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Effect of different varieties of scion and date of wedge grafting in guava (*Psidium guajava* L.)

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Abstract
The present investigation entitled "Effect of different varieties of scion and date of wedge grafting in Guava (*Psidium guajava* L.)" was carried out during 2022-23 at the shade net of Horticulture Research Farm, under Pt. Kishori Lal Shukla College of Horticulture and Research Station, Rajnandgaon, Chhattisgarh. The research was framed in Factorial Completely Randomized Design (FCRD) with 12 treatments which were replicated thrice. There were 2 factors, first factor with 6 levels of different date of wedge grafting viz, 10 September (D_1), 25 September (D_2), 10 October (D_3), 25 October (D_4), 10 November (D_5) and 25 November (D_6) and second factor with 2 levels of variety of scion i.e. Allahabad Safeda (V_1) and Lucknow-49 (V_2). The experiment was exempted to find out the effect of different date of wedge grafting and different varieties of scion on the success of guava grafts. The treatment combination D_1V_2 (10 September+Lucknow-49) was found superior for growth parameters viz, minimum number of days taken to bud sprouting (13.13 days), for first leaf opening (16.23 days), maximum number of sprouts (7.93), number of leaves (22.07), graft height (48.15 cm), rootstock girth (10.63 mm), scion girth (9.71 mm), leaf area (23.48 cm^2), graft success (74.84%) and graft survival (70.00%).

Keywords: Guava, wedge grafting, different date of wedge grafting, different variety of scion

Introduction
The Guava, often known as the poor man's apple and the 'Apple of the tropics', is a member of the Myrtaceae family. Psidium is a genus that contains approximately 150 species, including *P. cattleianum* (Strawberry guava), *P. acutangulum*, *P. firmum* (Wild species), *P. guineense* (Brazilian guava), *P. friedrichsthalianum*, which has acidic fruits, *P. pomiferum*, which has round fruits, and *P. pyriferum*, which has pear-shaped fruits. These genotypes can be found in the Indian collection and are kept in field gene banks around the nation. *P. guajava* is most usually farmed in India and other countries.

It was introduced to India by the Portuguese in the 17th century and is native to Tropical America, which stretches from Mexico to Peru (Menzel, 1985) [9]. Guava cultivation has extended to a variety of agro-climatic regions as a result of increased adaptability. It is successfully grown up to a height of 1500 metres above mean sea level. However, optimal climate conditions include temperature ranges of 20-30 °C, evenly spaced annual rainfall of 1000-2000 mm, well-draining soils with high quantities of organic matter and pH values of 5-7.

The antioxidants found in guava fruits can fight free radicals, which can harm cells and result in cancer, diabetes, and cardiovascular disorders. Guava has antibacterial, astringent, and antihelminthic characteristics that make it effective in treating a wide range of illnesses and also decreases blood sugar. It might be an organic method of preventing diabetes.

It is a popular fruit crop because of its plentiful output and excellent compensation. Guava is the fourth most significant fruit crop in terms of area and production after mango, banana and citrus. The annual production of Guava in India is 45.82 lakh MT with area of 3.08 lakh ha (Anon., 2021.) [2]. In Chhattisgarh area under Guava is 20.40 thousand ha with production 1.87 lakh MT (Anon., 2022.) [3]. In India it is grown in almost all states; However, Uttar Pradesh, Madhya Pradesh, Bihar, Chhattisgarh, West Bengal, Odisha, Gujarat, Haryana, Maharashtra, Punjab, Karnataka and Andhra Pradesh are the leading guava growing states. In Chhattisgarh it is grown in Korba, Mahasamund, Kabirdham, Janjgir-Champa, Raigarh, Sarguja, Korea, Bilaspur, Narayanpur, Kanker, Raipur, Surajpur, Durg, Mungeli and Dhamtari districts.

It is impossible to grow true-to-type plants from seeds because they are heterozygous in nature. All fruit crop needs initial planting material as a fundamental necessity because it affects quality and quantity of final yield (Singh *et al*., 2005) [11]. It is difficult to achieve desired levels of production in the traditional system of guava farming due to the low yield per unit area and high manpower inputs required by large-sized trees. Large trees also take a while to fully bear fruit, which raises the overall cost of production per square foot. Vegetative propagation has replaced typical trend of seed propagation of guava in recent years

