RESEARCH ARTICLE

OPTIMIZATION OF DIFFERENT PROPAGATING TECHNIQUE AND TIME PERIOD TO ENHANCE HIGHER SUCCESS RATE IN PROPAGATION OF LOW CHILL PEACH CV. SHAN-E-PUNJAB

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Abstract: An experiment was conducted to study the propagation of low-chill peaches in *Tarai* region of Uttarakhand. Three different methods of propagation *viz.*, chip budding, T-budding and tongue grafting were practiced during period of experiment. Growth parameters and economic study was made in peach cv. Shan-e-Punjab. The results of the experiment revealed that treatment tongue grafting practiced on 20th January was found superior for almost all the parameter studied except for days taken for sprouting initiation, which was least (6.00 days) with grafting on 20th February. The parameters such as graft diameter, number of branches, plant height, saleable plants, number of leaves, leaf area, number of primary and secondary roots, fresh weight of roots and shoots and root to shoot ratio were found to be maximum in case of tongue grafting followed by chip budding. However, economics of experiment as benefit cost ratio was found higher (2.08) in chip budded plant as compared to tongue grafting (1.78) and T-budding (0.81).

Keywords: Peach, Propagation, Tongue grafting, T-budding, Chip budding

INTRODUCTION

Peach *Prunus persica* (L.) Batsch is an important fruit crop of temperate climate of the world but it can be grown quite successfully in the sub-tropical condition using suitable low-chill cultivars. In India, peaches are being cultivated over an area of 18000 hectares with the production of 107,000 MT (Anonymous, 2018**),** whereas, Uttarakhand leads in the peach production with an area of 78.55 thousand hectare and an annual production of 57.93 thousand MT (Anonymous, 2017). The successful introduction of high-quality low chilling peach cultivars in India have created a tremendous scope for its cultivation in north western plains (Nijjar and Khajuria, 1979). The varieties like Florida Prince, Early Grande, Partap, Sharbati and Shan-e-Punjab have become very popular and are grown commercially in N.I. plains and valley area of Uttarakhand. However, the limited availability of sufficient planting material is a major constraint for the slow pace of area coverage under peach in this region. Whereas, to meet the increasing requirement of quality planting material of low chill peaches, standardization of suitable propagation methods for plains and *Tarai* region is essential. Worldwide, peaches are still principally propagated by either grafting or budding (Rom and Carlson, 1987). Success of budding/grafting does not only depend upon the choice of appropriate method but on time of operation also. Considering all these factors, the present experiment carried out to optimize the method and time of propagation in subtropical peaches at *Tarai* region of Uttarakhand.

MATERIALS AND METHODS

The investigation was carried out at Horticultural Research Centre, GBPUA&T, Pantnagar on peach cv. Shan-e-Punjab during 2016-2018. The treatment consists of three method of propagation (tongue grafting, chip budding and T-budding) performed at different months *i.e.* T_1-Tongue grafting (20th January, 2017), T_2-Tongue grafting (10th February, 2017), T_3-Tongue grafting (20th February 2017), T_4 -Chip budding (20th January, 2017), T_5-Chip budding (10th February, 2017), T_6 -Chip budding (20th February, 2017), T_7-Chip budding (1st June, 2017), T_8-Chip budding (20th June, 2017), T_9-Chip budding (10thJuly, 2017), T_{10}-Chip budding (10th August, 2017), T_{11}-Chip budding (30th August, 2017), T_{12}-T-budding (10th August, 2017) and T_{13} -T-budding (30th August,2017). Thus, there were total 13 treatments which were replicated thrice in a Randomized Block Design (RBD) with 15 grafts per treatment. One-year old uniform seedlings of wild peach having pencil thickness were used as rootstock. For grafting purpose, 10 cm long scion wood of peach cv. Shan-e-Punjab having more than 3 buds from the previous season growth was collected and used. For chip budding, scion with mature bud was selected and a chip was taken out from the scion wood and placed on rootstock followed by tying with alkathene tape in order to avoid desiccation of graft union. In case of T-budding, T-shaped incision was given on stock and bark was removed, then a chip of scion was placed in incision. Regular pinching was done to control the unwanted growth of shoot from the seedlings, below graft union. Uniform cultural treatments were given

