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Effect of grafting methods and rootstocks on graft success and growth in low chill peach cv Shan-i-Punjab under semi-arid irrigated ecosystem

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Abstract
The present investigation was carried with the objectives to standardize the grafting methods and rootstocks for low chill peach cv. Shan- e-Punjab under semi-arid irrigated ecosystem of Haryana at CCSHAU, Hisar. Experiment consisting of three rootstocks *viz*., Peach cv. Sharbati seedling and rooted cutting of Japanese plum cv. Kala Amritsari and European plum cv. Green Gage and three grafting method *viz*., tongue, wedge and whip laid out in Factorial Randomized Block Design (FRBD) with three replications. Results reveal that among grafting methods, tongue grafting was found superior to wedge and whip grafting; whereas, among rootstock, peach cv. Sharbati was superior to plum rootstocks for graft success, plant height, leaf area, percent increase in scion diameter, root: shoot ratio, relative water content (RWC), leaf nitrogen, phosphorus and chlorophyll contents. However, between plum rootstocks, European plum cv. Green Gage was found better than Japanese plum cv. Kala Amritsari for graft success, plant height, and root: shoot ratio, leaf nitrogen and chlorophyll contents. This study also provides the opportunity for further research whether this trend continues in the productive year of the peach plant.

Keywords: Peach, grafting methods, rootstocks, European plum, Japanese plum

Introduction
Peach (*Prunus persica* (L.) Batsch) is the third most important temperate fruit crop in India after apple and pear. In India, high chilling peach cultivars are mainly cultivated in the mid hill zone at an elevation of 1000-2000 m above mean sea level. For North-Western plains of the country, low chilling have been recommended for commercial cultivation. In India, the area under peach is 19 thousand hectares with 114 thousand Metric Tons production Saxena (2018) [9]. In Haryana, the area under peach is 322 hectares with production of 3038 Metric Tons Anonymous (2017) [2]. There has been remarked increase in scope of cultivation of peach in north western plains of India due to successful introduction of low chilling peach cultivars, highly remunerative crop and scarcity of local fresh fruit during summer. The climate of Haryana has the low chilling hour; hence sub-tropical peaches have come out as an important fruit crop for the farmers of this region (Gangwar *et al*., 2003) [5] which is highly remunerative. As the popularity of peach crop is increasing day by day among farmers of Haryana so, demand for high quality planting material is also increasing. To deal with this increasing demand, efforts should be made for large scale, rapid and true to type multiplication of healthy planting material of suitable cultivar. In Haryana, early maturing peach cultivar like Shan-i-Punjabis preferred due to the shortage of water availability during summers and more infection of fruit fly in late maturing cultivars like Sharbati. Peaches are highly sensitive to root rot, salinity, alkalinity water logged conditions as well as there is the problem of lodging and short life. Presently, peach is raised mainly through mallet cutting and rarely through grafting on peach rootstock, which further aggravate the problems. However, suitable rootstock has not been standardised for commercial propagation in present agro climatic conditions.
To get rid of these problems, peaches are budded onto different rootstocks, which not only offer adaptability to plant to different type of stress environment but also determine the canopy and overall stature of the plant as well as enhance the nutrient uptake and yield efficiency. Therefore proper selection of rootstock and propagation method is important for obtaining high yield and good quality fruits. The aim of any propagation technique is to increase overall plant survival and production.

However, physiological knowledge in terms of root to shoot signalling, transfer of metabolites through vascular tissue to execute and coordinate growth and development between rootstock and scion and their interaction is vital. But the information to elucidate the effect of rootstock and propagation method on scion physiology and root morphology of grafted plants are scanty in case of peach under semi arid irrigated ecosystem of north western plain of India. Therefore, the current study focussed and attended to study the influence of rootstock and propagation method on scion physiology which is the need of the hour for better growth and commercialization of peach orchard especially under nursery stage and to strengthen peach production system under semi-arid irrigated ecosystem of Haryana.

