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Effect of different time and growing conditions on success and growth rate of softwood grafting in guava (*Psidium guajava* L.)

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Abstract
An experiment was conducted different time and growing conditions on success and growth rate of softwood grafting in guava (*Psidium guajava* L.) under Bundelkhand region of Uttar Pradesh. The experiment was laid out in Randomized Block Deign in a Factorial with 18 treatments with three replication. The treatment on Different time (15th September, 15th October, 15th November, 15th December, 15th January, 15th February) and different field condition (Open field, Shade net house and Poly house). Among the Result revealed are the significant that the maximum Graft success percentage 30 days (63.74), Graft success percentage 60 days (73.48), sprouts/graft at 30 (2.06), sprouts/graft at 60 (5.97), sprout length at 30 (2.75), days sprout length at 60 days (7.55), leaf length (cm) at 30 days(6.90), leaf length (cm) at 60 days (9.07), leaf width (cm) at 30 days after (3.65), leaf width (cm) at 60 days (4.94) was recorded with C_1 (open field) condition. Days taken to bud sprouting (21.56), days taken to bud swell (23.82), expand full leaf (41.47) was recorded C_3 (Poly house) condition. Therefore, on the basic of result, open field condition from 15th February found best for highest success full growth condition.

Keywords: growing, softwood, grafting, guava, *Psidium guajava* L.

Introduction
Guava (*Psidium guajava* L.) is one of the most important fruit crops in India. It is the most important crop species within the Myrtaceae family Rai *et al.*, 2007 [10] and with chromosome number 2n=22. It is also known as "apple of the tropics" and "poor man's apple." Guava is originated to tropical America stretching from Peru. The most important guava growing states in India are Uttar Pradesh, Tamil Nadu, Kerala, Bihar, Karnataka, West Bengal, Orissa, Maharashtra, Gujarat, Madhya Pradesh, Andhra Pradesh, Rajasthan, Kerala and Punjab. It is a good source of Vitamin C (150-200 mg/100 g of pulp) Lal 1983, Tiwari *et al.* 1992 [6, 13]. When medium has the right conditions, such as appropriate aeration, proper watering, and enough nutrients available, it encourages the development of an extensive root system, which leads to exceptional plant growth Neelam and Ishtiaq, 2001. Guava is propagated by both sexually like by seed Zamir *et al.* 2003 [15] and asexually methods like layering, and cutting budding Chandra *et al.* 2004 [1]. Hence efforts are made to grow guava by cuttings. Cutting is the most economical method of vegetative propagation Davies and Hartman, 1988 [2]. It succeeded in growing guava softwood cutting by using root growth regulators Mukhtar *et al.* 1998 and *et al.* 1988 [3]. The primary factor determining whether grafts survive in the long run is the time of grafting. Guava softwood grafting offers a good response by boosting the percentage of quality grafts that survive and succeed with the least chance of dying, leading to better and more uniform orchard establishment.

Materials and Methods
The present investigation was carried Fruit Nursery, Department of Fruit Science, College of Horticulture, Banda University of Agriculture and Technology, Banda during 2021-22. The different time and growing conditions on success and growth were applied (T_1= 15th September, T_2= 15th October, T_3= 15th November, T_4= 15th December, T_5= 15th January and T_6= 15th February). The experiment was conducted under (C_1= Shade house, C_2= Poly house and C_3= Open field) conditions. There were eighteen treatment combination replicated thrice in Factorial Random Block Design.

Treatment details

The treatment combinations *i.e.* T_1C_1= 15th September in open field, T_2C_1=15th October in open field, T_3C_1=15th November in open field, T_4C_1=15th December in open field, T_5C_1=15th January in open field, T_6C_1=15th February in open field, T_1C_2=15th September in Shade net house, T_2C_2=15th October in Shade net house, T_3C_2=15th November in Shade net house, T_4C_2=15th December in Shade net house, T_5C_2=15th January in Shade net house, T_6C_2=15th February in Shade net house, T_1C_3 =15th September in Poly house, T_2C_3=15th October in Poly house, T_3C_3=15th November in Poly house, T_4C_3=15th December in Poly house, T_5C_3=15th January in Poly house and T_6C_3=15th February in Poly house.

Observation details

The observation on days required for graft success percentage 30 and 60 days, taken to bud sprouting, days taken to bud swell, expand full leaf, sprouts /graft at 30 and 60, sprout length at 30 and 60 days, leaf length (cm) at 30 and 60 days, leaf width (cm) at 30 and 60 days.