Commercial nursery management is becoming more prevalent as a result of advances in science and technology, which are replacing traditional plant propagation. As a result, in situations where there is a shortage of quality planting material or a sudden 3 increase in the area under guava production, a quick and effective propagation strategy is needed to provide guava grafts all year long. In guava, grafts multiplication through air-layering, stooling, grafting and inarching methods, is a cumbersome process because varying rates of graft success. To mitigate these problems, Dr. Gorkha Singh at Central Institute for Subtropical Horticulture (CISH), Lucknow, invented a viable propagation technique i.e. wedge grafting for rapid multiplication of grafts in guava (Singh et al., 2007) [12]. It is also practiced in other crops like sapota, custard apple and pomegranate etc. In order to do guava wedge grafting, rootstocks are required and these rootstocks have a significant impact on the scion's vigour, cold resistance, fruitfulness, fruit quality, mineral content of the leaves and disease tolerance. Psidium molle exhibits field resistance to wilt disease due to its tough texture (Singh *et al*, 2005) [11].

In extremely harsh environmental conditions, including extremely cold weather, the wedge grafting method has been found to be effective throughout year. Wedge grafts performed best in a controlled condition with the scion shoot wrapped in a poly tube (Beer *et al*., 2013) [5]. Using the polycap wedge method of grafting to increase the supply of high-quality planting material all year long (Singh *et al*., 2007) [12]. Many types of horticultural plants are cultivated in a several of plant-growing structures. Compared to the immediate outdoors, shade net condition gives a more ideal atmosphere condition. Shade nets can partially manage the environment by reducing light intensity and effective heat during the day. In shade net house situation, the quality and sprouting percentage of the grafts are higher. The homogeneity of the grafts is preserved because the shade net house growing environments protect the grafts from pathogen entrance, strong winds, heavy rain and graft union breakdown.

Material and Methods

The experiment was conducted at the shade net of Horticulture Research Farm Pt. K.L. Shukla College of Horticulture and Research Station Rajnandgaon (C.G.) during the year 2022-23. The research was framed in Factorial Completely Randomized Design (FCRD) with 12 treatments which were replicated thrice. There were 2 factors, first factor with 6 levels of different date of wedge grafting viz, 10 September (D_1), 25 September (D_2), 10 October (D_3), 25 October (D_4), 10 November (D_5) and 25 November (D_6) and second factor with 2 levels of variety of scion i.e. Allahabad Safeda (V_1) and Lucknow-49 (V_2).

The rootstock was cut after choosing the scion material, leaving a 12 to 15 cm long stem above the polyethylene bag. Using a grafting knife, the beheaded rootstock was split apart approximately 4.0 to 4.5 cm deep across the centre from the cut end of the rootstock. On the lower side of the scion shoot, a wedge-shaped grafting cut that was 4.0-4.5 cm long and slanted from both sides was formed. The scion stick was properly 21 placed into the stock split and squeezed to align the cambium tissues of the rootstock and scion stick. Following the aforementioned procedures, 150 gauge, 2 cm broad and 25 to 30 cm long polyethylene strip was used to tie the stock and scion combination and then covered with polycap. The grafts were separated after grafting and sheltered in a shade net condition with frequent watering.

The data were collected on the following parameters: Days taken to bud sprouting, days required for first leaf opening, number of sprouts per graft, number of leaves per graft, graft height (cm), rootstock girth (mm), scion girth (mm), leaf area (cm^2), percentage of graft success and percentage of graft survivability. Days required for bud breaking and leaf opening were calculated from date of operation. Growths of the grafts (graft height, rootstock girth, and scion girth) were recorded at 30 days interval up to 120 DAG. The collected data on the different parameters of study were statistically analyzed as described by Panse and Sukhatme (1985) [13] and significance was tested by 'F' test.

Result and Discussion

Day taken to bud sprouting

The experimental data presented in table 2 revealed that among various treatments combination which was found to be significant, treatment combination D_1V_2 (10 Sep.+ L-49) took minimum number of days (13.13 days) which was followed by (15.13 days) D_2V_2. Whereas D_6V_1 took maximum number of days (26.00 days) for sprouting of bud. Favourable environmental parameters like high relative humidity and ideal temperature presented in shade net that result in successful union of cambium layers of stock and scion, early callus formation, initiation of subsequent growth, faster graft union, cell sap flow, better translocation of assimilates associated with intrinsic characteristics of scion that have supported early emergence of buds. This result is closely related with findings of Gotur *et al*., (2017) [6] and Nanditha *et al*., (2017) [10] in guava.

Days required for first leaf opening

The data obtained during the experiment according to different treatment combinations has been shown in Table 2 for better understanding. Among various treatment combination, D_1V_2 (10 Sep.+ L-49) took less number of days (16.23 days) for first leaf opening followed by D_2V_2 (25 Sep.+ L-49) which took 18.34 days. Whereas combination D_6V_1 (25 Nov.+ Allahabad Safeda) took maximum number of days (29.72 days) for first leaf opening.

