



## Standardization of efficient propagation technique for production of quality planting material in walnut

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### ABSTRACT

To standardize the efficient propagation techniques of walnut an experiment was carried out to find out the ideal combination of environment, grafting method, time of grafting and scion type for optimum graft success with three types of scion (top, middle and bottom portion of one-year-old shoot), two grafting methods (wedge and tongue), four time of grafting (15<sup>th</sup> February, 1<sup>st</sup> March, 15<sup>th</sup> March and 1<sup>st</sup> April) and three environmental conditions (polyhouse, polytrench and open field). The middle portion of scionwood was found superior in graft success (56.39%) and plant growth (154.86 cm). Wedge grafting recorded the higher graft success (52.45%) and plant height than tongue grafting, whereas, polyhouse recorded the highest bud sprouting (65.50%) and graft success (54.46%). Among the time of grafting, the highest graft success (57.99%) was recorded with 15<sup>th</sup> March. The highest graft success (90.00%) was found in wedge grafting with middle portion of scion performed on 15<sup>th</sup> of March under polyhouse environmental conditions, thus can be used for mass multiplication of walnut under Kashmir valley.

**Key words:** Environmental condition, grafting time, *Juglans regia*, scion wood type.

### INTRODUCTION

The majority of walnut plantations in India are of seedling in origin. They have long juvenile period besides low productivity and large variability in term of quality traits like shape, size and colour of nuts as well as kernels, which is a great concern for our walnut industry. Production of vegetatively propagated walnut plants are much tricky and difficult mainly due to low rate of callus formation (Kruniyuki and Forde, 7; Coggeshall and Beineke, 2). This is attributed to the presence of high phenol content in its tissue and sensitive to oxidation browning at wounds (Rangting and Pinghai, 10). The variable degree of graft success in walnut has been reported in different method of vegetative propagation around the world (Gandev, 4). The success of any method of grafting depends on the environmental conditions of respective regions. Thus standardization of environment, grafting method and time, type of scionwood to be used is pre-requisite for maximum graft success in walnut.

### MATERIALS AND METHODS

The experiment was carried out at experimental farm of ICAR-CITH, Srinagar, (J&K) during 2008 & 2009 in Factorial Randomized Block Design with three replications. There were 72 treatment combinations comprising of two grafting methods, *i.e.*, wedge and tongue grafting, four grafting times (15<sup>th</sup> February, 1<sup>st</sup>

March, 15<sup>th</sup> March and 1<sup>st</sup> April), three scion wood types (top, middle and bottom portion of one-year-old shoot) with three environmental conditions (poly trench, open field and polyhouse conditions). Two-year-old seedling rootstock with uniform growth and thickness (1.5-2.0 cm dia.) were used for grafting. Wedge and tongue grafting methods were performed at 15 cm above the ground level on rootstock on four different dates at 15-day interval with three portions of scion shoot (top, middle and bottom) having four to five vegetative buds. The 400 gauge alkathene strips were used as tying material on graft union. The 100 plants were used for each treatment combination grown with uniform cultural operations. The temperature and humidity under polyhouse and poly trench was maintained at 25 ± 2°C and 80-85%, respectively by intermittent misting and using 50% shading nets. The mean of maximum and minimum humidity (%) and temperature of two years during the experimentation period are presented in Fig. 1&2. The sprouting percentage on scion stick was recorded after 45 days of grafting, whereas, graft success, plant height and number of leaves/ plant were recorded when plants started recessing their growth at the end of growing season. The pooled two year data was analyzed as per method suggested by Gomez and Gomez (5) using R software.

### RESULTS AND DISCUSSION

Different environmental conditions significantly influenced the graft sprouting, graft success and plant

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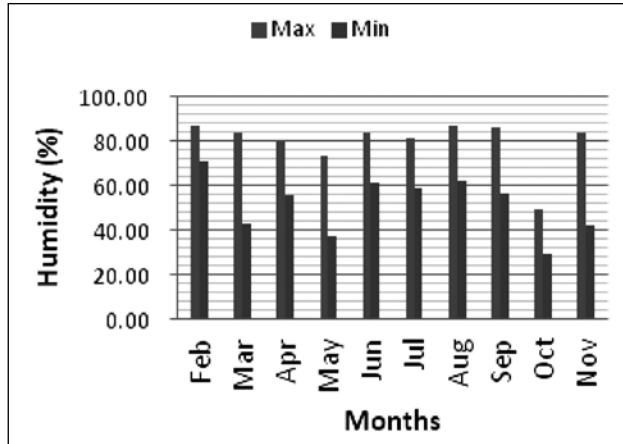


Fig. 1. Mean maximum and minimum humidity (2008 & 2009) at Srinagar J&K.

