T₃ treatment. The earlier sprouting may be due to early and good contact of cambial layers of stock and scion, resulting in early callus formation under polyhouse condition. The maximum days taken to bud sprouting (73.51 days) was recorded in tongue grafting in 3rd week of February (G₁T₄) treatment. The reason for late bud sprouting in tongue grafting might be due to lower temperature and humidity which delayed the callus formation and took more days for sprouting. These findings are in conformity with those of Joolka *et al.*, (2001) ^[3] and Mir and Kumar (2011) ^[4] who reported that cleft grafting took minimum days for bud sprouting when performed during 3rd week of March followed by tongue grafting when employed during the same time.

Shoot length (cm)

Data presented in Table.1 indicated that the effect of different methods and time of grafting were found significant variation with respect to shoot length. The maximum shoot length was found under cleft grafting in 1st week of February (52.40cm). The minimum length of shoot was recorded in tongue grafting in 3rd week of February (26.55cm). These findings are in conformity with those of (Mujaffar and Kumar 2011) ^[4].

Table 1: Effect of Different Methods and time of grafting on Various Characters

Treatment Combinations	Days taken to sprout (Days)	Shoot Length (cm)	Shoot Diameter (mm)	Number of branch	Number of leaves	Leaf Area (cm ²)	Survival of Grafted plants (%)	Saleable plants (%)
G ₁ T ₁	64.57	28.49	6.40	8.44	27.60	16.46	21.00	74.66
G ₁ T ₂	60.50	36.67	7.30	9.57	36.44	22.64	26.00	53.66
G ₁ T ₃	53.49	44.52	8.10	11.54	68.49	27.60	25.00	61.33
G ₁ T ₄	73.51	26.55	6.60	13.58	42.57	21.62	38.00	88.77
G ₂ T ₁	68.66	30.31	7.10	7.25	40.44	20.42	41.00	82.77
G ₂ T ₂	62.73	38.60	7.30	12.50	29.31	26.53	30.00	86.28
G ₂ T ₃	45.57	52.40	8.70	17.56	85.59	30.55	46.00	93.77
G ₂ T ₄	71.46	40.42	7.00	15.45	52.42	18.62	34.00	87.55
C.D (0.05)	0.25	0.28	0.02	0.27	0.27	0.32	1.75	1.89

G₁= tongue grafting, G₂= cleft grafting, T₁= 1st week of January, T₂=3rd week of January, T₃=1st week of February, T₄=3rd week of February.

Shoot Diameter (mm)

Data of Table.1 indicate that the interaction between different method and time show significant variation with respect to diameter of shoot. The maximum shoot diameter was shows in (G₂T₃) cleft grafting in 1st week of February (8.7mm). The better shoot diameter with optimum time and methods under polyhouse conditions might be due to better bud growth which augmented absorption and translocation of nutrients from soil which take active part in various plant metabolic processes (Singh, 2001). Minimum shoot diameter was recorded in tongue grafting in 1st week of January (6.4mm). It depends on the species.

Number of branch

The data shows that different grafting methods and time show significant effect with respect to number of branches. The maximum number of branch was found under (G₂T₃) cleft grafting in 1st week of February (17.56). Increase in number of branches may be due to better utilization of stored carbohydrates, nitrogen and other factors. In walnut cleft grafting is the commercial method of grafting (Ozkam and Gumus, 2001) [5]. The minimum total number of branch was recorded in cleft grafting 1st week of January (7.25).

Number of leaves

The data shows that different grafting methods and time show significant effect with respect to number of leaves. The maximum number of leaves was shows in (G₂T₃) cleft grafting in 1st week of February (85.59) and minimum number of leaves was recorded in tongue grafting in 1st week of January (27.60).) It may be due to favorable climatic conditions to the higher number of leaves. These results are corroborative with the findings of Mujaffar and Kumar, (2011) [4].

Leaf area (cm²)

The data recorded for average leaf area shows that different grafting methods and grafting time had significant effect on the leaf area. The maximum leaf area (30.55 cm²) was produced under cleft grafting in 1st week of February (G₂T₃) treatment. While the minimum leaf area was recorded under (16.46 cm²) tongue grafting in 1st week of January. It is due to stronger bud union and development of normal vascular tissues at the bud union which regulates the transport of water and nutrients and there by increases the leaf area (Ronting and Pingai, 1993).

Survival of grafted plants (%)

Data regarding percent of plant survival showed that different methods and time had significant effect with plant survival. Maximum plant survival (46%) was recorded with cleft grafting in 1st week of February (G₂T₃) treatment, while minimum plant survival (21%) was observed in tongue grafting in 1st week of January (G₁T₁). The higher success may be due to combined effect of congenial temperature, humidity and active state of scion and stock tissues, during this period which permits maximum regeneration of parenchyma cells in cambium region. Optimum humidity in polyhouse maintains high degree of hydration levels resulting in maximum graft success. These findings are in conformity with the findings of Ebrahimi *et al.* (2006) [1], who obtained better success under polyhouse conditions in walnut.

Saleable plant (%)

Data regarding percent of saleable plant showed that different methods and time had significant effect on the saleable plant. The maximum percentage of saleable plant (93.77%) was recorded under cleft grafting in 1st week of February (G₂T₃). It is due to more attributed to proper and quick union formation and early bud sprouting. While minimum saleable grafted plant (53.67%) was recorded in tongue grafting in 3rd week of January (G₁T₂). It is due to more attributed to not proper and quick union formation and un-healthy plants. (Mujaffar and Kumar, 2011) [4].

Conclusions

Conclusions based on experimental results are as:

- Walnut cv. Govind as a use of scion stock, grafted onto walnut seedling rootstock through cleft grafting showed better results with respect to survivility and most of the plant growth parameters as compared to tongue grafting under polyhouse condition.
- In case of grafting time interval most of the growth parameters showed best results with highest survivility when the plants are grafted on 1st Week of February as compared to 1st Week of January, 3rd Week of January and 3rd Week of February under polyhouse condition.

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