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to all plants during the course of investigation. Observation on days taken for sprouting initiation, sprout percentage, per cent success, plant growth parameters and cost benefit ratio were recorded. For calculating the economics of the experiment, the gross income (Table 2) was worked out after selling the obtained saleable plants at prevailing market price (Rs. 50 per plant), subsequently, the net income (Table 2) was calculated by subtracting the total expenditure from the gross return. Finally, the return per rupees invested i.e., benefit: cost ratio was calculated for the entire propagation method viz. tongue grafting, chip budding and shield/T-budding. The data obtained were analysed using standard statistical procedure (Cochran and Snedecor, 1987).

RESULTS AND DISCUSSION

The data pertaining to days to sprouting, sprouting percentage, success and plant growth parameters are presented in Table 1. Different methods of grafting and budding at different time intervals show the significant effect on days taken for initiation of sprouting. Treatment T_2 (Tongue grafting on 10th February) took minimum number of days (6.00 days) taken for initiation of sprouting which was statistically at par with T_3 (Tongue grafting on 20th February), T_5 (Chip budding on 10th February) and T_6 (Chip budding on 20th February) in which sprout initiation took place in 6.33 days, 7.33 days and 8.00 days respectively. Initiation of sprouting is different among the other methods succeeded by plants of T_9 *i.e.* chip budding on 10th July (9 days). However, treatment T_4 (chip budding on 20th January) took maximum days (24.33 days) to initiate sprouting. T-budded plants reached the sprout initiation stage ranging in 15.33-15.66 days depending upon the time of operation. Tongue grafted plants on 10th February sprouted earlier because the graft union formation was faster (Skene *et al.,* 1983) and the basic physiological flowering and leaf sprout initiation process in grafted plants compared to the other methods *i.e.,* chip and T-budded plants. This observed variation of days in reference to the propagation techniques at one or another date might be due to the fact that the growth of the plants occurs at faster pace due to breaking of dormancy after completion of the chilling requirement and remained into quiescence stage for shorter time period (Lockwood and Coston, 2005). Temperature, soil and air moisture played an important role in faster graft union formation due to the cell sap flow in both scion and rootstocks. Complete lacking of cell sap movement in plant may lead to the drying of cell sap and necrosis of cell. Similar findings have been reported in peach (Bohra, 2008; Chakraborty and Singh, 2011) and apple (Dimri *et al.,* 2009). The time and method of propagation have profound impact on sprouting percentage of plants, where, highest percent of sprouted plants (97.78%) were recorded on T_1 treatment (tongue grafting on 20th January) which was at par (86.66%) with the treatment T_3 *i.e.* plants grafted on 20th February. While, the minimum sprouting percentage (10.24%) was observed in T_{11} treatment (chip budding on 30th August) followed by T_{13} i.e., T-budding on 30th August. Maximum sprouting percentage in plants Tongue grafted on 20th January might be attributed to the availability of ample moisture in soil and air. The less success with T-budding might be due to the less and erratic rainfall and higher temperature at time when rain water was essentially required for successful operation. These results were found in harmony with finding of Bohra, (2008) in peach and Celik *et al.,* (2006) in kiwifruit, who recorded higher sprouting in chip budding than T-budding. Further, the efficacy of any propagation depends upon salability of the plants, *i.e.* plants gain enough height and girth to reach the saleable stage. Maximum number of saleable plants (97.28 per cent) were obtained when plants were propagated by tongue grafting carried out on 20th January (T_1), followed by T_2 (tongue grafting on 10th February) viz. 86.67 per cent whereas, minimum (13.44 per cent) was record with tongue grafting on 20th February succeeded by T-budding on 10th August (T_{11}) viz. 17.07 per cent. Amongst the methods, T-budded plants got minimum number of saleable plants than other two method utilized for propagation. More number of saleable plants obtained in tongue grafting might be because of proper and quick union formation, early bud sprouting and longer time period available for growth. Upadhyay (2016) also obtained maximum number of saleable plants with tongue grafting.

