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Rajat Sharma
Department of Horticulture, College of Agriculture, G.B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand, India

PN Singh
Department of Horticulture, College of Agriculture, G.B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand, India

DC Dimri
Department of Horticulture, College of Agriculture, G.B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand, India

KK Misra
Department of Horticulture, College of Agriculture, G.B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand, India

Navin Singh
Department of Horticulture, College of Agriculture, G.B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand, India

Correspondence
Rajat Sharma
Department of Horticulture, College of Agriculture, G.B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand, India

Effect of different methods of propagation on peach cv. Shan-e-Punjab in *Tarai* condition of Uttarakhand

Rajat Sharma, PN Singh, DC Dimri, KK Misra and Navin Singh

Abstract
The present study was conducted during 2017-18 to investigate the impact of grafting methods on performance of peach cv. Shan-e-Punjab as scion cultivar on wild peach rootstock. Three methods of propagation were employed *viz*., tongue grafting, chip budding and T-budding. The experiment was laid out in randomized block design with 13 treatments and replicated thrice. Peach seedlings were grafted on 20th January, 10th February and 20th February. Whereas, chip budding was practiced on 20th January, 10th February, 20th February, 1st June, 20th June, 10th July, 10th August and 30th August. T-budding carried out on 10th and 30th August. The results obtained indicated that sprouting percentage (97.78%), per cent success (97.78%), plant height (128.67 cm), number of branches (11.63) and stem girth were highest in T_1 (Tongue grafting on 20th January), whereas, days taken to 50 per cent sprouting was found maximum in T_4 (chip budding on 20th January). Therefore, it was concluded that tongue grafting on 20th January, 2017 is best method of propagation for peach cv. Shan-e-Punjab in *Tarai* condition of Uttarakhand.

Keywords: Peach, tongue grafting, chip budding, T-budding and growth

Introduction
Peach (*Prunus persica* (L.) Batsch) is one prime temperate fruit crops after apple and pear throughout the World. It ranks third after apple and pear among temperate fruits. Peach is originally a crop of temperate region covering a considerable area in Uttarakhand hills. The chilling requirement of the peaches varies between 650-1100 hours at below 7°C. The peach cultivation in India is mainly restricted to 1500-2000 meters above mean sea level. Peach are acclimatized to slightly acidic soil to neutral soils pH (6.7-7.0). The interest in growing these crops under subtropical regions during the last three decade has also increased due to availability of high quality and low chilling cultivars (Sharpe *et al*., 1990) [12]. Low chilling peaches are grown in sub-tropical region of Uttarakhand, Punjab, Haryana, Himanchal Pradesh and in limited area with hills of South India. Rajgarh area of Sirmour district of Himanchal Pradesh and Ramgarh area of Nainital, Uttarakhand is known for quality peach production. Among various peach growing states, Uttarakhand shares 51.57% in production followed by Punjab (31.6) and Jammu and Kashmir (5.28%). In Uttarakhand major growing districts are Pauri, Almora, Nainital, Uttarkashi and Udham Singh Nagar. The rootstocks are known to influence almost every scion character ranging from plant vigour, precocity, fruit quality, yield and bearing life of scion varieties and the nutrient uptake and water use efficiency in fruit crop plants. They are known to affect the vulnerability of scion trees to various diseases and pests. It is an established fact that the optimum performance of scion cultivar depends on the use of a suitable rootstock under a given agro-climatic setting. Peach seedlings were utilized as the rootstocks for the peaches. Beside this, some other rootstocks *i.e.*, plum, apricot are used**.** The greater the taxonomic distance between stock and scion the smaller the chances of successful graft union. The sub-tropical peaches have come out as a promising fruit crops in North western plains due to availability of required chilling hours. Peach is generally propagated by tongue grafting or shield budding and occasionally by splice or cleft grafting. Among the various methods, tongue grafting gives the highest success. For successful grafting to take place, it is very necessary to match the vascular cambium. Sub-tropical peaches are propagated by grafting with variable success percentage throughout the winter season.

