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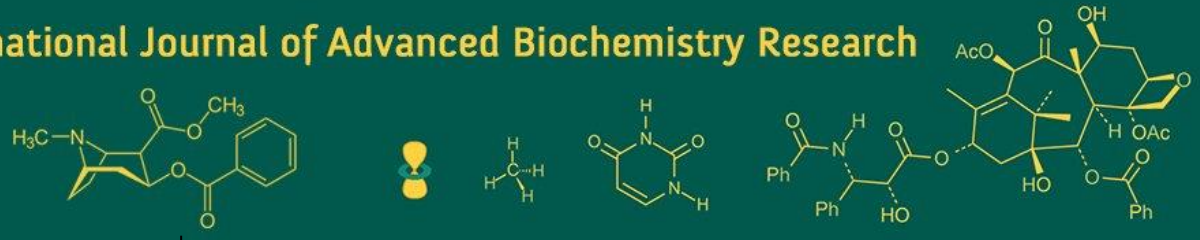

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Assessment and performance of front line demonstrations through improved techniques of grafting in walnut (*Juglans regia*) at district Ganderbal Jammu and Kashmir

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Abstract
On farm trails were conducted on walnut propagation using two different types of scion woods for maximum graft take percentage under both polyhouse as well as in open field conditions during the year 2023 & 2024 at different locations viz on farm as well as farmers field. Two different types viz terminal and basal portions were used for grafting at different levels of timings viz 1st, 2nd week of February in 2X2 factorial CRBD under polyhouse and repeated at 3rd week of Feb. and 1st week of march in 2x 2 factorial RCBD under open field conditions with three replications to standardize portion of scion wood for maximum scion take percentage and feasible timing for walnut propagation in District Ganderbal (J&K). Terminal scion wood in grafting under polyhouse conditions revealed maximum scion take (68.75%) and scion sprouting (63.12%) respectively, whereas type of basal scion wood in grafting recorded scion-take (60.23%), scion sprouting (52.84%) however significantly more than field conditions. Whereas interaction between methods x timings revealed type of terminal scion wood grafting in 2nd week of February showed maximum scion take (73.19%) and scion sprouting(68.90%) significantly higher than First week of February (64.32%) scion take and (57.34%) scion sprouting under Polyhouse conditions. Graft success under open field conditions at interaction of terminal scion wood x first week of march showed significantly higher scion take(63.78%) and scion sprouting (56.98%) comparatively higher than basal type of scion wood grafting at first week of march recorded minimum scion take (59.67%) and scion sprouting (51.89%). Vegetative growth viz. stem diameter (3.69 mm), No. of leaves (4.31), leaflet size (40.66 cm^2), plant height (18.80 cm), were significantly influenced in walnut grafts under polyhouse conditions The results indicate that walnut grafting while using terminal type of scion wood could be economically feasible for vegetative propagation. Wedge Grafting using terminal portion of scion wood performed in 2nd week of February under polyhouse conditions was observed most suitable procedure to propagate walnuts at mass scale under climatic conditions of District Ganderbal. Bud wood taken from selected variety were distributed among progressive walnut nurserymen for successful scion take percentage in second year under front line demonstrations.

Keywords: Terminal, basal, time, walnut and scion type

Introduction
The Persian walnut (*Juglans regia* L.) known as English walnut is the most valuable commercial species in its genus belonging to family Juglandaceae, origin in eastern Europe, Asia minor, extending from Turkey, Iran and western China to eastward to the Himalayan regions. All *Juglans* species are monoecious, with catkins being borne laterally on one year old wood and pistillate flowers borne terminally on current seasons wood. Walnut is rich source of fat (64%) in which 49 percent is polyunsaturated (PUFA) a healthy fat. In India, it is grown in Jammu and Kashmir, Uttar Pradesh and Himachal Pradesh. Jammu Kashmir is principal walnut growing state having monopoly in the production of export quality nuts. The state of Jammu and Kashmir occupies an important position, as for as growing of walnuts is concerned, producing about 85 percent of total production of walnuts of the country, and has monopoly in production of export quality walnuts.

Jammu & Kashmir has an area of about 93641 Hectares with a production of 262167 MT, giving an average productivity of 1.89 metric tones/ha. Among which District Ganderbal UT J&K has an area of 5450 Ha with 22552 MT production (Anonymous, 2022) [1]. The existing plantations in the world are generally of seedling origin and notably variable in production and nut quality (Avanzato, 2001; Vahdati, 2008) [2, 11, 13]. Since entire walnut population of J&K is seedling origin, there is non availability of planting material of known pedigree. Due to higher market demand for quality nuts and increased productivity, satisfactory methods of vegetative production in Persian walnut are needed in order to supply quality planting material. Secondly walnut is hard to propagate due to accumulation of the phenolic compound like 4 hydroxynaphthoquinone (Juglone) is more harmful for growth of walnut callus formation (Solar *et al*., 2001; Ozkan *et al*., 2001) [14, 9] Temperature and humidity and portion of scion wood have major effects on the process of walnut graft union. Specially changing in temperature, time of grafting and type of scion wood used has direct effect on callus development and successful grafting percentage and Best temperature for walnut grafting is 25-27 °C (Vahdati, K. 2006) [11, 13]. To achieve highest graft success percentage in order to provide quality planting material to the growing farmers of district Ganderbal. Due to these facts availability of quality planting material to the farmers is not adequate as per the demand. The On farm trial was carried for as assessment at different level of temperatures for maximum graft success percentage in order to develop quality planting material of known pedigree using different types of scion woods and different timing for vegetative propagation for higher percentage of graft success.