Favourable relative humidity and temperature presented in shade net enhances 35 mitotic division which continues and maximises elongation, differentiation and cell development viz., collenchyma and fibres in L-49 which finally leads to the formation of xylem and phloem tissues which promotes good water uptake, nutrients and increases rapid growth resulted in early emergence of leaf. The results are supported by findings of Gotur *et al*. (2017) [6] in guava.

Number of sprouts per graft

The experimental data given in Table 2 shows that among different treatment combinations, highest number of sprouts (7.93) was recorded in grafts whose grafting were performed on 10th September with scion of L-49 (D_1V_2) followed by D_2V_2 with number of sprouts (7.07). Whereas in grafts which were grafted on 25th November with scion of Allahabad Safeda (D_6V_1), lowest number of sprouts (3.13) was recorded.
Amiable relative humidity associated with genetic performance of scion and the advantageous microclimate favoured early bud break which ultimately begin to sprout early with maximal sprouting. Our results are similar with findings of Anil *et al*. (2013) [1] in guava cv. Sardar

Number of leaves per graft

The data recorded during the experiment according to different treatment combinations has been shown in Table 2 for better understanding. Among various treatment combination, highest number of leaves (12.03) and (22.07) was noted in grafts which were grafted with L-49 on 10th September (D_1V_2) followed by (11.13) and (20.63) D_2V_2 at 60 and 120 days after grafting, respectively and lowest number of leaves (7.90) and (14.50) was recorded in grafts in which grafting were performed on 25th November with scion of Allahabad Safeda (D_6V_1) at 60 and 120 days after grafting, respectively.
Favourable environmental conditions, better production of nutrients and the genotypic characteristics of the variety, ensured water availability and increases the rate of photosynthesis which result in the formation of more food materials and facilitate more number of leaves. Our results are in accordance with findings of Kholia *et al*. (2021) [7] in guava

Graft height (cm)

As per the data concerned presented in table 2 shows that among different treatment combination, maximum graft height (32.49 cm) and (48.15 cm) was found in grafting performed on 10th September with L-49 (D_1V_2) which was followed by (30.87 cm) and (45.67 cm) D_2V_2 at 30 and 120 days after grafting, respectively. However, grafting performed on 25th November with Allahabad Safeda (D_6V_1) recorded minimum graft height (26.06 cm) and (34.86 cm) at 30 days after grafting and 120 days after grafting, respectively.
Maximum graft height may be due to 46 the presence of suitable temperature and relative humidity associated with genotypic characteristic of scion. Present findings are duly supported by Basunia *et al*. (2016) [4] in guava.

Rootstock girth (mm)

The experimental data presented in Table 2 shows that among various treatments combinations, highest rootstock girth (7.23 mm) and (10.63 mm) was recorded in plants in which grafting was performed on 10th September with L-49 (D_1V_2) which was followed by (6.82 mm) and (10.31 mm) D_2V_2 at 30 and 120 days after grafting, respectively. Whereas, plants grafted on 25th November with Allahabad Safeda (D_6V_1) noted lowest rootstock girth (5.37 mm) and (7.77 mm) at 30 and 120 days after grafting, respectively.
Maximum rootstock girth might be due to suitable temperature and relative humidity present in shade net house, prevailing during the graft growth period associated with genotypic character of variety which ultimately enhances rootstock girth. Our findings are closely related with findings of Kholia *et al*. (2022) [7] in guava.

Scion girth (mm)

The data gathered during the experiment presented in table 2 shows that Among different combination, grafts in which grafting was performed on 10th September with L-49 (D_1V_2), maximum scion girth (6.58 mm) and (9.71 mm) was noted which was at par (6.31 mm) and (9.41 mm) with D_2V_2 at 30 and 120 days after grafting, respectively. Whereas, minimum scion gith (4.22 mm) and (6.87 mm) was obtained in grafts whose grafting was done with variety Allahabad Safeda on 25th November (D_6V_1) at 30 days after grafting and 120 days after grafting, respectively.
Maximum scion girth may be due to the favourable temperature and relative humidity level associated with genotypic character of variety. This results are closely related with results of Kholia *et al*. (2022) [7] in guava.

