Bangladesh J. Bot. **45**(2): 313-320, 2016 (June)

PROPAGATION TECHNIQUES OF *PSIDIUM GUAJAVA* L. UNDER DIFFERENT GROWING CONDITIONS

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Key words: *Psidium guajava*, Wedge grafting, Propagation techniques

Abstract

The experiment was conducted to assess the success of various techniques of propagation under open and polyhouse condition. The experimental material consisted of scion cultivar Allahabad Safeda. Five methods of propagation *viz.,* shield budding, patch budding, veneer grafting, wedge grafting and wedge grafting with polycap were tried on two rootstocks namely L-49 and local guava in both open and polyhouse condition. The result exhibited significant variation with respect to number of days taken for sprouting, sprouting per cent, per cent bud/graft success and length and girth of sprout as affected by various rootstocks, methods, condition and their interaction. Polyhouse condition positively influenced the success rate and growth parameter under study.

Introduction

Guava (*Psidium guajava* L.) is one of the most nutritional fruit crops of the tropics. It is a highly cross pollinated crop. Consequently, being heterozygous in nature, it does not breed true to type plants through seeds. The greatest handicap in guava plantation is discriminate multiplication of plant from unreliable sources by nurserymen. The initial planting material is the basic requirement on which the final crop depends both in quality and quantity (Singh *et al*. 2005). Guava is being propagated through air layering, stooling, grafting and inarching, but these methods are not good enough due to varying rate of success, absence of tap root and cumbersome process. In view of high return and potential for processing, there is a tremendous scope for bringing substantial area under guava crop in India, a rapid and successful propagation technique is required as the area under crop is expanding and there is great demand for guava saplings throughout the year. Due to unfavourable climatic condition during winter months, propagation of guava is restricted to months of mild climate in open field condition. So keeping these points in mind, the present investigation was carried out to assess the success of various methods of propagation under open and polyhouse condition during winter months.

Materials and Methods

The present investigation was carried out during 2010-11 and 2011-12 at Horticulture Research Garden, Institute of Agricultural Sciences, B.H.U., Varanasi. The experimental material consisted of scion cultivar Allahabad Safeda. Five methods of propagation *viz.*, shield budding (M_1), patch budding (M_2), veneer grafting (M_3), wedge grafting (M_4) and wedge grafting with polycap (M_5) were tried on two rootstocks, namely L-49 (S_1) and local guava (S_2) in open (C_1) and polyhouse (C_2) conditions. Thus there were 20 treatment combinations replicated three times in CRD. The budding or grafting was practiced on 9 - 12 months old rootstock of guava raised by seed in poly bags. The scion shoots of 15 to 18 cm long of pencil thickness (0.5 to 1.0 cm) with 3 to 4 healthy buds were selected for grafting. Each selected shoot was defoliated one week before

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separation from the mother plant in order to invigorate the auxiliary buds. However, fresh buds were used for budding methods. In polyhouse the humidity ranged from 60 - 70 per cent and the temperature was maintained between 25 and 30ºC. The data on bud sprouting was recorded and the average time taken for a bud to sprout from the date of budding or grafting was worked out and expressed in days. Observations were recorded on success of grafting such as percentage of sprouting, mortality and success. The sprouted buds/grafts which survived for next 15th days after sprouting were counted and expressed in per cent. The survival per cent was calculated in relation to the number of buds/grafts attempted. Data on vegetative growth *viz.*, length and girth of sprouted shoot were recorded at 90 days after propagation. The data were analyzed as per method outlined by Panse and Sukhatme (1987) and results were evaluated at 5% level of significance.

Results and Discussion

Results presented in Table 1 show that during 2010-11, variation due to rootstocks, methods and conditions were found significant with respect to days taken for sprouting of bud, sprouting per cent and success per cent. Polyhouse condition significantly reduced the number of days taken for sprouting of bud. The minimum number of days (12.56) taken for sprouting of bud was recorded with treatment $S_2M_5C_2$ (local + wedge grafting with polycap + polyhouse), while the bud sprouting took maximum time (39.16) with treatment $S_1M_1C_1$ (L-49 + shield budding + open). The minimum days taken for sprouting of bud (24.06) was recorded in rootstock S_2 (local) as compared to S_1 (L-49). It could be attributed to genetical performance of the local rootstock and suitable micro-climatic condition inside polyhouse, which had favourable effect on early sprouting of graft-scion. This result is in agreement with that of Bajpai *et al*. (1989), who recorded varietal differences in relation to sprouting of grafts. Earliest sprouting (19.05 days) was observed with method M_5 (Wedge grafting with polycap). For double factor interaction, earliest sprouting of bud was recorded in treatment combination S_2M_5 (local + wedge grafting with polycap), S_2C_2 (local + polyhouse), M_5C_2 (wedge grafting with polycap + polyhouse). When the experiment was repeated during 2011-12 (Table 1), almost similar trends were recorded as observed during 2010-11. Graft sprouting took place 7 - 10 days earlier in polyhouse as compared to open field and this result is in accordance with findings of Samiullah *et al*. (2004) and Singh *et al*. (2007) who reported that grafting in green house significantly reduces the time taken for sprouting than those grafted in open field.