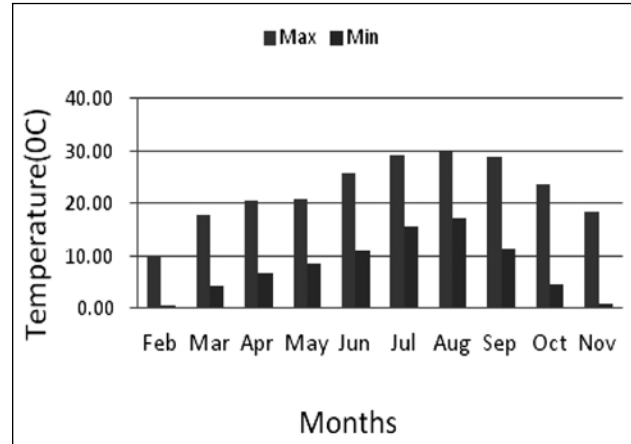


Fig. 2. Mean maximum and minimum temperature (2008 & 2009) at Srinagar J&K.

growth parameters. The highest sprouting (65.50%) with high graft success (54.46%), plant height (168.75 cm) and number of leaves/ plant (120.06) were recorded in polyhouse closely followed by polytrench with (61.94%) sprouting, 52.17% graft success, 154.57 cm height and 119.19 leaves/ plant (Fig. 3). The maximum graft success under polyhouse conditions may be due to congenial environment, which helps in new parenchymatus callus proliferation between rootstock and scion (Hartman *et al.*, 6). Grafting methods affected the graft sprouting, graft success and plant growth significantly. The better sprouting was found in wedge grafting (62.22%) with higher graft success (52.45%) more plant height (151.54 cm) and more number of leaves/plant (116.73) as compared to tongue grafting, *i.e.* bud sprouting (59.32%), graft success (50.54%), plant height (150.14 cm) and No. of leaves/ plant (116.19), respectively (Fig. 4). This may be attributed to better union between scion and rootstock in wedge as compared to tongue grafting. These results are in conformity with the findings of Singh *et al.* (11).

Grafting time also affected the graft sprouting, graft success and plant growth significantly. The grafting on 15<sup>th</sup> March recorded the maximum sprouting (71.11%), graft success (57.99%), plant height (163.78 cm) and number of leaves/ plant (133.24) closely followed by 15<sup>th</sup> February irrespective of other factors (Fig. 5). This might be due to the rapid regeneration of the cambium tissues of scion and rootstock and their intermingling result of activation of scion and rootstock hormonal and energy producing nutrients at ideal temperature, which occurs from 2<sup>nd</sup> fortnight of March in polyhouse and sometimes in open conditions under Kashmir valley. These results are corroborative with the findings of Porebsiki *et al.* (9).

Scionwood portion also influenced significantly bud sprouting, graft success and plant growth. The middle portion of scion wood recorded the highest sprouting (68.56%), graft success (56.39%), plant height (154.86 cm) and number of leaves/ plant (121.61) (Fig. 6). This may be attributed to

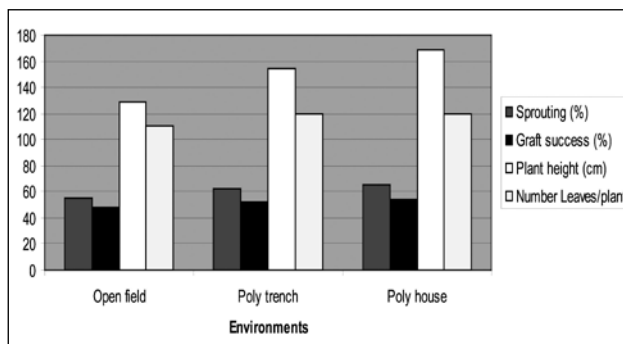


Fig. 3. Effect of environment on sprouting, graft success, plant height and number of leaves in walnut.