Leaf area (cm^2)

The data gathered during the experiment in accordance with various treatment combinations are displayed in Table 2 shows that the maximum leaf area (23.48 cm^2) was recorded in grafts which were grafted on 10th September with L-49 (D_1V_2) followed by (21.88 cm^2) D_2V_2. Whereas, the grafts which were grafted on 25th November with Allahabad Safeda (D_6V_1) observed minimum leaf area (17.05 cm^2)
Highest leaf area may be due to an increase in the number of sprouts with higher meristematic activity as well as an early healing of the graft union due to the prevailing optimum temperature and relative humidity associated with cellular compatibility characteristics of the scion wood of L-49 and favourable physiological conditions of the scion. Our results are duly supported by findings of Gotur *et al*. (2017) [6] in guava.

Graft success (%)

The data collected during the trial in accordance with various treatment combinations has been demonstrated in Table 2. Result revealed that maximum graft success percent (74.84%) was found in the plants which were grafted on 10th September with scion of L-49 (D1V2) which was followed by (65.88%) D1V2. However, plants which were grafted on 25th November with Allahabad Safeda (D6V1) recorded minimum graft success percent (34.44%).
Highest graft success may be due to the presence suitable temperature and atmospheric humidity associated with genetic characteristic of scion, which may have been the primary factor in the increased graft compatibility and rapid formation of vascular cambium and ultimately graft success. This result is closely related with findings of Kholia *et al*. (2022) [7] and Khunte *et al*. (2023) [8] in guava.

Graft Survival (%)

The results acquired during the experiment in accordance with various treatment combinations are shown in Table 2. Result showed that grafts which were grafted on 10th September with scion of L-49 (D1V2) showed maximum graft survival percent (70.00%) followed by (62.33%) D1V2. While the minimum graft success percent (32.89%) was found in grafts which were grafted on 25th November with scion of Allahabad Safeda (D6V1).
Maximum graft survival percent may be due to congenial weather conditions like temperature, light, sunshine rate, and

relative humidity that prevailed during its growth period inside shade net led to increased cell activity and improved callusing at the union of stock and scion, which may be the cause of the higher survival percent during this time period which is associated with genetic characteristics of scion. This is closely related with findings of Kholia *et al*. (2022) [7] in guava.

Table 1: Main effect of different date of wedge grafting and different varieties of scion on success of guava grafts.

Treatment combinations	Days taken to bud sprouting	Days required for first leaf opening	Number of sprouts per graft	Number of leaves per graft		Graft Height (cm)		Rootstock girth (mm)		Scion girth (mm)		Leaf area (cm^2)	Graft Success (%)	Graft survival (%)
				60 DAG	120 DAG	30 DAG	120 DAG	30 DAG	120 DAG	30 DAG	120 DAG			
Date of wedge grafting														
D_1	14.97	18.07	7.23	11.02	20.55	30.93	45.84	6.99	10.45	6.42	9.54	21.91	70.18	65.55
D_2	16.38	19.59	6.57	10.40	19.43	29.80	43.77	6.77	10.19	6.20	9.29	20.95	61.83	59.11
D_3	19.34	22.64	5.37	9.40	17.53	28.67	40.22	6.23	9.56	5.59	8.66	19.41	53.61	51.11
D_4	20.23	23.65	4.93	9.08	16.98	28.52	38.52	6.08	9.26	5.29	8.36	19.03	47.28	45.44
D_5	23.57	26.53	3.77	8.30	15.40	27.33	36.23	5.86	8.60	4.65	7.70	18.32	39.89	37.44
D_6	24.02	27.74	3.45	8.17	15.02	26.83	35.18	5.59	8.08	4.33	7.18	17.84	35.89	33.78
SEM	0.297	0.282	0.1	0.186	0.253	0.302	0.495	0.076	0.079	0.072	0.079	0.317	0.82	0.953
CD at 5%	0.871	0.827	0.293	0.547	0.742	0.885	1.453	0.222	0.233	0.21	0.231	0.932	2.407	2.797
Varieties of Scion														
V_1	21.22	24.44	4.81	8.88	16.64	27.93	38.68	6.15	9.12	5.21	8.21	20.33	48.06	45.81
V_2	18.28	21.62	5.63	9.91	18.33	29.43	41.24	6.36	9.60	5.61	8.69	23.48	54.82	51.66
SEM	0.171	0.163	0.058	0.108	0.146	0.174	0.286	0.044	0.046	0.041	0.046	0.183	0.473	0.55
CD at 5%	0.503	0.477	0.169	0.316	0.428	0.511	0.839	0.128	0.134	0.121	0.134	0.538	1.39	1.615

D1-10 September V1-Allahabad Safeda
D2-25 September V2-Lucknow - 49
D3-10 October
D4-25 October
D5-10 November
D6-25 November

Table 2: Interaction effect of different date of wedge grafting and different varieties of scion on success of guava grafts.