Materials and Methods

The present investigation was carried out at nursery block of Department of Horticulture, CCS HAU, Hisar to study the effect of rootstock and grafting methods on graft success and growth in peach cv. Shan-i-Punjab. The orchard situated at 215.2 m above mean sea level with coordinates of 29º10′ N latitude and 75º46′ E longitudes has a typical semi-arid climate with hot and dry summer and extremely cold winter. The total rainfall as well as its distribution in the region is subjected to large variations. The experimental treatment consisting of three rootstocks *viz.* Peach seedling cultivar Sharbati; Japanese plum (*Prunus salicina*) cv. Kala Amritsari cuttings and European plum (*Prunus domestica*) cv, Green Gage cuttings; and three grafting methods *viz.* Tongue, wedge and whip grafting. There were nine treatment combinations laid out in randomized block design with three replications. Each replication had 15 plants for taking observations. One year old Sharbati seedlings and cuttings of European and Japanese plum were grafted on 25 January. Scion wood was collected from nine year old healthy, disease free tree of peach cv. Shan-i-Punjab.

The grafted plants were observed for recording the data on various parameters The date of bud sprouting of individual plants were recorded on alternate days up to the completion of the sprouting and the number of days taken to first and complete sprouting from date of grafting was calculated for every method and rootstock. Number of grafts sprouted and number of successful survived grafts out of total number of plants grafted for each replication was counted and expressed in percentage for sprouting and graft success, respectively. The plant height was measured from level of soil surface to the highest tip with the help of meter scale. Scion diameter was measured 5 cm above graft union at the time of grafting and 150 days after grafting with the help of vernier caliper and expressed in percent increase in scion diameter over initial diameter. Leaf area was measured with the help of leaf area meter. Relative water content (RWC) of leaves was measured using formula: RWC = (FW-DW/ TW-DW) X 100, where FW = Fresh weight DW = Dry weight, which was measured by drying in oven at 60^0C for 24 hours and TW = Turgid weight of leaves, which was measured with the help of electronic balance by dipping of leaves, selected for fresh weight in distilled water for 24 hours. Total chlorophyll content of leaves was estimated according to the method of Hiscox and Israelstam (1979) [6] using dimethyl sulfoxide (DMSO). Dry weight of root and shoot was measured by drying in oven for several days at 48^0C till constant weight separately and ratio was worked out. For leaf nutrients analysis fully mature leaves were collected, washed, dried, grinded and digested in diacid mixture (H_2SO_4 and $HClO_4$ in the ratio of 4:2). Nitrogen was estimated by Nessler's reagent method; Phosphorus by Vando-molybdo yellow colour method. The data for the above parameters was collected at 150 days after grafting. Data recorded was compiled and subjected to statistical analysis (Panse and Sukhatme, (2000) [7].

Results and Discussion

Grafting method and rootstock significantly influenced the days taken for first and complete sprouting (Table1). Days taken for first sprouting were recorded minimum (23.31) in tongue grafting which was significantly lower to wedge grafting (27.31) and whip grafting (29.97) irrespective of rootstock. Rootstocks did not differ significantly among each other for influencing days taken for first sprouting. Days taken for complete sprouting were recorded minimum (44.89) in tongue grafting which was significantly lower to wedge grafting (50.00) and whip grafting (48.66) which was found otherwise at par with each other, irrespective of rootstock. Similarly, irrespective of grafting method, days taken for complete sprouting were minimum (46.00) in peach rootstock i.e. Sharbati seedling which was significantly lower to plum rootstocks, Kala Amritsari (49.11) and Green Gage (48.44) which were otherwise at par with each other. Plathia *et al.* (2016) [8] also confirmed that among the three methods tried, tongue and cleft method of grafting were early for first and full sprouting than side grafting. Chakraborty and Singh (2011) [3, 4] also reported that earliness in scion sprouting when low chill peach cultivars i.e. Shan-e-Punjab, Pratap and Saharanpur Prabhat were tongue grafted on wild peach rootstock than the plum rootstocks.