During 2010-11, data (Table 2) show that the maximum per cent of sprouting (96.08) was recorded in treatment combination $S_2M_5C_2$ (local + wedge grafting with polycap + polyhouse). However, minimum sprouting percentage (45.98) was recorded in treatment combination $S_1M_1C_1$ (L-49 + shield budding + open). The maximum per cent of sprouting with treatment combination $S_2M_5C_2$ was due to production and interlocking of parenchymatous cells (callus tissue) by both stock and scion along with establishment of intimate contact of considerable amount of cambial region of both stock and scion under favourable environmental conditions (Hartmann *et al*. 1993). The results are in consonance with the earlier findings of Singh and Pandey (1998) in guava and Keskar *et al*. (1991) in aonla. Higher per cent of sprouting (68.97) was recorded with S_2 (local) rootstock. Method M_5 (Wedge with polycap) gave highest sprouting per cent (86.17). Maximum sprouting percentage (77.98) was recorded in polyhouse condition (C_2). During 2011-12, both the rootstocks, all methods of budding or grafting and growing condition performed almost in the same way as during 2010-11.

Table 1. Effect of rootstocks, methods and conditions on days taken for sprouting of bud.

Treatments	2010-11			2011-12		
	C_1	C_2	Mean	C_1	C_2	Mean
S_1M_1	39.16	28.89	34.03	38.28	27.14	32.71
S_1M_2	37.50	26.22	31.86	36.37	23.71	30.04
S_1M_3	33.43	24.57	29.00	35.01	22.50	28.76
S_1M_4	30.77	18.42	24.60	31.15	16.33	23.74
S_1M_5	25.03	16.19	20.61	26.35	14.92	20.64
S_2M_1	33.11	24.80	28.95	32.69	24.21	28.45
S_2M_2	31.10	23.65	27.38	31.38	23.24	27.31
S_2M_3	30.47	22.70	26.59	30.88	22.36	26.62
S_2M_4	25.05	15.94	20.50	25.33	14.00	19.67
S_2M_5	22.42	12.56	17.49	22.89	11.24	17.07

(b) Rootstock × condition, method × condition

Treatments	2010-11			2011-12		
Rootstocks	C_1	C_2	Mean	C_1	C_2	Mean
L-49 (S_1)	33.18	22.86	28.02	33.43	20.92	27.18
Local (S_2)	28.43	19.93	24.18	28.63	19.01	23.82
Methods of budding or grafting						
Shield budding (M_1)	36.14	26.84	31.49	35.49	25.68	30.58
Patch budding (M_2)	34.30	24.94	29.62	33.87	23.48	28.67
Veneer grafting (M_3)	31.95	23.64	27.79	32.95	22.43	27.69
Wedge grafting (M_4)	27.91	17.18	22.55	28.24	15.17	21.54
Wedge grafting with polycap (M_5)	23.73	14.37	19.05	24.62	13.08	18.85
Mean	30.80	21.39		31.03	19.97	

ANOVA

Particulars	2010-11		2011-12	
	SEm±	CD at 5%	SEm±	CD at 5%
Rootstock (S)	0.19	0.53	0.18	0.51
Method of budding/grafting (M)	0.29	0.84	0.28	0.80
Conditions (C)	0.19	0.53	0.18	0.51
Rootstock (S) × method (M)	0.42	1.19	0.40	1.13
Rootstock (S) × condition (C)	0.26	0.75	0.25	0.71
Method (M) × condition (C)	0.42	1.19	0.40	1.13
Rootstock (S) × method (M) × condition (C)	0.59	1.69	0.56	1.60