Graft diameter is one of the indicator criteria for standardization of propagation technique. The plant is considered as marketable when they acquire the optimum girth. In present experiment, the girth was measured from three positions from the shoot *i.e.*, 5 cm above union, at union and 5 cm below the union, respecttively. In relation to the method and time of propagation, tongue grafted plant produced maximum stem diameter and least was noticed in chip budded plant on 30th August (T_{11}). Tongue grafted plants on 20th January (T_1) produced the diameter of 18.44 mm, 21.49 mm, 19.47 mm, respectively, followed by chip budding on 20th January (T_4) which obtained a girth of 15.13 mm, 18.88 mm and 16.68 mm, while, minimum was observed in T_{11} with 5.90 mm, 9.71 mm and 7.77 mm succeeded by T_9 *i.e.*, chip budding on 10th July (5.24 mm, 14.47 mm and 9.48 mm) respectively. The tongue grafted plants grafted earlier produced girth higher than later grafted plants because of the better graft union of cambium layers of both stock and scion, more surface contact of scion with stock, optimum humidity and temperature, early initiation of bud sprouting. Similarly plant height was recorded maximum (128.67 cm) when plants tongue grafted on 20th January which was statistically at par with T_4

(123.20 cm) when chip budding practiced on 20th January followed by T_3 (115.83 cm) when plants tongue grafted on 20th February. Minimum plant height (18.20 cm) was recorded in T_{11} treatment (chip budding on 30th August) which was at par with T_{13} (T-budding on 30th August) and T_{10} (Chip budding on 10th August) producing plant of height 19.83 cm and 21.57 cm respectively. These results were in conformity with results of Awasthi and Negi, (2016). The maximum plant height in tongue grafted plants may be attributed to favorable climatic conditions, presence of greater number of leaves that might have raised the rate of photosynthesis and hence increased carbohydrate formation. In the similar pattern, maximum number of branches (11.63) were obtained when tongue grafting was practiced on 20th January (T_1) followed by T_4 (9.82) when chip budding was carried out on 20th January and minimum branches were produced when T-budding was done on 30th August (T_{13}) i.e., 1.50 followed by T_5 and T_9 viz., chip budding on 10th of February and 10th of July both obtained 1.63 branches. The number of branches obtained was maximum under T_1 that might be due to the production of more number of primary and secondary numbers of roots. These finding are in lined with the results of Bohra (2008) and Ahmad, (2012).

Maximum number of leaves (96.33) were obtained when tongue grafting was carried out on 20th January (T_1) followed by T_4 (72.33) when chip budding was carried out on 20th January and minimum number of leaves were obtained when chip budding was done on 1st June (T_7) i.e., 16.80 which was at par with T_8, T_9 and T_{11} viz., chip budding on 20th June, 10th July and 30th August obtained 17.35, 18.05 and 19.33 leaves respectively. The maximum number of leaves on plants grafted on 20th January might be due to higher shoot length attained and number of branches produced by such plants. Similarly, the maximum leaf area (23.98 cm^2) was recorded on T_1 treatment (tongue grafting on 20th January), followed by treatment T_4 i.e. 21.76 cm^2 (chip budding on 20th January), whereas, minimum leaf area (12.16 cm^2) was recorded in T_8 treatment (chip budding on 20th June), which was found to be statistically at par with T_7 and T_9, when plants chip budded on 1st June and 10th July where leaf area was 12.28 cm^2 and 12.76 cm^2 respectively. The maximum leaf area may be due to prevailing moisture and temperature availability during course of experiment. The above result was found in harmony with finding of Chakraborty and Singh (2011) and Gill *et al.*, (2014) in peach.