Graft success percentage

$$\text{Graft success percentage} = \frac{\text{Number of sprouted grafts}}{\text{Total number of grafts}} \times 100$$

Results and Discussion

Graft successful percentage: It is clear from the experiment that different time and growing conditions had a significant effect on graft success percentage 30 and 60 days (Table-1) maximum graft success percentage was recorded with C_1 (73.13) and (81.93) and minimum graft success percentage C_3 (55.82) and (66.88) in Open field. For the graft success percentage time it was significant higher in T_6 (73.13) and (81.93) in 15th February and minimum graft success percentage T_4 (43.78) and (50.03) interaction effect on Graft success percentage was significant higher with T_6C_1 (77.10) and (85.17) and minimum with T_4C_3 (41.03) and (47.23). The higher graft success during February month might be due to enhanced the metabolic activity involved in production of cell tissue and cell activity reported by Visen *et al.* (2010) [14]. High humidity around the graft scion reduce the aridity of active tissue of graft scion resulting less possibelity for mort ability of graft union under poly house condition reported by Jholgiker P. *et al*. (2019) [4] in soft wood grafting in guava.

Days taken to bud sprouting

Significant maximum days taken bud sprouting (21.56) was observed with C_3 (poly house) whereas minimum days taken bud sprouting C_1 (14.95) was recorded with open field. For the days taken bud sprouting it was significant maximum T_4 (23.04) and minimum T_6 (12.54) interaction effect on days taken to bud sprouting was significant maximum T_3C_3 (26.41) and minimum of days taken bud sprouting T_6C_1 (9.25). The minimum day taken to bud sprouting may due to better contact of cambial layers of stock and scion resulting in early callus formation and beginning of subsequent growth. These finding are also supported by the result Kholi *et al.* (2017) [5] in guava and similarly result visen *et al.* (2010) [14] in guava. Temperature and water availability increase the rate of photosynthesis it is most important to the accumulation of carbohydrate facilitate improved growth and development Raghavendra *et al.* (2009).

Days taken to bud swell

Significant effect (table -1) higher days taken to bud swell (23.82) was observed with C_3 (poly house) whereas minimum days taken to bud swell C_1 was recorded open field condition. For the days taken to bud swell it was significant higher T_4 (24.91) and minimum T_6 (17.37) interaction effect on days taken to bud swell was significant higher T_4C_3 (26.10) and minimum T_6C_1 (12.56). Might be due to more photosynthetic adaptation at source and reduced sink activity in the grafting scion along with capable for translocation of assimilates from mature leaves and roots Sing *et al.* (2014) in guava.

Expand full leaf and Sprouts/graft

Significant effect maximum expand full leaf (41.47) was observed with C_3 poly house whereas minimum expand full leaf (37.13) was recorded with C_1 open field condition. For expand full leaf it was significant maximum T_4 (42.62) and minimum T_6 (36.08) interaction significant effect on expand full leaf maximum T_5C_3 (45.36) and minimum T_6C_1 (34.26). Humidity play vital role in sprouting of graft scion as higher humidity enhance in expand full leaf Visen *et al.* (2010) [14]. Significant higher Sprouts/graft at 30 and 60 days (2.06) and (5.97) was observed with C_3 (open field) whereas minimum Sprouts/graft at 30 and 60 days (1.28) and (4.88) was recorded with C_3 poly house. Significant higher Sprouts/graft 30 and 60 days (2.11) and (5.78) was observed T_6 whereas minimum Sprouts/graft (1.23) and (4.66) was observed T_4 interaction maximum effect on Sprouts/graft at 30 and 60 days (2.53) and (6.55) was recorded T_6C_1 Whereas minimum (0.93) and (4.46) with T_4C_3.

Sprout length

The experiment (Table -2) that different time and growing conditions had a significant effect maximum sprout length at 30 and 60 days (2.75) and (7.55) was observed with C_1 Open field whereas minimum sprout length (1.82) and (6.33) was observed with C_3 poly house. Significant maximum sprout length 30 and 60 days (2.84) and (8.81) was observed T_6 and minimum sprout length (1.37) and (5.06) was observed T_4 interaction maximum effect on sprout length 30 and 60 days (3.50) and (9.14) was recorded T_6C_1 whereas minimum sprout length 30 and 60 days (1.00) and (4.40) with T_4C_3. Highest number of sprout and sprout length this may be due to the high rate of photosynthesis and higher accumulation of carbohydrate which easily served as a reservoir of food for new growth reflected to higher number of sprout and sprout length reported by Padmapriya *et al* (2021) [9].

