Indian Journal of Agricultural Sciences **84** (2): 205–8, February 2014/Article
https://doi.org/10.56093/ijas.v84i2.38032

Effect of grafting time on graft success of walnut (*Juglans regia*) in zero energy polyhouses

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Received: 27 June 2012; Revised accepted: 3 January 2014

ABSTRACT

This study was carried out during three successive seasons (2009, 2010 and 2011) on walnut (*Juglans regia* L.) seedlings. Grafting was done by wedge methods on nine dates (5 January, 15 January, 25 January, 5 February, 15 February, 25 February, 5 March, 15 March and 25 March). The pooled data showed that, highest success percentage of grafting was obtained on 25 January and lowest was recorded on 25 March. The maximum number of shoots/scion and leaves/scion was observed on 25 January. The highest value for scion diameter (0.94cm) was found on seedlings grafted on 25 January while as lowest scion diameter of 0.45cm from grafts, grafted on 25 March. The highest proportion of salable plants was observed on 15 January and lowest proportion was found on 25 March. Our results also suggest that January grafting produces better bud-take, number of leaves and scion growth as compared with February and March grafting. Therefore, the best time for grafting is January under polyhouse conditions.

Key words : Date of grafting, Environment, Polyhouse, Propagation, Wedge grafting

Persian walnut (*Juglans regia* L.) is one of the main nut crops in Central Asia, and is especially important in India. It is extensively grown almost in all the temperate countries of world where the summers are not too cool or too hot. 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. In Jammu and Kashmir, is presently grown on an area of 89 788 ha with annual production of 163 745 Million tonnes (Anonymous 2011). The existing plantations in the world are generally of seedling orgin and notably variable in production and nut quality (Ozkan *et al.* 2001). Selections of promising walnut cultivars in these populations along with the market demand for better quality products have increased interest in vegetative propagation of this species (Vahdati 2003). Walnut trees are more difficult to graft than most of other fruit trees (Ozkan and Gumus 2001) and poor grafts take has always been considered a drawback in mass propagation of superior walnut selections (Ozkan *et al.* 2001, Vahdati 2003). Environmental conditions during and after grafting, have a major impact on callus formation in walnut (Avanzato and Atefi 1997). Optimally, the temperature should be maintained at about 27°C after grafting for better callus formation and graft success in walnut (Germain 1998, Reil *et al.* 1998). Accordingly, outdoor grafting is always restricted by the time of year when such favorable temperatures can be expected (Karadeniz 2005, Hartmann *et al.* 2001). Different techniques of grafting have been examined by several researchers to improve the temperature and humidity effects by using controlled environmental conditions (Achim and Botu 2001, Avanzato 2001), however, most of these methods were inefficient, expensive, and not applicable on a large scale. The wedge grafting method is one of the best methods of propagation for fruit trees in nurseries. The best time to wedge grafting is dormant season before growth starts. El-Sayed *et al.* (2000) which have been found to be quite successful in the month of February, when both the stocks and scions were in dormant conditions. Abou-taleb *et al.* (2011) carried experiment on vegetative propagation of pecan as date of grafting (24 February or 2 March), graft wood storage (without storage or storing at 5°C for two weeks), position of grafting zone (above-ground or covered with soil) and scion cultivar by using cleft grafting method under shaded polyethylene tunnel. Neplus ultra with cleft grafting method in December gives higher success percentage and enhances scion activity. Callus tissue filled the internal air pockets between stock and scion (Abou Rayya *et al.* 2009).

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Both state agriculture university (SKUAST-K) and Department of Horticulture of J and K Government, Srinagar are making full efforts in developing technologies for mass multiplication of vegetatively propagated plant material. The demand for the grafted/budded plant material is increasing day by day within the state and from outside the state as well. The best technique to increase the production of grafted plant material is to adopt vegetative propagation under polyhouses. Keeping in view the importance of increasing the demand of grafted plants, the present study was conducted to compare the efficiency of walnut grafting time under green house conditions for producing walnut plants in different months of a year and in different areas than those currently in use.