During 2010-11, data presented in Table 3 reveal that maximum survival per cent (94.85) was recorded with treatment $S_2M_5C_2$ (local + wedge grafting with polycap + polyhouse). However, minimum survival of bud/graft (42.45%) was recorded in treatment combination $S_1M_1C_1$ (L-49 + shield budding + open). The highest survival per cent of bud/graft (67.25) was observed in S_2 (local) rootstock. Among various methods of propagation, M_5 (Wedge grafting with polythene cap) was found to be best for higher success per cent (85.25). Bud/graft survival was recorded highest (76.15%) in polyhouse condition (C_2) as compared to C_1 (open field). For double factor

interactions, highest bud/graft survival per cent was recorded again with treatment combination S_2M_5 (local + wedge grafting with polycap), S_2C_2 (local + polyhouse), M_5C_2 (wedge grafting with polycap + polyhouse). During 2011-12, when bud success was expressed as percentage, almost similar pattern was recorded as observed during 2010-11 (Table 3).

Table 2. Effect of rootstocks, methods and conditions on per cent sprouting of bud/graft.

Treatments	2010-11			2011-12		
	C_1	C_2	Mean	C_1	C_2	Mean
S_1M_1	45.98	65.81	55.89	42.12	63.41	52.77
S_1M_2	47.96	69.07	58.52	48.27	67.51	57.89
S_1M_3	49.52	70.31	59.92	51.15	72.13	61.64
S_1M_4	56.62	85.29	70.96	58.43	83.00	70.72
S_1M_5	72.80	94.86	83.83	73.65	90.83	82.24
S_2M_1	46.92	67.19	57.05	44.64	65.85	55.25
S_2M_2	48.15	70.32	59.23	45.92	68.74	57.33
S_2M_3	54.69	75.86	65.27	57.11	76.11	66.61
S_2M_4	64.57	85.00	74.79	65.16	83.55	74.35
S_2M_5	80.95	96.08	88.51	81.44	91.91	86.67

(b) Rootstock × condition, method × condition

Treatments	2010-11			2011-12		
Rootstocks	C_1	C_2	Mean	C_1	C_2	Mean
L-49 (S_1)	54.58	77.07	65.82	54.72	75.38	65.05
Local (S_2)	59.06	78.89	68.97	58.85	77.23	68.04
Methods of budding or grafting						
Shield budding (M_1)	46.45	66.50	56.47	43.38	64.63	54.01
Patch budding (M_2)	48.06	69.69	58.88	47.09	68.13	57.61
Veneer grafting (M_3)	52.11	73.09	62.60	54.13	74.12	64.12
Wedge grafting (M_4)	60.60	85.14	72.87	61.80	83.28	72.54
Wedge grafting with polycap (M_5)	76.87	95.47	86.17	77.54	91.37	84.46
Mean	56.82	77.98		56.79	76.30	

ANOVA

Particulars	2010-11		2011-12	
	SEm±	CD at 5%	SEm±	CD at 5%
Rootstock (S)	0.25	0.70	0.20	0.57
Method of budding/grafting (M)	0.39	1.11	0.32	0.91
Conditions (C)	0.25	0.70	0.20	0.57
Rootstock (S) × method (M)	0.55	1.58	0.45	1.28
Rootstock (S) × condition (C)	0.35	1.00	0.28	0.81
Method (M) × condition (C)	0.55	1.58	0.45	1.28
Rootstock (S) × method (M) × condition (C)	0.78	2.23	0.63	1.81

Table 3. Effect of rootstocks, methods and conditions on per cent survival of bud/graft.

Treatments	2010-11			2011-12		
	C_1	C_2	Mean	C_1	C_2	Mean
S_1M_1	42.45	62.87	52.66	40.26	62.35	51.31
S_1M_2	44.06	65.62	54.84	46.14	66.73	56.44
S_1M_3	45.14	68.25	56.70	47.89	69.85	58.87
S_1M_4	54.03	83.69	68.86	55.45	81.76	68.61
S_1M_5	71.67	93.74	82.71	71.45	89.30	80.38
S_2M_1	45.02	66.71	55.86	42.90	64.82	53.86
S_2M_2	45.62	68.64	57.13	44.10	67.48	55.79
S_2M_3	53.60	74.69	64.14	55.60	73.35	64.48
S_2M_4	61.22	82.41	71.82	62.15	81.61	71.88
S_2M_5	79.74	94.85	87.30	80.33	90.33	85.33