Sprouting percentage and graft success was influenced significantly with rootstock and grafting methods (Table 2). Maximum sprouting recorded in tongue grafting (66.76%) and was significant over wedge grafting (60.22%) and whip grafting (61.77%) which was otherwise at par with each other irrespective of rootstock. Likewise, maximum sprouting was observed in Japanese plum rootstock i.e. Kala Amritsari (65.14%) which was significantly higher to peach rootstock Sharbati (63.28%) and European plum i,e, Green Gage (60.33%) which were at par with each other irrespective of grafting method. As the cambial layer of rootstock and scion woods are more in contact with each other, it might be a possible reason for higher sprouting percentage in tongue grafting. The results of present findings are in confirmation with Bohra *et al.* (2011) [3] who found that the tongue grafting had highest bud take over cleft grafting, veneer grafting and splice grafting for peach cv. Sharbati.

Tongue grafting resulted in statistically higher graft success (61.07%) over wedge grafting (56.13%) and whip grafting (57.16%) irrespective of rootstock. Similarly, Sharma and Dhillon (1981) [10] also obtained very high success percentage in Flordasun peach by tongue grafting. Likewise, significantly higher graft success (60.98%) was found in peach rootstock Sharbati as compared to plum rootstocks i.e. Kala Amritsari (56.62%) and Green Gage (57.08%), which were further found at par with each other irrespective of grafting method. Plathia *et al.* (2016) [8] confirmed our findings that tongue grafting showed highest bud take success when Shan-e-Punjab scion was grafted on peach seedling rootstock. Japanese plum rootstocks (Kala Amritsari) showed highest sprouting percentage but lowest survival due to more mortality of buddlings caused by more attack of leaf bacterial

canker disease. Higher graft success of Shan-e-Punjab grafted on Sharbati seedling might be due to better grafting compatibility among peach rootstocks and scion woods due to similar genetic makeup as compared to plum rootstock. Chakraborty and Singh (2011) [3, 4] found that sprouting percentage was higher in peach rootstock than the plum rootstock for low chill peach cultivar Shan-e-Punjab.

Plant height and increase in scion diameter was significantly affected by both the treatments, i.e., grafting method and rootstock (Table 3). Maximum plant height (159.26 cm) and increase in scion diameter (4.24%) was measured in tongue grafting and minimum plant height (141.79cm) increase in scion diameter (3.95%) with whip grafting method irrespective of rootstock. The possible reason for more plant height in tongue grafting is better translocation of nutrients and water from rootstock to scion via graft union. Peach rootstock Sharbati had significantly more plant height (157.11cm) and increase in scion diameter (4.25%) and minimum plant height (141.61cm) in Japanese plum Kala Amritsari. Between plum rootstock, plant height was observed more in European plum, whereas, more increase in scion diameters was found in Japanese plum. This may be due to the effect of rootstock on scion as European plum has more upright and less stem radial growth as compare to Japanese plum. Higher plant height and scion diameter in peach rootstock as compared to plum rootstock might possibly be speculated due to better cambial contact resulting into greater uptake of water and nutrients from soil as evident from present study. It further might be possible due to better rooting system of Sharbati seedling which favored better translocation of nutrients and water from the soil. Shah *et al.*, (2017) [11] also reported maximum scion height and girth in peach when budded over peach as compared to plum and apricot rootstocks. These results are also in accordance with the earlier findings of (Sharma and Dhillon, 1981 and Chakraborty and Singh, 2011) [10, 3, 4].

Leaf area was significantly affected by grafting method and rootstock (Table 4). Tongue grafted plants had significantly more leaf area (37.58 cm^2) over wedge grafted plants (35.04 cm^2) and whip grafted plants (34.08 cm^2), which were further found at par with each other irrespective of rootstock. In consonance to these findings, Plathia *et al.* (2016) [8] also reported maximum leaf area in tongue grafting than cleft and side grafting. Peach rootstock Sharbati seedling had significantly more leaf area (36.73 cm^2) as compared to plum rootstocks Kala Amritsari (35.56 cm^2) and Green Gage (34.41 cm^2) which were found otherwise at par with each other, irrespective of grafting method.