On the other hand, the method of propagation had profound and significant influence on number of primary and secondary roots as shown in Table 1. The maximum number of primary and secondary roots was produced in case of tongue grafted plants. The tongue grafting on 20th January (T_1) produced 14.60 and 20.33 primary and secondary roots, respectively. In case of various chip budding dates, 20th January (T_4) produced 13.33 and 15.00 primary and secondary roots respectively. While lowest values for primary (4.83) and secondary roots (4.50) were observed when chip budding was done on 20th June (T_8) and 10th February (T_8). More number of primary and secondary roots was noticed with tongue grafted plants might be attributed to early establishment of grafted plant which resulted in more transport of nutrients from roots. Similarly, tongue grafted plants on 20th January (T_1) obtained maximum fresh root (107.06g) and shoot (122.33g) weight followed by chip budding on 20th January (T_4) *i.e.,* 104.17g and 106.83g, respectively. While, the fresh weight of root was observed to be minimum (27.54g) in T_{10} and shoot weight (26.33g) in T_{11} treatment. Variation in fresh weight of root and shoot may be due to the variation in the length of shoot and number of roots which might have absorbed more nutrient and water (Deshmukh *et al.,* 2017), beside this, higher accumulation of carbohydrates in plant body might contributed to the gain in fresh weight. The maximum root to shoot ratio (2.39) on fresh weight basis was recorded when chip budding of plants done on 10th February (T_5) followed by chip budding on 30th August (1.58), *i.e.* T_{11}, whereas, the minimum value (0.73) was noted when plants were tongue grafted on 20th February (T_2), which might be attributed to optimum weather condition of the rootstock and propagation methods coincide with synthesis of required quantities of secondary metabolites like phenolic and alkaloid compounds which were needed for the protection of the rootstocks with less root attack by the soil-borne pathogens and insect-pests (El-motty *et al.*, 2010). The economics of any experiment is an important aspect as farmers are convinced considering input-output ratio of cropping. The careful scrutiny of data indicates that total expenditure was found highest being Rs. 27,250.00 in tongue grafting method followed by Rs. 20,750 in chip budding method, whereas, lowest expenditure (Rs. 18500.00) was calculated in control shield budding. Similarly, the maximum number of saleable plants (972) was recorded in tongue grafting followed by (866) in chip budding, however, the minimum number of saleable plants (243) was recorded in under shield budding. Therefore, based on saleable plants obtained in individual methods, the highest gross income (Rs. 48,600.00) was recorded in tongue grafting, followed by Rs. 43,300.00 in chip budding, whereas, lowest gross income (Rs. 15,000.00) was calculated in shield budding. Further, after deducting the total expenditure from the gross income of corresponding methods of propagation, the highest net income (Rs. 22,550.00) was calculated in chip budding, whereas it was found lowest (Rs. 12,150) under shield budding. The finding of experiment revealed that chip budding (2.08) followed by tongue grafting (1.78) were found higher in their benefit-cost ratio. On contrary, T-budding recorded minimum success

and minimum number of saleable plants, therefore, its benefit-cost ratio is minimum (0.81) among various techniques (Table 2). The chip budding was found economical superior because of budding, wherein, one need only single bud, whereas, in grafting, the scion wood must contain two or three dormant buds (Misra *et al.*, 2017). Therefore, more amounts were spent on procuring scion wood for tongue grafting compared to chip budding.

Therefore, based on results obtained, it can be concluded that, among all the propagation techniques studied, tongue grafting and/followed by chip budding on 20th January was found to be superior having all desirable growth characters, whereas, from economic point of view, chip budding followed by tongue grafting and T-budding produced higher profitable values.

Table 1. Effect of different method and time of propagation on growth attributes of peach cv. Shan-e-Punjab.