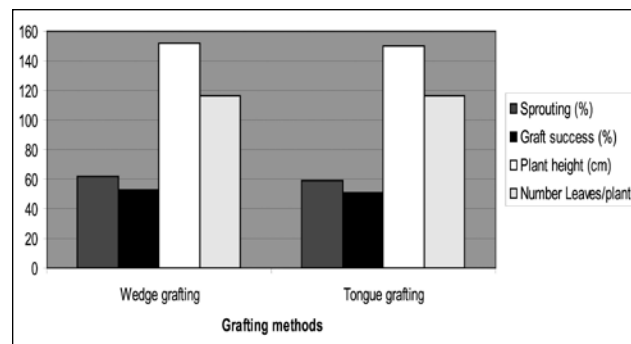


Fig. 4. Effect of grafting methods on sprouting, graft success, plant height and number of leaves in walnut.

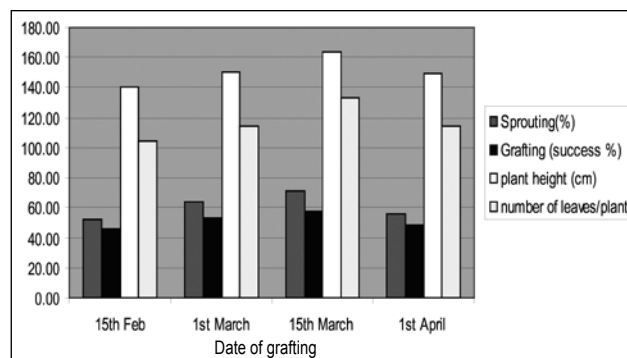


Fig. 5. Effect of grafting time on bud sprouting, graft success and plant growth in walnut.

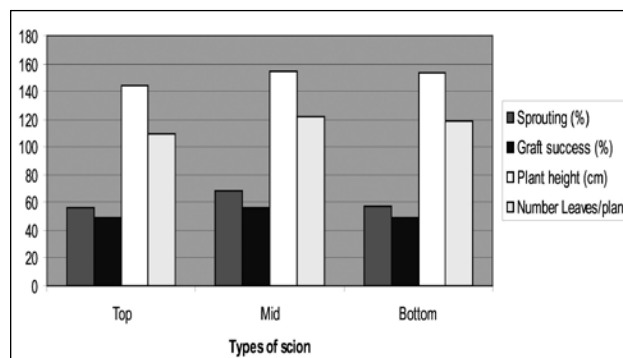


Fig. 6. Effect of scion types on sprouting, graft success, plant height and number of leaves in walnut.

balanced C: N ratio scion wood, which is responsible for maximum parenchyma cell proliferation and intermingling of union, which ultimately results in better union and plant growth (Hartmann *et al.*, 6). Interaction of grafting method and scion type significantly affects the bud sprouting, graft success and plant growth. Wedge grafting with middle portion of scion recorded the highest bud sprouting (71.11%), graft success (41.39%) and plant height (156.44 cm), whereas, maximum number of leaves/plant (123.37) was recorded with tongue grafting and middle portion of scion (Tables 1 & 2). Further the interaction of grafting method and environment influenced the bud sprouting, graft success and plant growth. The highest sprouting (69.72%), graft success (43.33 %) and plant height (169.06 cm) was observed with wedge grafting under polyhouse conditions (Tables 1 & 2). Interaction of grafting time and environment influenced the bud sprouting, graft success and plant growth, significantly.

Highest sprouting (73.51%), graft success (62.40%) and number of leaves /plant (121.55) was recorded with 15<sup>th</sup> March grafting under polyhouse conditions (Tables 1 & 2). This may be due to naturally active state of scion and rootstock tissues and especially the cambium layer during this period coupled with the conducive temperature and humidity under polyhouse, which permits maximum regeneration of parenchyma cells in cambium region and maintains high degree of hydration levels resulting in high graft success by permitting the active graft area for longer period. These findings are in conformity with the findings of Ebrahimi *et al.* (3). Interaction effect of grafting methods, scion type, grafting time and environment showed significant effect on sprouting percent, graft success and plant growth. Wedge grafting with middle portion of scion grafted on 15<sup>th</sup> March under polyhouse conditions recorded the highest sprouting (94.44%), graft success (90.00%)

Table 1. Effect of different environmental conditions, scion type, grafting method and time in walnut.