There are various varieties of peaches being grown in *Tarai* region of Uttarakhand, among these, Shan-e-Punjab, Sharbati, Florida Prince and Early Grande performing well. Therefore, keeping the above facts in view, cultivar Shan-e-Punjab was selected as scion material for the study.

Materials and Methods

The present study was carried out at Horticultural Research Centre, Pantnagar, U.S Nagar (Uttarakhand) which is situated at the foothills of the Shivalik range of Himalayas at 29˚ North latitude and 79.3˚ East longitude in *tarai* region. The one year old wild peach seedling was used as rootstock for peach cv. Shan-e-Punjab which were propagated by various methods. The experiment consist of three method of propagation *viz.*, tongue grafting, chip budding and T-budding practiced on different time (January, February, June, July and August). The treatments were, T_1-Tongue grafting on Peach (20th January, 2017); T_2-Tongue grafting on Peach (20th February 2017); T_3-Tongue grafting on Peach (10th February, 2017); T_4 -Chip budding on Peach (20th January, 2017); T_5-Chip budding on Peach (10th February, 2017); T_6 -Chip budding on Peach (20th February, 2017); T_7-Chip budding on Peach (1st June, 2017); T_8-Chip budding on Peach (20th June, 2017); T_9-Chip budding on Peach (10thJuly, 2017); T_{10}-Chip budding on Peach (10th August, 2017); T_{11}-Chip budding on Peach (30th August, 2017); T_{12}-T-budding on Peach (10th August, 2017) and T_{13} -T-budding on Peach (30th August,2017). Grafting and budding were the propagation method used during study. Grafting on 20th February was made possible by trenching the scion cultivar into 30 cm soil layer. For grafting purpose, 12 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 grafting. For chip budding, scion with mature bud was selected and a chip was taken out from the scion wood and placed on rootstock and tied 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 and then a chip of scion was placed in T-shaped incision. Various cultural operations were followed in nursery bed like weeding, hoeing, irrigation, control of insect-pests and diseases from time to time. The parameters *viz*., days taken for 50% sprouting, sprout percentage, per cent success, plant height (cm), plant girth (mm), number of primary branches were studied during course of study. The experiment was laid out on Factorial Randomized Block Design (FRBD) with 13 treatments and 3 replications. The data obtained were analysed using standard statistical procedure (Cochran and Snedecor 1987) [5].

Results and Discussion

The growth of the plants is calculated in terms of plant height, number of branches and stem girth was are known to be the true indicator of the growth of grafted plants. Beside this, days taken for 50 per cent sprouting, sprouting percentage and success percentage are also the factors which ultimately affects the efficacy of the operation. The data pertaining to days taken for 50 per cent sprouting is as affected significantly by different grafting and budding time (Table 1). This was recorded in the range of 7.33 to 27.00 days. The maximum number days (27.00 days) was taken by T_4 followed by T_2 and T_1. Whereas, the minimum number of days taken to 50 per cent sprouting were obtained in T_9 (7.33 days) followed by T_3 (8.33 days), T_6 (10.33 days) and T_7 (10.67 days). The difference in days taken to 50 per cent sprouting in the grafting as well as budding at different times may be due to the different time taken to union with respect to grafting/budding and the time of their operation which are mainly influence by climatic condition mainly temperature, relative humidity and soil moisture. The optimum climatic condition such as temperature and relative humidity prevailed during operation and the flow of cell sap in the rootstock and scion may led to the quick union formation. In the absence of active sap flow made the cell dry and even in some cases cell dies. The results obtained in the study are supported by Dimri *et al.* (2009) [7] who performed chip budding in apple cv. Red Fuji and obtained minimum number of days to sprouting when chip budding carried out on 30th July. On the contrary, Chakraborty and Singh (2011) [3] observed minimum number of days to sprouting (18.29 days) when tongue grafting performed at third week of February than the other grafting times *i.e.*, second week of January to last week of February. Dimri *et al.* (2009) [7] while comparing chip budding over tongue grafting on l st March observed that the number of days to sprouting was lower under tongue grafting compared to chip budding.