Treatments	Days taken for sprouting initiation	Sprouting percentage	Saleable plants (%)	Graft diameter (mm)			Number of branches	Plant height (cm)	Number of leaves	Leaf area (cm^2)	Number of primary roots	Number of secondary roots	Fresh weight of root (g)	Fresh weight of shoots (g)	Root to shoot ratio on fresh weight basis
				5cm above union	At union	5cm below union									
T_1	23.33	97.78	97.28	18.44	21.49	19.47	11.63	128.67	96.33	23.98	14.60	20.33	107.06	122.33	0.88
T_2	06.00	(76.06)*	(84.82)*	9.97	16.43	11.41	4.00	95.07	55.67	15.05	7.33	4.50	52.00	71.00	0.73
T_3	06.33	55.72 (51.58)	13.44	11.50	15.13	11.73	6.83	115.83	66.00	18.09	4.67	5.00	77.50	100.67	0.77
T_4	24.33	86.66 (54.73)	(21.47)	15.13	18.83	16.68	9.82	123.20	72.33	21.76	13.33	15.00	104.17	106.83	0.98
T_5	07.33	61.08 (49.46)	86.67	9.41	14.84	10.19	1.63	52.90	53.37	18.03	7.17	4.50	67.83	28.42	2.39
T_6	08.00	59.67 (43.07)	(69.01)	8.40	13.80	9.62	4.48	54.53	35.31	15.67	8.83	6.67	54.83	51.83	1.06
T_7	11.66	36.60 (34.01)	56.96	10.24	14.13	10.26	2.50	40.13	16.80	12.28	5.33	4.63	46.27	32.8	1.41
T_8	10.66	29.51 (40.94)	(49.01)	8.55	12.59	10.59	3.00	39.00	17.35	12.16	4.83	6.67	34.17	30.20	1.13
T_9	09.00	47.52 (48.88)	52.74	5.24	14.47	9.48	1.63	29.30	18.05	12.76	6.50	4.92	31.36	29.33	1.07
T_{10}	11.66	53.33 (30.58)	(46.58)	7.20	11.04	8.30	2.23	21.57	21.44	17.24	6.17	5.33	27.54	32.97	0.84
T_{11}	17.33	21.84 (23.63)	39.99	5.90	9.71	7.77	1.83	18.20	19.33	16.54	6.33		41.67	26.33	1.58
T_{12}	15.33	10.24 (5.20)	(39.20)	9.24	14.41	10.43	2.30	27.07	27.83	18.05	7.17	5.10	33.08	35.83	0.92
T_{13}	15.66	22.94 (24.53)	29.78	7.82	12.31	10.40	1.50	19.83	22.33	17.16	4.00	4.50	29.25	26.67	1.10
		14.66 (07.51)	(33.04)									4.50			
			43.70												
			(41.38)												
			44.44												
			(41.75)												
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			25.55												
			(30.37)												
S.Em.±	0.79	(61.21)	(17.25)	0.60	0.88	0.59	0.15	2.04	1.22	0.50	0.63	0.68	2.12	2.0	0.10
C.D. at 5%	2.33	(13.18)	(7.00)	1.74	2.58	1.73	0.45	5.99	3.60	1.45	1.87	1.98	6.24	5.87	0.29

*The figure under the parentheses are the angular transformed values.

Table 2. Economics of experiments using different method and time of propagation in peach cv. Shan-e-Punjab.

Treatments	Rootstock procuring	Bed preparation and transplanting	Scion cost	Propagation cost	Irrigation cost	Weeding and hoeing cost	Uprooting & grading cost	Total expenditure (rupees)	Gross income		Net income (Rupees)	Cost : Benefit ratio
									Number of saleable plants @ 50/-	Total return		
Tongue grafting	3500.0	250*4 = 1000.0	1000*10 = 10000.0	250*4 = 1000.0	150*50 = 7500.0	250*15 = 3750.0	250*2 = 500.0	27250.0	972.0	48600.0	21350.0	1:1.78
Chip budding	3500.0	250*4 = 1000.0	350*10 = 3500.0	250*4 = 1000.0	150*50 = 7500.0	250*15 = 3750.0	250*2 = 500.0	20750.0	866.0	43300.0	22550.0	1:2.08
T-budding	3500.0	250*4 = 1000.0	350*10 = 3500.0	250*4 = 1000.0	150*50 = 7500.0	250*6 = 1500.0	250*2 = 500	18500.0	243.0	15000.0	12150.0	1:0.81

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REFERENCES

Ahmad, I., Cheng, Z., Liu, T., Nan, W., Ejaz, M., Khan, M.A. and Wasila, H. (2012). Effect of different time of budding on the bud take success of peach on peach Rootstock. *Advances in Environmental Biology*. **6**(5): 1848-1852.