Rootstock influenced significantly and grafting method non-significantly the root: shoot ratio. Tongue grafting resulted in significantly higher root: shoot ratio (0.32). Japanese plum Kala Amritsari had significantly higher root: shoot ratio (0.37) as compared to Peach rootstock Sharbati (0.27) and European plum Green Gage (0.30). This may be due to vigorous growth on peach and European plum rootstock as compared to Japanese plum. The increased vegetative growth in terms of plant height, leaf area, percent increase in scion and rootstock diameter etc. was reflected in the fresh and dry weight of shoot and roots, hence, the ratio.

Grafting method and rootstock significantly influenced relative water content (RWC) and leaf chlorophyll contents (Table 5). Tongue grafted plants had significantly higher RWC (89.46%) over wedge grafted plants (84.63%) and whip grafted plants (83.55%) which were found otherwise at par with each other, irrespective of rootstock. Tongue grafting improved the translocation of water and nutrients from rootstock to leaves through well-developed graft union for photosynthesis. RWC differed significantly with various rootstock treatments. Peach rootstock Sharbati had significantly maximum RWC (90.20%) whereas Japanese plum Kala Amritsari showed minimum RWC (83.30%) followed by European plum Green gage (84.15%). The maximum RWC in leaves on peach rootstock might be due to inherent character of this species, as it is vigorous both in terms of water and nutrients absorption as compared to plum. Similar findings were earlier reported by Singh *et al.*, (2012) [12] in Nagpur mandarin that vigorous rootstock rough lemon had more RWC than lazy rootstocks, carrizo and rangpur lime rootstocks.

Tongue grafting resulted in significantly higher total chlorophyll content (1.37 mg/g of fresh weight) followed by whip grafting (1.30 mg/g of fresh weight) over wedge grafting (1.16 mg/g of fresh weight), irrespective of the rootstock. Maximum total chlorophyll content (1.54 mg/g of fresh weight) was found in peach rootstock Sharbati and minimum (1.04 mg/g of FW) in Japanese plum Kala Amritsari, irrespective of grafting method. However, plum rootstocks also differ significantly in respect of chlorophyll content and more chlorophyll was measured in European plum as compared to Japanese plum rootstock. Such type of findings may be due to better potency of peach and European plum than Japanese plum rootstock to absorb and translocate nutrients besides their better photosynthetic abilityas evident from the present investigation.

Leaf nitrogen and phosphorus contents were significantly affected by grafting method and rootstock (Table 6). Tongue grafted plants had significantly higher leaf nitrogen content (3.06%) over wedge grafted plants (2.88%) and whip grafted plants (2.83%) which were found otherwise at par with each other, irrespective of rootstock. Rootstock differed significantly in influencing leaf nitrogen content. Peach rootstock Sharbati had significantly maximum leaf nitrogen (3.12%) followed by European plum rootstock whereas, Japanese plum rootstock Kala Amritsari showed minimum leaf nitrogen content (2.69%), irrespective of grafting method. Tongue grafted plants had significantly more leaf phosphorus content (0.26%) over wedge grafted plants (0.22%) and whip grafted plants (0.20%), irrespective of rootstock. Peach seedling Sharbati had significantly maximum leaf phosphorus content (0.26%) as compared to plum rootstocks i.e. Kala Amritsari (0.22%) and Green Gage (0.20%), irrespective of grafting method. The interaction effect of grafting method and rootstock was found statistically significant. Maximum leaf phosphorus content (0.29%) was recorded when peach rootstock Sharbati was wedge grafted. Whereas, minimum leaf phosphorus content (0.17%) was recorded when Green Gage was whip grafted. This also shows that peach and European plum rootstock has better N uptake as compared to Japanese plum rootstock for peach. Higher leaf nitrogen and phosphorus content through tongue grafting might be due to union formation between scion and rootstock in tongue grafting which resulted in more translocation of nitrogen and phosphorus form roots to leaves.

It can be concluded that for propagation of peach cv. Shan-i-Punjab, tongue grafting method and Sharbati seedling as rootstock were found superior under semi-arid irrigated ecosystem of Haryana for maximum sprouting percentage, graft success, plant height, percent increase in scion diameter,

leaf area, root: shoot ratio, relative water content, leaf N and P content and chlorophyll content, respectively. Whereas, between plum rootstocks, European plum was better to Japanese plum for peaches in respect of graft success, plant height, leaf N and chlorophyll contents. Overall, the results suggest differences in the growth and physiological traits of young grafted peach trees with the propagation method and rootstocks. Whether this trend continues throughout the productive years is the subject of continuing investigations.