A critical observation regarding sprouting percentage in response to the different propagation techniques and time of operation exhibited significant difference presented in Table 1. The maximum sprouting was obtained with tongue grafting (97.78%) followed by chip budding (61.08%) and shield/T-budding (22.94%). Among the various methods of propagation utilized during study, maximum sprouting percentage was obtained in T_1 (76.06) followed by T_2 (54.73). Whereas, the minimum sprouting percentage (7.51) was recorded T_{13} followed by T_{10} (23.63). The difference in the per cent sprouting might be attributed to the variation in environmental condition *i.e.* temperatures and relative humidity prevailed during course of study. In February, some increase in temperature was observed as compared to January. This slight increase in temperature helped in breaking scion's dormancy and sprouting was noted to occur in the mid-February. The results of present study were found in harmony with the finding of Chandel *et al.* (1998) [4] who reported the highest mean sprouting of 98.00% with tongue grafting, followed by chip budding in kiwifruit. On the contrary, Chhukit (2009) [6] in kiwifruit recorded highest bud sprouting (96.50%) when the plants were chip budded in comparison to tongue grafting.

Treatments	Days taken for 50% sprouting	Sprouting percentage	Success percentage	Number of branches	Plant height (cm)	Stem girth (mm)		
						5cm above union	At union	5cm below union
T_1	26.00	97.78 (76.06)	97.78 (84.82)	11.63	128.67	18.44	21.49	19.47
T_2	15.67	86.66 (54.73)	82.22 (65.73)	6.83	115.83	11.50	15.13	11.73
T_3	8.33	55.72 (51.58)	72.85 (58.69)	4.00	95.07	9.97	16.43	11.41
T_4	27.00	61.08 (49.46)	47.55 (43.59)	9.82	123.20	15.13	18.83	16.68
T_5	17.67	59.67 (43.07)	62.22 (52.20)	1.63	52.90	9.41	14.84	10.19
T_6	10.33	36.60 (34.01)	60.00 (50.80)	4.48	54.53	8.40	13.80	9.62
T_7	10.67	29.51 (40.94)	31.11 (33.87)	2.50	40.13	10.24	14.13	10.26
T_8	11.00	47.52 (48.88)	26.66 (30.97)	3.00	39.00	8.55	12.59	10.59

T_9	7.33	53.33 (30.58)	53.33 (46.92)	1.63	29.30	5.24	14.47	9.48
T_{10}	25.67	21.84 (23.63)	23.89 (29.22)	2.23	21.57	7.20	11.04	8.30
T_{11}	23.67	10.24 (24.20)	22.22 (28.07)	1.83	18.20	5.90	9.71	7.77
T_{12}	17.33	22.94 (24.53)	13.33 (20.98)	2.30	27.07	9.24	14.41	10.43
T_{13}	20.00	14.66 (07.51)	8.88 (17.11)	1.50	19.83	7.82	12.31	10.40
S.Em.±	0.77	(61.21)	(24.34)	0.15	2.04	0.60	0.88	0.59
C.D. at 5%	2.29	(13.18)	(8.49)	0.45	5.99	1.74	2.58	1.73

The data presented in Table 1 clearly showed the influence of different grafting and budding on success percentage. Among the various propagation techniques used in experiment, highest success percentage was noted when tongue grafting was carried out in comparison to chip or shield/T-budding. Maximum success percentage of 84.22 was noted in T_1 followed by T_2 (65.73), whereas, the minimum success percentage of 17.11 was recorded in T_{11} followed by T_{12} (20.98). This may be due to congenial temperature and relative humidity which help in expansion of callus *i.e.*, faster formation of graft union between rootstock and scion. This may be attributed to more sprouting percentage in tongue grafted plants in comparison to the chip and T-budded plants which ultimately lead to more success percentage. A success rate of 25.00, 87.50 and 87.50 per cent were recorded in Santa Rosa, Mariposa and Greengage plum cultivars, respectively, when the plants were bench grafted with tongue grafting method on wild apricot seedlings rootstock (Sharma and Sharma, 1986) [11]. While, contradictory results were obtained by Sharma and Singh (1979) [10] who reported that T-budding gave a success of 90.80 per cent in January. Sharma and Dillon (1981) [9] obtained 99% bud-take success in peach cv. Flordasun under the subtropical conditions of Punjab when the plants were tongue grafted.