Anonymus (2018). Horticultural Statistics at a Glance, 2016, Horticulture Statistics Division, Department of Agriculture, Cooperation & Farmers Welfare (DAC&FW), Ministry of Agriculture and Farmer Welfare, Government of India (Website: Agricoop.nic.in/imagedefault/hortstat_ Galance.pdf)

Anonymous (2017). State profile: State Horticulture Mission, Department of Horticulture, Government of Uttarakhand (shm.uk.gov.in).

Awasthi, M. and Negi, M. (2016). Effect of different time and methods of budding on the bud take sucess of nectarine on peach (*Prunus persica* L.) seedling rootstock. *International Journal of Research in Applied Natural and Social Science*, **4**(11):25-30.

Bohra, J.S. (2008). Performance of different grafting methods in peach cv. Sharbati under *Tarai* condition of Uttarakhand. *Thesis*, M.Sc. Ag. (Horticulture), department of Horticulture, G.B.P.U.A&T, Pantnagar, Uttarakhand, India.

Celik, H., Zengınbal, H. and Ozcan, M. (2006). Effect of budding performed by hand and with manual grafting unit on kiwifruit propagation in the field. *Hort Science*, **33**(2): 57–60.

Chakraborty, B. and Singh, P.N. (2011). Effect of rootstock and time of grafting in low-chill Peach cultivars. *Progressive Horticulture*, **43**(2): 281-284.

Cochran, W.G. and Snedecor, G. (1987). Experimental designs. *John Wiley and Sons, Inc.*, New Delhi Dekker, Inc.

Deshmukh, N.A., Patel, R.K., Krishnappa, R., Verma, B.C., Rymbai, H., Assumi, S.R., Lyngdoh, P., Jha, A.K. and Malhotra, S.K. (2017). Influence of rootstock age and propagation methods on scion physiology and root morphology of Khasi mandarin (*Citrus reticulata*). *Indian Journal of Agricultural Sciences* **87** (2): 203–209.

Dimri, D.C., Petwal, A. and Kamboj, P. (2009). Determination of optimum time for chip budding in apple cv. Red Fuji. *Indian Journal of Horticulture*, **66**(2): 254-256.

El-Motty, E.Z.A., Metwally, S.E., Abou, Y.R. and Farahat, S.A. (2010). Studies on growth, nutritional and microbiological status of citrus seedlings infested with root-rot disease. *Nature and Science*, **8**(4): 112–121.

Gill, J.K., Singh, H., Thakur, A. and Jawandha, S.K. (2014). Studies on simultaneous grafting and rooting of peach on Flordagrourd rootstock. *Hort Flora Research Spectrum*, **3**(3): 259-262.

Lockwood, D.V. and Coston, D.C. (2005). Peach Tree Physiology. In: Horton, D. and Johnson, D. (eds) Southeastern Peach Growers Handbook. GES Handbook No. 1. University of Georgia College of Agricultural & Environmental Sciences, Athens, Georgia, 7.

Misra, K.K., Mishra, N.K. and Chand, S. (2017). Plant Propagation: Biotech Books, New Delhi.

Nijjar, J.S. and Khajuria, H.N. (1979). New peach cultivars for Punjab. *The Punjab Horticultural Journal*, **19**: 46-49.

Rom, R.C. and Carlson, R.F. (1987). Rootstocks for Fruit Crops. Wiley, New York.

Skene, D.S., Shepherd, H.R. and Howard, B.H. (1983). Characteristic anatomy of union formation in budded fruit and ornamental tree. *Journal of Horticultural Sciences*, **58**:2 95–9.

Upadhyay, K. (2016). Studies on different method and times of grafting in Walnut (*Juglans regia* L.) under different growing condition. *Thesis*, M.Sc. Fruit science VCSG Uttarakhand University of Horticulture and Forestry, Bharsar.