Table 1: Effect of rootstock and grafting methods on days taken to sprouting in peach cv. Shan-i-Punjab

Rootstocks	Grafting methods							
	Tongue	Wedge	Whip	Mean	Tongue	Wedge	Whip	Mean
	Days taken to first sprouting				Days taken for complete sprouting			
European plum cv. Green Gage	23.66	26.33	30.33	26.78	47.33	48.67	49.33	48.44
Japanese plum cv. Kala Amritsari	23.00	28.33	31.00	27.44	44.67	51.33	51.33	49.11
Peach cv. Sharbati	23.26	27.26	28.59	26.37	42.67	50.00	45.33	46.00
Mean	23.31	27.33	29.97		44.89	50.00	48.66	
CD at 5% Method	1.22				1.57			
Rootstock	NS				1.57			
Method x rootstock	NS				NS			

Table 2: Effect of rootstock and grafting methods on sprouting and graft success in peach cv. Shan-i-Punjab

Rootstocks	Grafting methods							
	Tongue	Wedge	Whip	Mean	Tongue	Wedge	Whip	Mean
	Sprouting (%)				Graft success (%)			
European plum cv. Green Gage	83.78 (66.47)	72.55 (58.52)	68.11 (56.09)	74.81 (60.33)	77.50 (61.77)	65.39 (53.96)	68.06 (55.85)	70.32 (57.08)
Japanese plum cv. Kala Amritsari	85.89 (68.34)	77.33 (61.56)	82.67 (65.51)	81.96 (65.14)	73.06 (59.00)	68.17 (55.65)	67.61 (55.31)	69.61 (56.62)
Peach cv. Sharbati	82.67 (65.46)	76.00 (60.82)	80.33 (63.70)	79.67 (63.28)	80.17 (63.58)	73.17 (58.80)	75.83 (60.58)	76.39 (60.98)
Mean	84.11 (66.76)	75.30 (60.22)	77.04 (61.77)		76.91 (61.07)	68.91 (56.13)	70.50 (57.16)	
CD at 5% Method	3.44				1.98			
Rootstock	3.44				1.98			
Method x rootstock	NS				NS			

Table 3: Effect of rootstock and grafting methods on height and increase in scion diameter in peach cv. Shan-i-Punjab

Rootstocks	Grafting methods							
	Tongue	Wedge	Whip	Mean	Tongue	Wedge	Whip	Mean
	Height (cm)				Increase in scion diameter (%)			
European plum cv. Green Gage	158.28	153.06	138.11	149.82	16.16 (4.41)	14.20 (3.89)	13.58 (3.81)	14.65 (3.95)
Japanese plum cv. Kala Amritsari	156.50	137.39	130.94	141.61	16.06 (4.13)	15.10 (4.01)	14.79 (3.97)	15.32 (4.03)
Peach cv. Sharbati	163.00	152.00	156.33	157.11	18.81 (4.45)	16.93 (4.23)	15.59 (4.07)	17.11 (4.25)
Mean	159.26	147.48	141.79		17.02 (4.24)	15.41 (4.04)	14.65 (3.95)	
CD at 5% Method	3.87				0.05			
Rootstock	3.87				0.05			
Method x rootstock	NS				0.09			

Table 4: Effect of rootstock and grafting methods on leaf area and root: shoot ratio in peach cv. Shan-i-Punjab

Rootstocks	Grafting methods							
	Tongue	Wedge	Whip	Mean	Tongue	Wedge	Whip	Mean
	Leaf area (cm^2)				Root: Shoot ratio			
European plum cv. Green Gage	35.42	35.67	32.13	34.41	0.33	0.29	0.28	0.30
Japanese plum cv. Kala Amritsari	38.27	34.88	33.52	35.56	0.34	0.35	0.42	0.37
Peach cv. Sharbati	39.04	34.56	36.58	36.73	0.30	0.27	0.24	0.27
Mean	37.58	35.04	34.08		0.32	0.30	0.31	
CD at 5% Method	1.57				0.07			
Rootstock	1.57				0.07			
Method x rootstock	NS				NS			