MATERIALS AND METHODS

An experiment to study the effect of grafting time on grafting success in walnut (*Juglans regia* L.) under controlled environmental conditions was carried out at the experimental field of Division of Fruit Science, Shalimar Campus of Sher-e-Kashmir University of Agricultural Sciences and Technology, Kashmir during three consecutive years 2009, 2010 and 2011. The experimental site is located at an elevation of 1 587 m above mean sea level and situated at 34.08° North latitude and 74.08° East longitude. The experiment was carried out under polyhouse and method of grafting, viz wedge but with different timing, viz 5 January, 15 January, 25 January, 5 February, 15 February, 25 February, 5 March, 15 March and 25 March. The seedlings of walnuts having pencil size thickness or more were transplanted in all the polyhouses. The scion material was collected from elite sources already identified trees. The scion was 10-15 cm long with 3-4 buds. 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 and covered with grafting wax. Temperature and humidity were maintained in all the polyhouses during all the consecutive years. Since temperature and humidity have crucial effects on the healing process, they were recorded during the experiment using a maximum-minimum thermometer and a hygrometer, respectively (Table 1). Percentage of union success for the grafting was recorded one month after each date. Number of shoots and number of leaves per scion were counted in August. Mean shoot length and scion diameter (5cm above grafting union) were measured in August. The experiment was laid in a Completely Randomized Design (CRD) using three replications. Statistical analyses were conducted using the SAS and means were compared by critical difference (CD) at 0.05.

RESULTS AND DISCUSSION

Results revealed (Table 2) that union success percentage in walnut was significantly affected by grafting dates. Maximum grafting success 74.40% was recorded 25 January, followed by 72.17% on 5 January. The success percentage obtained on 25 January was statistically significant with all grafting dates but was at par with that of 5 January. However minimum success percentage (46.65) was observed on 25 March. The successful grafted plants are shown in Fig 1. The comparatively lower percentage of success in March grafting in comparison to the January and February grafting might due to the fact that in March tissue attains active growth and loses their tolerance to injury. These results are partially in harmony with the finding of EL-Sayed *et al.* (2000) on pecan trees and Abou- Rayya *et al.* (2009) on almond cv. Neplus ultra. Data in Table 1 showed January grafting gave significantly higher number of shoots than from the seedlings which were grafted in February and March. The highest number of shoots/scion (4.12) was observed from seedlings which were grafted on 5 January and were statistically significant from rest of treatment dates while as lowest number of shoots/scion (1.85) was observed from seedlings

Fig 1 Successful grafted plants under zero energy polyhouse

Table 1 Average temperature (°C) and relative humidity (%) in greenhouse and outside

Month	Greenhouse temperature			Outside temperature			Greenhouse humidity			Outside humidity		
	2009	2010	2011	2009	2010	2011	2009	2010	2011	2009	2010	2011
January	14.82	17.33	15.22	4.12	4.37	1.93	42.60	43.23	44.66	81.24	73.06	81.88
February	16.86	18.23	14.33	5.72	4.61	4.86	51.10	56.45	49.11	74.35	75.44	79.02
March	19.54	24.44	18.34	9.68	12.26	9.54	58.13	67.45	55.60	67.46	62.58	63.70
April	21.91	26.22	23.60	13.42	13.65	11.92	56.11	65.22	68.70	65.52	69.53	67.83
May	27.10	28.11	27.66	16.95	15.86	18.88	78.39	77.81	70.74	62.67	71.34	55.61

Table 2 Effect of grafting time on graft success, number of shoots and number of leaves in polyhouse