Treatment			Sprouting (%)				Graft success (%)			
Grafting method	Scion	Time	Polytrench	Open	Polyhouse	Mean	Polytrench	Open	Polyhouse	Mean
Wedge grafting	Top	15 <sup>th</sup> Feb	47.77	44.44	52.22	48.14	23.33	8.89	23.33	18.52
		1 <sup>st</sup> March	66.66	51.11	64.44	60.74	32.22	12.22	42.33	29.26
		15 <sup>th</sup> March	64.44	57.78	68.89	63.70	43.33	14.44	50.00	35.92
		1 <sup>st</sup> April	50.00	46.66	65.55	54.07	26.66	10.00	38.89	25.18
	Mean		57.22	50.00	62.78	56.67	31.39	11.39	37.89	27.22
Middle	Middle	15 <sup>th</sup> Feb	63.33	52.22	65.55	60.37	30.00	14.44	30.22	25.55
		1 <sup>st</sup> March	80.00	64.44	77.78	74.07	50.00	18.89	55.67	41.85
		15 <sup>th</sup> March	86.66	67.77	94.44	82.96	67.78	23.33	90.00	60.37
		1 <sup>st</sup> April	63.33	62.22	75.55	67.03	41.11	17.77	52.44	37.77
	Mean		73.33	61.66	78.33	71.11	47.22	18.61	53.19	41.39

Contd...

Table 1 Contd...

Treatment			Sprouting (%)				Graft success (%)			
Grafting method	Scion	Time	Polytrench	Open	Polyhouse	Mean	Polytrench	Open	Polyhouse	Mean
	Bottom	15 <sup>th</sup> Feb	53.33	45.55	60.00	52.96	22.22	10.00	25.66	19.63
		1 <sup>st</sup> March	63.33	52.22	66.66	60.74	36.66	14.44	46.66	32.59
		15 <sup>th</sup> March	70.00	60.00	76.66	68.89	50.00	14.44	57.77	40.74
		1 <sup>st</sup> April	48.88	41.11	68.89	52.96	25.55	12.22	43.33	27.03
Mean		58.89	49.72	68.05	58.89	33.61	12.77	42.61	30.00	
Sub-mean		63.14	53.79	69.72	62.22	32.85	14.21	43.33	32.87	
Tongue grafting	Top	15 <sup>th</sup> Feb	44.44	46.66	48.89	46.66	22.22	8.89	20.00	17.03
		1 <sup>st</sup> March	64.44	54.44	61.11	60.00	23.22	12.33	41.11	28.88
		15 <sup>th</sup> March	72.22	61.11	66.66	66.66	43.33	13.33	47.77	34.81
		1 <sup>st</sup> April	53.33	45.55	54.44	51.11	28.89	8.88	31.11	22.96
Mean		58.61	51.94	57.78	56.11	29.41	10.11	35.00	25.92	
	Middle	15 <sup>th</sup> Feb	60.00	54.44	57.77	57.40	31.11	16.66	27.77	25.18
		1 <sup>st</sup> March	68.88	66.66	73.33	69.62	43.33	17.77	46.66	35.92
		15 <sup>th</sup> March	76.66	75.55	82.22	78.14	64.44	20.00	74.44	52.96
		1 <sup>st</sup> April	64.44	52.22	60.00	58.89	41.11	18.89	43.33	34.44
Mean		67.50	62.22	68.33	66.02	45.00	18.33	48.05	37.13	
	Bottom	15 <sup>th</sup> Feb	44.44	46.66	45.55	45.55	23.33	11.11	25.55	20.00
		1 <sup>st</sup> March	59.99	54.44	70.00	61.48	35.55	14.44	37.11	29.03
		15 <sup>th</sup> March	65.55	63.33	52.22	60.37	52.22	16.66	54.44	41.11
		1 <sup>st</sup> April	54.44	50.00	57.78	54.07	31.11	11.11	34.44	25.55
Mean		56.11	53.61	68.29	59.34	35.55	14.26	40.20	28.92	
Sub-mean		60.74	55.92	61.62	59.85	36.65	14.23	41.08	40.31	
CD at 5%					-					
Environment		1.03			-		2.00		-	
Graft method					-				-	
Graft time					-				-	
Scion type					-				-	
Env. × Graft method					-				-	
Env. × Graft time					-				-	
Env. × Scion		5.71 2.86	5.71 2.86		-				-	
Graft method × Scion		5.59 2.79	5.59 2.79		-		3.45		-	
Scion × Time							5.43			
Env. × Graft method × Time				5.71		3.45		3.45		
Env. × Graft method × Time × Scion type				5.59		5.43		5.43		

*Standardization of Propagation in Walnut*

**Table 2.** Effect of different environmental conditions, scion type, grafting methods and time on vegetative growth of grafted walnut.