Materials and Methods

On farm assessment trial was carried out at polyhouse as well as open field conditions to evaluate techniques of using different types of scion wood on rootstocks viz. Terminal and basal type scion woods at different timing, viz. first week of February, 2nd week of February under poly house and 3rd week of February and 1st week of March in open field conditions (Tables 1 and 2). Experiment under different environmental conditions was carried out at the Campus of KVK farm field SKUAST-Kashmir under polyhouse conditions and different locations of farmers field under open conditions. in district Ganderbal. The experimental site is located at Latitude. 34.1955° and Longitude. 74.825°E with average elevation of 1612 m. Walnut seeds were sown in black polythene bags (45.72 × 22.86 cm) containing mixture of soil, FYM and sand (2: 1: 1). One year old seedling was raised from thick shelled nuts were used as rootstock in on farm trial. The seedling rootstock of 1-1.5 cm thickness were utilized for grafting purpose. The scion material was taken from identified healthy walnut mother orchard. The bud sticks used for grafting were one year old of two different cuts viz terminal and basal end shoots. The scions were collected from mother trees during dormancy and they were stored in a refrigerator until the time of grafting. The scion was 10-15 cm long with 3-4 buds for terminal portion and 2-3 buds for basal ends. The basal end was cut in a long gently sloping wedge of 5 cm long, then inserted in the split of stock, wrapped with polyethylene strips. The polyhouse used under experiment was made of simple iron structure covered with white polythene. To provide the suitable relative humidity for the success of walnut grafts, water was sprayed once or two times a day. In open field conditions, natural environment prevailed. The experiment was laid in factorial CRBD under polyhouse and 2x 2 factorial RCBD in open field conditions. Next year assessed type of bud wood was also distributed among the progressive orchardists for multiplication of walnut quality planting martial through Front line Demonstrations.

Results and Discussion

The data on the graft-take success in walnut under polyhouse and open field conditions are given in tables 1, 1.1 and 2, 2.1. Results revealed that scion take and sprouting success percentage in walnut was significantly influenced by using type of scion woods and grafting on different timings. Terminal type of scion through wedge grafting performed on 2nd week of February recorded maximum scion take (73.19%) and scion sprouting (63.12%), followed by (63.25%) and (56.34%) with grafting using basal type of scion wood performed at 2nd week of February under poly house conditions. While as grafting in open field conditions showed success which was statistically non significant. The success percentage obtained on wedge grafting using terminal end of bud wood performed at first week of march under open field conditions recorded scion take (61.61%) and scion sprouting (55.27%) was statistically significant. However minimum scion take (58.61%) and scion sprouting (50.11%) was recorded in grafting using basal type of scion wood performed at 1st week of March under open field conditions (table 2). Terminal type grafts x first week of march interaction recorded scion take 63.78 and scion sprouting 55.27 comparatively higher success percentage than February third week might be due to fact that temperature and relative humidity favored movement of auxins available at apex end for establishment and continuity of vascular tissues leaded to graft success. The results are in conformity with Duman and Serdar (2006) [20] who reported that 55 percent scion sprouting was observed in chestnut when grafting was performed under controlled conditions. Higher percentage of scion sprouting was observed in grafting performed with terminal type of scion wood in ploy-house conditions at second week of February when compared grafting with basal type of scion wood performed during February first week, the results are in agreement with, who reported that wedge grafting as superior method in order to achieve maximum grafting success. However Rezaee and Vahdati (2008) [11, 13] have reported that time of grafting affects grafting success percentage. Whereas Gandev S (2009) [5] reported that wedge grafting in walnut recorded maximum graft success percentage performed during last week of January under poly house conditions and lowest during 4th week of February under open field conditions. Balata *et al*. (1996) [3] who reported that the change of temperature and relative moisture especially during and after grafting directly affects the development of a good graft union in walnut. The comparatively lower percentage of success in grafting performed in the month of February third week on walnut rootstocks in field conditions using basal type scion wood in comparison to the March grafting with same type of scion wood might due to the fact that in February tissue attains active growth and loses their tolerance to injury. These results are in agreement with Rongting and Pinghai (1993)