Treatment combinations	Days taken to bud sprouting	Days required for first leaf opening	Number of sprouts per graft	Number of leaves per graft		Graft Height (cm)		Rootstock girth (mm)		Scion girth (mm)		Leaf area (cm^2)	Graft Success (%)	Graft survival (%)
				60 DAG	120 DAG	30 DAG	120 DAG	30 DAG	120 DAG	30 DAG	120 DAG			
D_1V_1	16.80	19.90	6.53	10.00	19.03	29.37	43.52	6.74	10.27	6.26	9.36	20.33	65.51	61.11
D_1V_2	13.13	16.23	7.93	12.03	22.07	32.49	48.15	7.23	10.63	6.58	9.71	23.48	74.84	70.00
D_2V_1	17.63	20.84	6.07	9.67	18.23	28.72	41.87	6.71	10.06	6.09	9.16	20.02	57.77	55.88
D_2V_2	15.13	18.34	7.07	11.13	20.63	30.87	45.67	6.82	10.31	6.31	9.41	21.88	65.88	62.33
D_3V_1	20.17	23.47	5.07	9.00	16.87	28.31	38.91	6.03	9.30	5.33	8.40	19.03	49.89	47.78
D_3V_2	18.50	21.80	5.67	9.80	18.20	29.03	41.53	6.44	9.83	5.86	8.93	19.78	57.33	54.44
D_4V_1	21.24	24.66	4.60	8.67	16.40	28.25	37.05	6.27	8.81	4.85	7.91	18.90	42.89	41.00
D_4V_2	19.21	22.63	5.27	9.50	17.57	28.79	39.99	5.89	9.71	5.72	8.81	19.15	51.66	49.88
D_5V_1	25.47	28.08	3.47	8.07	14.80	26.86	35.86	5.75	8.49	4.54	7.59	17.85	37.89	36.22
D_5V_2	21.67	24.98	4.07	8.53	16.00	27.80	36.60	5.97	8.71	4.77	7.81	18.78	41.89	38.66
D_6V_1	26.00	29.72	3.13	7.90	14.50	26.06	34.86	5.37	7.77	4.22	6.87	17.05	34.44	32.89
D_6V_2	22.03	25.75	3.77	8.43	15.53	27.60	35.50	5.80	8.39	4.45	7.49	18.63	37.33	34.66
SEM	0.42	0.398	0.141	0.264	0.357	0.426	0.7	0.107	0.112	0.101	0.111	0.449	1.16	1.347
CD at 5%	1.232	1.169	0.414	0.774	1.049	1.252	2.054	0.314	0.329	0.297	0.327	1.317	3.405	3.956
CV%	3.68	3.00	4.70	4.87	3.54	2.58	3.03	2.95	2.08	3.25	2.27	3.97	3.90	4.79

D_1V_1 (10 Sep+A.S.)
D_1V_2 (10 Sep+L-49)
D_2V_1 (25 Sep+A.S.)
D_2V_2 (25 Sep+L-49)
D_3V_1 (10 Oct+A.S.)
D_3V_2 (10 Oct+L-49)
D_4V_1 (25 Oct+A.S.)
D_4V_2 (25 Oct+L-49)
D_5V_1 (10 Nov+A.S.)
D_5V_2 (10 Nov+L-49)
D_6V_1 (25 Nov+A.S.)
D_6V_2 (25 Nov+L-49)

Conclusion

It is possible to draw the following conclusion from the findings of research that among the different date of wedge grafting, minimum number of days taken to bud sprouting, minimum number of days required for first leaf opening, maximum number of sprouts per graft, number of leaves per graft, graft height, rootstock girth, scion girth, leaf area and highest graft success and survival percent was observed when grafting was performed on 10 September (D1). In case of different varieties of scion, Lucknow-49 is best in all parameters like minimum number of days taken to bud sprouting, for first opening of leaf, maximum number of sprouts per graft, number of leaves per graft, graft height, rootstock girth, scion girth, leaf area and finally maximum graft success and graft survival percent. Treatment combination D1V2 (10 September + L-49) was found superior for growth parameters viz, minimum number of days taken to bud sprouting, for first opening of leaf, maximum number of sprouts per graft, total number of leaves per graft, graft height, rootstock girth, scion girth, leaf area, graft success percent and graft survival percentage. Hence, the treatment combination D1V2 (10 September + L-49) was found to be the most appropriate for graft preparation of guava and also can be recommended for the production of quality planting materials of guava in Chhattisgarh agro-climatic condition.

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