The data pertaining to the influence of grafting and budding on the plant height were presented in table 1. The results obtained during study indicated that among various methods of propagation, the plant height was highest in the tongue grafted plants compared to the chip and shield budding. The highest plant height (128.67 cm) was obtained with T_1 succeeded by T_4 and T_2 *i.e.,* (123.20cm and 115.83cm), respectively. On the other hand, minimum plant height (18.20cm) was recorded with T_{11} followed by T_{13} (19.83cm), T_{10} (21.57cm) and T_{12} (27.07). The significant variation in plant height might be due to the stronger bud union and development of normal vascular tissues at the bud union which regulates the transport of water and nutrients and therefore, enhance the active growth of scion with the starts of growing seasons. The increase mean height of plant is due to congenial weather conditions, presence of higher number of leaves, that boost the photosynthesis rate and hence carbohydrate formation accelerated. Moreover, the time of grafting/budding operation also have significant effect on plant growth particularly plant height. Bohra (2008) [2] obtained tongue grafted plants got maximum mean length of scion (61.87 cm) as compared to other methods of propagation in peach cv. Sharbati.

The impact of method and time of grafting/budding on number of branches was found significant (Table 1). The maximum number of branches (11.63) was recorded with tongue grafting succeeded by chip (9.82) and T-budding (2.30). Maximum number of branches (11.63) was noted in T_1 followed by T_4 and T_2 *i.e.,* (9.82 and 6.83). On the other hand, minimum number of branches (1.50) was recorded in T_{13} followed by T_5 and T_9. Number of branches in response to method and time of propagation were found to have difference which may be attributed to rapid graft union formation and presence of favorable growing condition. Tongue grafted plants showed best mean length of scion (61.87 cm) as compared to other grafting methods in peach cv. Sharbati (Bohra, 2008) [2]. Dimri *et al.,* (2009) [7] reported the highest number of branches were recorded for chip budding on 1 March compared with tongue grafting in apple.

The data on stem girth measured at three different heights *i.e.*, plant height 5cm above union, at union and 5cm below union presented in Table 1 showed that it vary significantly in response to various grafting/budding treatments. Among various grafting/budding methods, the maximum stem girth (18.44, 21.49 and 19.47mm) was obtained in T_1 succeeded by T_4 (15.13, 18.83 and 16.68mm). Whereas, the lowest value for the stem girth (5.90, 9.71 and 7.77mm) was recorded under T_{11} followed T_9. The plant grafted in January produced plants of more stem diameter, it might be due to maximum growth obtained in due period which led to maximum stem diameter due to having more photosynthesis. The results obtained from the study were in lined with Dimri *et al.* (2009) [7] who observed that the sprout girth was greatest for tongue grafting, followed by chip budding on 1st March in apple cv. Red Fuji. On the other hand, Awasthi and Negi (2016) [1] in Nectarine observed that highest diameter of budded plant (0.93 cm) by practicing shield budding followed by chip and patch budding method on peach rootstock. Madhwal (1985) [8] observed that the stem girth, 5cm below and 5cm above the union was recorded to be highest in T_1 and T_5 (5.19mm and 2.77mm) using Kabuli Greengage/Double Farming/Sharbati and SRE-6 (Peach seedling)/Early Round/Sharbati as rootstock/interstock/scion.

Conclusion

Among the various method of propagation, tongue grafted plants obtained highest value for sprouting percentage, success percentage, plant height, number of branches and stem girth. Whereas minimum values were obtained for T-budded plants.

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