Table 5: Effect of rootstock and grafting methods on relative water content (RWC) and total chlorophyll content in peach cv. Shan-i-Punjab

Rootstocks	Grafting methods							
	Tongue	Wedge	Whip	Mean	Tongue	Wedge	Whip	Mean
	RWC (%)				Total chlorophyll (mg/g of leaf fresh weight)			
European plum cv. Green Gage	87.62	83.15	81.67	84.15	1.42	1.15	1.17	1.25
Japanese plum cv. Kala Amritsari	87.21	80.85	81.83	83.30	1.12	1.03	0.98	1.04
Peach cv. Sharbati	93.55	89.98	87.16	90.20	1.58	1.29	1.74	1.54
Mean	89.46	84.63	83.55		1.37	1.16	1.54	
CD at 5% Method	1.67				0.13			
Rootstock	1.67				0.13			
Method x rootstock	NS				NS			

Table 6: Effect of rootstock and grafting methods on leaf nitrogen and phosphorus content in peach cv. Shan-i-Punjab

Rootstocks	Grafting methods							
	Tongue	Wedge	Whip	Mean	Tongue	Wedge	Whip	Mean
	Nitrogen (%)				Phosphorus (%)			
European plum cv. Green Gage	3.12	2.95	2.80	2.96	0.25	0.18	0.17	0.20
Japanese plum cv. Kala Amritsari	2.79	2.62	2.65	2.69	0.27	0.19	0.21	0.22
Peach cv. Sharbati	3.26	3.06	3.05	3.12	0.27	0.29	0.23	0.26
Mean	3.06	2.88	2.83		0.26	0.22	0.20	
CD at 5%Method:	0.09				0.01			
Rootstock	0.09				0.01			
Method x rootstock	NS				0.02			

References

1. Blonska E, Lasota J, Gruba P. Effect of temperate forest tree species on soil dehydrogenase and urease activities in relation to other properties of soil derived from less and Glaciofluvial sand. Ecological Research 2016;31(5):655-664.
2. Anonymous. Horticulture Department Report, Government of Haryana 2017. www.hortharyana.gov.in.
3. Bohra JS, Singh PN, Chakraborty B. Standardization of suitable grafting method for propagation of low chilling peach [*Prunus persica* (L.) Batsch] cv. Sharbati. Pantnagar Journal of Research 2011;9:245-247.
4. Chakraborty B, Singh PN. Effect of rootstock and time of grafting in low-chill peach cultivars. Progressive Horticulture 2011;43:281-284.
5. Gangwar D, Arora RL, Gaur GS. Compatibility behaviour of plum rootstocks with Peach Scions. VII International Symposium on Temperate Zone Fruits in the Tropics and Subtropics-Part Two 2003;696:177-180.
6. Hiscox JD, Israelstam GF. A method for the extraction of chlorophyll from leaf tissue without maceration. Canadian Journal of Botany 1979;57:1332-1334.
7. Panse VG, Sukhatme PV. Statistical methods for Agricultural Workers (4th Edition), Publication and information Division, ICAR, New Delhi 2000.
8. Plathia M, Sharma A, Wali VK, Shah RA, Gupta R. Standardization of method and time of grafting of peach cv. Shan-e-Punjab on peach seedling rootstock. Green Farming 2016;7:1244-1247.
9. Saxena M. Horticultural Statistics at a Glance 2018. www.agricoop.nic.in
10. Sharma RC, Dhillon BS. Grafting peach in October. Indian Horticulture 1981;26:27.
11. Shah RA, Sharma A, Wali VK, Bakshi P, Kumar R, Gupta R. Response of budding method and time on bud success and buddling growth of peach (Prunus persica) on different rootstocks. Indian J Agric. Sci 2017;87:669-676.
12. Singh J, Yadav A, Bhatnagar P, Arya CK, Jain MC, Sharma SK *et al*. Budding performance of Nagpur mandarin on different rootstocks under Hadoti region of Rajasthan. Indian J Hort 2012;69:20-26.