[21] who reported that walnut callus quality and formation plays important role in grafting success. Lowest scion sprouting 44.16 percent was recorded in tongue grafting performed at 1st week of March Table-2. This could be due to improper lining up of cambial layers of rootstock and scion, role of critical requirement of temperature and relative humidity for successful scion sprouting. The results in agreement with Millikan (1984) who have found optimum temperature as 27 °C (±3.5 °C) in walnut for callus formation. Karadeniz (2005) [7] reported that graft take is affected by relative moisture and temperature. The studies of Gandev and Dzhuvino (2009) [5] also supports the fact that walnut grafting is successful in controlled conditions than in open field conditions. The data (table-1.1) further reveals that interaction between terminal type x 2nd week of February (Time) have influenced Stem diameter (3.33 mm) of walnut grafts, No. of leaves (4.09), Leaflet size (40.66 cm^2) and Overall height (18.80 cm) recorded under polyhouse conditions statistically significant when compared with growth of walnut grafts (table-2.1). in open field conditions. This might be due fact that optimum temperature and relative humidity under reasi conditions. The results are in agreement with (Zaen *et al*., 2011) [22] who Reported that pistachio trees grafted by cleft or side grafting methods in January gave higher significant number of shoots than from the trees which were grafted by the same method in February date in both studied seasons. Suk-In *et al* 2006. Vegetative growth of the walnut grafts were also influenced significantly under polyhouse conditions comparatively vigorous to open conditions.

Table 1: Effect of portion of scion wood on grafting success under polyhouse conditions

Parameters	Scion take (%)			Scion Sprouting (%)			Stem diameter (mm)		
Grafting Methods	Grafting Time		Mean	Grafting Time		Mean	Grafting Time		Mean
	T_1	T_2		T_1	T_2		T_1	T_2	
Terminal	64.32	**73.19**	**68.75**	57.34	**68.9**	**63.12**	2.98	3.69	3.33
Basal	57.21	63.25	**60.23**	49.34	56.34	**52.84**	3.12	3.43	3.27
Mean	**60.76**	**68.22**					3.05	3.56	
CD (p<0.05)	Method (M) = 2.67 Time (T) = 3.54 (MxT) = 3.95			Method (M) =1.88 Time (T) = 2.79 (MxT) = 3.16			Method (M) = 0.02 Time (T) = 0.11 (MxT) =0.17		

T_1= 1st week of February, T_2= 2nd week of February

Table 1.1: Effect of portion of Scion wood on Growth of walnut grafts under polyhouse conditions.

Parameters	No. of leaves			Leaflet size (cm^2)			Overall height (cm)		
Grafting Methods	Grafting Time		Mean	Grafting Time		Mean	Grafting Time		Mean
	T_1	T_2		T_1	T_2		T_1	T_2	
Terminal	3.88	4.31	4.09	39.22	42.11	40.66	18.43	19.31	18.8
Basal	3.31	4.11	3.71	35.1	37.2	36.15	17.54	18.23	17.88
Mean	3.60	4.21		37.16	39.655		17.985	18.77	
CD (p<0.05)	Method (M) = 0.15 Time (T) = 0.19 (MxT) = 0.21			Method (M) = 0.98 Time (T) = 1.15 Method*Time (M*T) =1.47			Method (M) = 0.25 Time (T) = 0.33 MxT = 0.39		

T_1= First week of February, T_2= Second week of February

Table 2: Effect of portion of scion wood on grafting success under open conditions

Parameters	Scion take (%)			Scion Sprouting (%)			Stem diameter (mm)		
Grafting Methods	Grafting Time		Mean	Grafting Time		Mean	Grafting Time		Mean
	T_1	T_2		T_1	T_2		T_1	T_2	
Terminal	59.45	63.78	61.61	53.56	56.98	55.27	2.97	3.45	3.21
Basal	57.56	59.67	58.61	48.34	51.89	50.11	2.7	3.23	2.96
Mean	58.51	61.72		50.95	54.43		2.83	3.34	
CD (p<0.05)	Method (M) = 1.18 Time (T) = 2.05 (MxT) =2.23			Method (M) = 2.77 Time (T) = 2.85 (MxT) = 3.09			Method (M) = 0.19 Time (T) = 0.28 (MxT) = 0.35		

T_1= 3rd week of February, T_2=1st week of March

Table 2.1: Growth of walnut grafts under open field conditions.

Parameters	No. of leaves			Leaflet size (cm^2)			Overall height (cm)		
Grafting Methods	Grafting Time		Mean	Grafting Time		Mean	Grafting Time		Mean
	T_1	T_2		T_1	T_2		T_1	T_2	
Terminal	3.56	4.19	3.87	41.45	45.56	43.50	17.9	18.34	18.12
Basal	3.78	2.9	3.34	37.89	39.06	38.47	17.56	17.98	17.77
Mean	3.67	3.54		39.67	42.31		17.73	18.16	
CD (p<0.05)	Method (M) = 0.10 Time (T) = 0.05 MxT=0.13			Method (M) = 1.88 Time (T) = 2.09 MxT = 2.54			Method (M) = 0.39 Time (T) = 0.45 MxT = 0.77		

T_1= 3rd week of February, T_2=1st week of March

Conclusion

The wedge grafting using terminal portion of scion wood performed on second week of February under polyhouse conditions gave highest scion sprouting percentage, however growth was also seen in grafts with basal end of scion wood and more than 70 percent plants attain a saleable size in a year. The terminal portion of scion wood with terminal type of scion wood method of grafting in second of February is recommended for commercial multiplication of nursery plants of walnut under protective conditions and front line demonstrations.

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