Time of grafting	No of plants grafted			No of successful grafts			Success (%)			Pooled success (%)	No of shoots/scion			Pooled No. of shoots/scion	No of leaves/scion			Pooled No. of leaves/scion
	2009	2010	2011	2009	2010	2011	2009	2010	2011		2009	2010	2011		2009	2010	2011	
5 January	147	247	347	101	186	266	68.50	75.50	72.50	72.17	4	6	4.12	4.71	35	38	39	37.33
15 January	176	376	276	124	265	209	70.37	70.27	75.37	72.00	3.5	4.5	3.22	3.74	29.40	34.40	31.40	31.73
25 January	174	274	175	132	196	127	75.45	71.41	76.35	74.40	3.22	5.23	4.5	4.32	42	44.23	42.89	43.04
5 February	200	250	230	127	156	158	63.35	62.47	68.27	64.70	3.08	3.78	2.88	3.25	26.70	32	36.23	31.64
15 February	230	210	260	135	109	140	58.52	51.49	53.50	54.52	2.71	2.91	3.21	2.94	24.23	33.43	33.32	30.33
25 February	140	190	170	71	104	87	50.57	52.57	50.87	51.34	1.29	2.29	2.69	2.09	27.11	31.17	35.15	31.14
5 March	179	129	179	89	63	90	49.40	48.40	49.80	49.20	2.02	2.52	2.72	2.42	22.12	25.21	23.23	23.52
15 March	184	124	284	85	60	159	45.83	47.82	51.80	48.49	1	1.83	1.85	1.56	21.12	27.78	25.27	24.72
25 March	173	153	373	81	66	189	46.63	42.67	50.65	46.65	2	2.10	2.02	2.04	22.43	28.69	22.82	24.65
SEM±							0.81	0.76	0.83	0.83	0.03	0.04	0.03	0.03	0.42	0.43	0.42	0.42
CD (P=0.05)							2.4	2.5	2.81	2.61	0.09	0.14	0.11	0.10	1.32	1.41	1.40	1.36

Table 3 Effect of grafting time on scion diameter and number of salable plants in polyhouse

Time of grafting	No. of plants grafted			No of successful grafts			Scion diameter (cm)			Pooled scion diameter (cm)	No of salable plants (%)			Pooled No. of salable plants (%)
	2009	2010	2011	2009	2010	2011	2009	2010	2011		2009	2010	2011	
5 January	147	247	347	101	186	266	o.90	0.89	0.90	0.90	59.33	58.33	58.32	58.66
15 January	176	376	276	124	265	209	0.81	0.91	0.81	0.84	62.35	51.32	64.21	59.43
25 January	174	274	175	132	196	127	0.93	0.95	0.93	0.94	64.12	65.22	68.22	65.85
5 February	200	250	230	127	156	158	0.53	0.55	0.63	0.57	56.29	60.10	65.29	43.89
15 February	230	210	260	135	109	140	0.54	0.45	0.52	0.50	49.23	46.77.	57.23	50.74
25 February	140	190	170	71	104	87	0.51	0.52	0.49	0.51	48.88	42.12	51.45	47.48
5 March	179	129	179	89	63	90	0.52	0.43	0.53	0.49	46.13	42.15	48.11	45.46
15 March	184	124	284	85	60	159	0.49	0.41	0.51	0.47	36.23	37.23	47.26	40.24
25 March	173	153	373	81	66	189	0.43	0.44	0.48	0.45	32.37	33.32	44.27	36.65
SEM±							0.003	0.003	0.003	0.003	0.71	0.61	0.82	0.68
CD (P=0.05)							0.01	0.01	0.01	0.01	2.20	1.92	2.52	2.21

which were grafted on 15 March. Zaen El-Deen and Abd El-Rhman (2011) 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 (2010 and 2011) which support our findings. Regarding, number of leaves highest values (43.04) was recorded from seedlings which were grafted on 25 January followed by 37.33 on 5 January while the lowest number 23.52 was observed seedlings grafted on 5 March.

Data in Table 3 indicated that scion diameter was significantly influenced by grafting dates. The maximum scion diameter of 0.94 cm was observed from seedlings grafted on 25 January which is statistically superior from rest of grafting dates while as minimum of 0.45 cm was recorded from seedlings grafted on 25 March. Data on number of salable plants (%) presented in Table 3 revealed that the salable percentage of plants were significantly influenced by time of grafting. The highest proportion of saleable plants (59.43) was obtained when grafting was performed on 15 January and was statistically at par with the seedling grafted on 5 January while as lowest proportion of saleable plants (36.65) was obtained when grafting was performed on 25 March. The highest number of shoots, leaves, scion diameter and proportion of salable plants might be due to quick union formation, early bud sprouting and availability of long period of growth of the grafts. These results are partially in harmony with the finding of EL-sayed *et al.* (2000) on pecan trees, Muzaffar and Ajay Kumar (2011) on walnut and Zaen El-Deen and Abd El-Rhman (2011) on pistachio trees. Our results also suggest that January grafting produces better bud-take, number of leaves and scion growth as compared with February and March grafting.Therefore, the best time for grafting of walnut is January under polyhouse condition.

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