Treatment			No. of leaves / plant				Plant height (cm)			
Grafting method	Scion	Time	Polytrench	Open	Polyhouse	Mean	Polytrench	Open	Polyhouse	Mean
Wedge grafting	Top	15 <sup>th</sup> Feb	113.33	97.00	107.33	105.89	140.33	118.67	134.67	131.22
		1 <sup>st</sup> March	116.00	113.33	115.33	114.89	151.33	120.33	148.00	139.89
		15 <sup>th</sup> March	112.67	106.33	139.33	119.44	146.33	134.00	178.33	152.89
		1 <sup>st</sup> April	97.00	124.33	115.00	112.11	161.00	119.00	150.67	143.56
Mean		109.75	110.25	119.25	113.08	149.75	123.00	152.92	141.89	
Mean	Middle	15 <sup>th</sup> Feb	115.00	114.67	102.33	110.67	159.00	126.33	162.67	149.33
		1 <sup>st</sup> March	173.67	127.33	116.67	139.22	175.33	140.00	172.33	162.55
		15 <sup>th</sup> March	115.67	129.00	89.33	111.33	159.33	130.33	201.33	163.66
		1 <sup>st</sup> April	129.25	121.67	97.42	116.11	158.67	119.00	173.00	150.22
Mean		133.40	123.17	101.44	119.33	163.08	128.92	177.33	156.44	
Mean	Bottom	15 <sup>th</sup> Feb	125.00	106.00	124.33	118.44	162.00	148.00	168.33	159.44
		1 <sup>st</sup> March	144.00	117.33	151.67	137.67	163.67	124.00	187.67	158.45
		15 <sup>th</sup> March	100.67	120.00	102.00	107.56	135.33	117.67	189.67	147.56
		1 <sup>st</sup> April	123.67	113.25	119.67	118.86	153.33	126.67	162.00	147.33
Mean		123.34	114.15	124.42	120.63	153.58	129.09	176.92	153.20	
Sub-mean		122.16	115.85	115.03	117.68	155.47	127.00	169.06	150.51	
Tongue grafting	Top	15 <sup>th</sup> Feb	113.67	100.67	125.00	113.11	148.00	115.33	149.00	137.44
		1 <sup>st</sup> March	120.33	117.67	153.33	130.44	155.00	138.00	169.00	154.00
		15 <sup>th</sup> March	119.00	101.67	114.33	111.67	167.00	154.00	178.67	166.56
		1 <sup>st</sup> April	112.25	102.25	125.67	113.39	156.00	125.33	166.00	149.11
Mean		116.31	105.57	129.58	117.15	156.50	133.17	165.67	151.78	
Mean	Middle	15 <sup>th</sup> Feb	120.00	107.33	116.33	114.55	155.67	121.33	153.33	143.44
		1 <sup>st</sup> March	176.00	117.33	132.00	141.78	126.33	170.67	161.33	152.78
		15 <sup>th</sup> March	109.00	105.67	138.00	117.56	156.67	119.00	189.33	155.00
		1 <sup>st</sup> April	126.17	107.58	125.00	119.58	140.33	118.67	175.67	144.89
Mean		132.79	109.48	127.83	123.37	144.75	132.42	169.92	149.03	
Mean	Bottom	15 <sup>th</sup> Feb	116.00	106.00	112.33	111.44	146.33	134.00	148.67	143.00
		1 <sup>st</sup> March	112.67	115.33	140.00	122.67	161.00	119.00	163.33	147.78
		15 <sup>th</sup> March	97.00	99.00	146.33	114.11	152.67	126.00	196.33	158.33
		1 <sup>st</sup> April	109.75	105.75	125.33	113.61	159.00	126.33	170.67	152.00
Mean		108.86	106.52	131.00	115.46	154.75	126.33	169.75	150.28	
Sub mean		119.32	107.19	129.47	117.98	152.00	130.64	168.44	150.36	
CD at 5%										
Environment			2.76	2.77	2.78	-	2.79	2.80	2.81	-
Graft method			2.25	2.26	2.27	-	2.28	2.29	2.30	-
Graft times			3.19	3.20	3.21	-	3.22	3.23	3.24	-
Scion type			2.76	2.76	2.76	-	2.76	2.76	2.76	-
Env. × Graft method			2.91	2.91	2.91	-	2.91	2.91	2.91	-
Env. × Graft Time			5.52	5.52	5.52	-	5.52	5.52	5.52	-
Env. × Scion			4.78	4.78	4.78	-	4.78	4.78	4.78	-
Graft method × Scion			3.91	3.91	3.91	-	3.91	3.91	3.91	-
Scion × Time			5.52	5.52	5.52	-	5.52	5.52	5.52	-
Env. × Graft method × Time			7.82	7.82	7.82	-	7.82	7.82	7.82	-
Env. × Graft method × Time × Scion type			13.54	13.54	13.54	-	14.25	14.25	14.25	-