Leaf length and leaf width

Leaf length 30 and 60 days are significant effect higher (6.90) and (9.07) was observed with C_1 Open field whereas minimum leaf length (6.22) and (8.32) was observed with C_3 poly house. Significant effect higher leaf length at 30 and 60 days (7.16) and (9.23) was observed T_6 and minimum leaf length at 30 and 60 days (6.02) and (8.05) was observed T_4 interaction higher leaf length 30 and 60 days (7.50) and (9.60) was recorded T_6C_1 whereas minimum leaf length at 30 and 60 days (5.63) and (7.73) with T_4C_3. Significant effect maximum leaf width at 30 and 60 days are (3.65) and (4.94) was observed with C_1 Open field whereas minimum leaf width (3.11) and (4.48) was observed with C_3 poly house. Significant effect higher leaf width at 30 and 60 days (3.85) and (5.07) was observed T_6 and minimum leaf width at 30 and

60 days (2.76) and (4.23) was observed T_4 interaction higher leaf width at 30 and 60 days (4.26) and (5.43) was recorded T_6C_1 whereas minimum leaf width at 30 and 60 days (2.80) and (4.06) with T_4C_3.

Table 1: Effect of grafting time, growing conditions and their interaction on graft success percentage 30 and 60 days, days taken to bud sprouting, days taken to bud swell, expand full leaf, sprouts /graft at 30 and 60 days.

Treatment	Graft success percentage 30 days	Graft success percentage 60 days	Days taken to bud sprouting	days taken to bud swell	Expand full leaf	Sprouts /graft at 30	Sprouts /graft at 60
T_1	65.36	76.00	17.01	20.73	38.17	1.73	5.34
T_2	57.23	68.71	19.00	22.38	39.71	1.57	5.19
T_3	53.58	65.36	22.29	23.56	41.24	1.43	5.03
T_4	43.78	50.03	23.04	24.91	42.62	1.23	4.66
T_5	66.61	79.05	14.09	19.68	37.16	1.73	5.55
T_6	73.13	81.93	12.54	17.37	36.08	2.11	5.78
S.Em±	0.09	0.04	0.20	0.30	0.10	0.04	0.04
CD at 5%	0.27	0.13	0.59	0.86	0.29	0.12	0.12
C_1	63.74	73.48	14.95	18.24	37.13	2.06	5.97
C_2	60.29	70.17	17.89	22.26	38.90	1.56	4.93
C_3	55.82	66.88	21.56	23.82	41.47	1.28	4.88
S.Em±	0.13	0.06	0.29	0.42	0.14	0.06	0.62
CD at 5%	0.39	0.18	0.83	1.22	0.42	0.17	0.17
T_1C_1	68.33	79.33	13.83	17.13	36.36	2.30	6.10
T_2C_1	62.10	72.30	16.46	19.10	37.26	2.03	5.99
T_3C_1	58.23	68.43	18.48	21.63	39.36	1.76	5.76
T_4C_1	46.40	53.36	20.91	23.83	40.23	1.50	5.03
T_5C_1	70.30	82.37	10.41	15.20	35.20	2.24	6.39
T_6C_1	77.10	85.17	9.25	12.56	34.26	2.53	6.55
T_1C_2	66.33	76.26	16.67	21.63	37.90	1.50	5.07
T_2C_2	57.40	68.40	18.71	21.63	39.70	1.46	4.83
T_3C_2	54.23	65.43	21.62	23.73	40.73	1.36	4.68
T_4C_2	43.93	49.30	22.52	24.80	42.26	1.26	4.49
T_5C_2	66.56	79.26	15.24	20.60	36.63	1.50	5.20
T_6C_2	73.30	82.33	12.57	19.06	36.16	2.26	5.30
T_1C_3	61.43	72.40	20.52	23.43	40.26	1.40	4.87
T_2C_3	52.20	65.43	21.84	24.33	42.16	1.23	4.75
T_3C_3	48.30	62.23	26.41	25.33	43.63	1.16	4.65
T_4C_3	41.03	47.23	25.71	26.10	45.36	0.93	4.46
T_5C_3	62.96	75.56	19.05	23.26	39.60	1.46	5.06
T_6C_3	69.00	78.27	15.82	20.50	37.73	1.53	5.50
S.Em±	0.23	0.11	0.50	0.73	0.25	0.10	0.10
CD at 5%	0.67	0.31	1.44	2.11	0.72	0.29	0.30

Where C_1= Open field, C_2= Shade net house, C_3= Poly house, T_1= 15th September, T_2= 15th October, T_3= 15th November, T_4= 15th December, T_5= 15th January, T_6= 15th February, T_1C_1= 15th September in open field, T_2C_1=15th October in open field, T_3C_1=15th November in open field, T_4C_1=15th December in open field, T_5C_1=15th January in open field, T_6C_1=15th February in open field, T_1C_2 =15th September in Shade net house, T_2C_2=15th October in Shade net house, T_3C_2=15th November in Shade net house, T_4C_2=15th December in Shade net house, T_5C_2=15th January in Shade net house, T_6C_2=15th February in Shade net house, T_1C_3=15th September in Poly house, T_2C_3=15th October in Poly house, T_3C_3=15th November in Poly house, T_4C_3=15th December in Poly house, T_5C_3=15th January in Poly house and T_6C_3=15th February in Poly house.

Table 2: Effect of grafting time, growing conditions and their interaction on sprout length at 30 and 60 days, leaf length (cm) at 30 and 60 days, leaf width (cm) at 30 and 60 days.

Treatment	Sprout length at 30 days	Sprout length at 60 days	Leaf length (cm) at 30 days	Leaf length (cm) at 60 days	Leaf width (cm) at 30 days	Leaf width (cm) 60 days
T_1	2.46	7.37	6.71	8.81	3.54	4.80
T_2	2.12	6.76	6.50	8.63	3.23	4.54
T_3	2.07	5.31	6.21	8.45	3.00	4.43
T_4	1.37	5.06	6.02	8.05	2.76	4.23
T_5	2.70	8.33	6.90	9.02	3.63	4.86
T_6	2.84	8.81	7.16	9.23	3.85	5.07
S.Em±	0.05	0.08	0.02	0.02	0.02	0.04
CD at 5%	0.16	0.23	0.07	0.08	0.07	0.12
C_1	2.75	7.55	6.90	9.07	3.65	4.94
C_2	2.21	6.94	6.61	8.70	3.25	4.50
C_3	1.82	6.33	6.22	8.32	3.11	4.48
S.Em±	0.08	0.11	0.03	0.04	0.03	0.06
CD at 5%	0.23	0.33	0.10	0.12	0.10	0.17
T_1C_1	3.20	7.93	7.00	9.30	3.93	5.30
T_2C_1	2.40	7.66	6.80	9.16	3.43	4.70

T_3 C_1	2.40	5.90	6.50	8.66	3.23	4.50
T_4 C_1	1.70	5.84	6.30	8.33	2.96	4.33
T_5 C_1	3.21	9.13	7.30	9.40	4.06	5.33
T_6 C_1	3.50	9.14	7.50	9.60	4.26	5.43
T_1 C_2	2.30	7.60	6.70	8.66	3.30	4.56
T_2 C_2	2.30	6.63	6.40	8.46	3.00	4.43
T_3 C_2	2.20	5.30	6.30	8.50	2.76	4.40
T_4 C_2	1.40	4.96	6.06	8.10	2.50	4.30
T_5 C_2	2.60	7.96	6.93	9.16	3.40	4.66
T_6 C_2	2.40	8.83	7.26	9.33	3.70	4.90
T_1 C_3	1.90	6.53	6.43	8.46	3.40	4.53
T_2 C_3	1.66	6.00	6.30	8.26	3.26	4.43
T_3 C_3	1.53	4.73	5.80	8.20	3.00	4.40
T_4 C_3	1.00	4.40	5.63	7.73	2.80	4.06
T_5 C_3	2.30	8.20	6.43	8.50	3.43	4.60
T_6 C_3	2.50	8.16	6.73	8.78	3.60	4.83
S.Em±	0.14	0.20	0.06	0.07	0.06	0.10
CD at 5%	0.41	0.58	0.19	0.20	0.17	0.30

Where C_1=Open field, C_2= Shade net house, C_3=Poly house, T_1= 15th September, T_2= 15th October, T_3= 15th November, T_4= 15th December, T_5= 15th January, T_6= 15th February, T_1C_1= 15th September in open field, T_2C_1=15th October in open field, T_3C_1=15th November in open field, T_4C_1=15th December in open field, T_5C_1=15th January in open field, T_6C_1=15th February in open field, T_1C_2= 15th September in Shade net house, T_2C_2=15th October in Shade net house, T_3C_2=15th November in Shade net house, T_4C_2=15th December in Shade net house, T_5C_2=15th January in Shade net house, T_6C_2=15th February in Shade net house, T_1C_3=15th September in Poly house, T_2C_3=15th October in Poly house, T_3C_3=15th November in Poly house, T_4C_3=15th December in Poly house, T_5C_3=15th January in Poly house and T_6C_3=15th February in Poly house.

Conclusion

It can concluded that study of different time and growing conditions on success and growth rate of softwood grafting in guava the best during February (M_6) month under poly house (C_1) condition is more favorable for better success rate and better graft survived from Bundelkhand region.

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