and maximum plant height (201.33 cm) closely followed by tongue grafting with middle portion of scion grafted on 15<sup>th</sup> March under polyhouse 82.22%, 74.44% and 189.33 cm, sprouting, graft success and plant height, respectively. This may be attributed to the firm placement of scion and rootstock components with maximum union surface of cambium region under wedge grafting, balanced carbohydrate and nitrogen ratios and ideal bud maturity in middle portion of scion, active cell regeneration stage in mid of march, conducive temperature and humidity under polyhouse environment, which activates maximum parenchyma cells in cambial layer at higher humidity resulting better union in scion and rootstock and higher growth of plants. These results are in conformity with earlier findings (Bayazit *et al.*, 1; Ozkan and Giimmis, 8). On the basis of above findings wedge grafting with middle portion of scion grafted in mid of March under polyhouse conditions may be recommended for mass clonal multiplication of walnut in Kashmir valley.

## REFERENCES

1. Bayazit, S., Imrak, B. and Kiden, A. 2005. Determination of grafting time and methods of walnut under Adana ecological conditions. *Bance Ceviz*. **34**: 231-34.
2. Coggeshall, M.V. and Beineke, W.F. 1997. Black walnut vegetative propagation: The challenge continues. In: *Knowledge for Future of Walnut*, Sambeek, J.W.V. (Ed.), *Proc., 5<sup>th</sup> Black Walnut Symposium*, Gen Tech. rep. NC-191. St. Paul, MN: U.S. Dept. of Agriculture, Forest Services, North Central Forest, Experiment Sta., pp. 70-77.
3. Ebrahimi, A., Vahdali, K. and Fallahi, E. 2006. Walnut grafting under environmentally controlled conditions. *Int. J. Fruit Sci.* **6**: 8-12.
4. Gandev, S. 2007. Propagation of walnut under controlled temperature by the method of omega bench grafting, hot callus and epicotyl grafting. *Prop. Orn. Plants*, **41**: 105-11.
5. Gomez, K.A. and Gomez, A. 1989. *Statistical Procedures for Agricultural Research* (2<sup>nd</sup> Edn.), John Wiley and Sons, Inc. New York.
6. Hartmann, H.P., Kester, D.E., Davies, F.T. and Geneve, R.L. 1997. Theoretical aspects of grafting and budding. In: *Plant Propagation-Principals and Practices* (6<sup>th</sup> Edn.), Prentice Hall of India Pvt. Ltd., New Delhi.
7. Kruniyuki, A. and Fordi, H. 1985. Walnut propagation. In: *Walnut Orchard Management*, Ronaas, D. (Ed.), Publication 21410, University of California, USA, pp. 38-46.
8. Ozakan Y. and Giimmis, A. 2001. Effect of different application of grafting under controlled conditions of walnut (*Juglans regia* L.). *Acta Hort.* **412**: 187-99.
9. Porebski, S., Rzeznicka, B. and Poniedzialek, W. 2002. Comparison of two methods of walnut grafting. *J. Fruit Orn. Plant Res.* **10**: 55-62.
10. Rangting, X.I. and Pinghai, D. 1993. A study on the uniting process of walnut grafting and factors affecting. *Acta Hort.* **311**: 160-70.
11. Singh, S.R., Srivastava, K.K. and Sharma, M.K. 2008. Hot cable callusing and zero energy polyhouse propagation techniques of walnut. In: *Advances in Temperate Fruit Production*, Banday, F.A. and Sharma, M.K. (Eds.), Kalyani Pub., Ludhiana, pp. 228-31.

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