(b) Rootstock × condition, method × condition

Treatments	2010-11			2011-12		
Rootstocks	C_1	C_2	Mean	C_1	C_2	Mean
L-49 (S_1)	51.47	74.83	63.15	52.24	74.00	63.12
Local (S_2)	57.04	77.46	67.25	57.02	75.52	66.27
Methods of budding or grafting						
Shield budding (M_1)	43.74	64.79	54.26	41.58	63.58	52.58
Patch budding (M_2)	44.84	67.13	55.98	45.12	67.11	56.11
Veneer grafting (M_3)	49.37	71.47	60.42	51.75	71.60	61.67
Wedge grafting (M_4)	57.63	83.05	70.34	58.80	81.69	70.24
Wedge grafting with polycap (M_5)	75.71	94.29	85.00	75.89	89.81	82.85
Mean	54.26	76.15		54.63	74.76	

ANOVA

Particulars	2010-11		2011-12	
	SEm±	CD at 5%	SEm±	CD at 5%
Rootstock (S)	0.24	0.69	0.26	0.73
Method of budding/grafting (M)	0.38	1.09	0.40	1.15
Conditions (C)	0.24	0.69	0.26	0.73
Rootstock (S) × method (M)	0.54	1.54	0.57	1.63
Rootstock (S) × condition (C)	0.34	0.97	0.36	1.03
Method (M) × condition (C)	0.54	1.54	0.57	1.63
Rootstock (S) × method (M) × condition (C)	0.76	2.18	0.81	2.30

Out of all the techniques mentioned, the highest sprouting per cent was recorded with M_5 (wedge grafting with polycap). It may be attributed that wedge grafting itself brings the cambium of scion and rootstock together which leads to earlier formation of cambium union and ultimately results into more success per cent of graft. In addition to this covering of polycap over scion protect the vital buds from direct sunlight, desiccation and also modifies temperature around the buds and thus reduces the mortality percentage (Fig. 1).

The variations due to rootstock (S), method of propagation (M), growing condition (C) and their interaction S × M, S × C, M × C and S × M × C were significant for length of sprout and girth of sprout after 90 days of budding or grafting. However, interaction between different rootstocks and months differed non-significantly with respect to girth of sprout during both the year of experimentation. During 2010-11, longest length of sprout (18.89 cm) was recorded in treatment combination $S_2M_5C_2$ (local + wedge grafting with polycap + polyhouse). S_2 (Local) rootstock produced longest sprout (11.68 cm) as compared to S_1 (L-49). Among various methods of budding/grafting, longest length of sprout (13.32 cm) was recorded with M_5 (Wedge grafting with polythene cap). Longest length (15.13 cm) of sprout was recorded in C_2 (polyhouse) as

Fig. 1. Growth of sprout in open (a) and polyhouse (b).

compared to C_1 (7.35 cm). During 2011-12, length of sprout at 90 days after budding/grafting followed similar trend with respect to variations in S, M, C and their interactions (Table 4). During 2010-11, thickest girth of sprout (0.41 cm) was measured with treatment combination $S_2M_5C_2$ (local + wedge grafting with polycap + polyhouse), while it was minimum (0.16 cm) with treatment $S_1M_1C_1$ (L-49 + shield + open). The thickest sprout (0.33 cm) was produced by S_2 (Local) rootstock. Among various methods of propagation, method M_5 (Wedge grafting with polycap) produced thickest sprout (0.34 cm). Maximum girth of sprout (0.33 cm) was recorded in C_2 (polyhouse) as compared to C_1 (open condition). During 2011-12, girth of sprout at 90 days after budding/grafting followed similar trend with respect to variations in S, M, C and their interactions (Table 4). In C_2 (polyhouse), girth of sprout was comparable to C_1 (open field). It is due to the fact that warmer and humid air inside the polyhouse induces the soil to warm up. Thus, the growth parameters like length and girth of sprout were positively influenced by the warmer environment inside the polyhouse. These results are in agreement of the results of Pandey *et al.* (2004).

Table 4. Effect of rootstocks, methods and conditions on length and girth of sprout at 90 days after budding/grafting.

Treatments	Length of sprout						Girth of sprout					
	2010-11			2011-12			2010-11			2011-12		
	C_1	C_2	Mean	C_1	C_2	Mean	C_1	C_2	Mean	C_1	C_2	Mean
S_1M_1	5.62	12.53	9.08	6.00	13.12	9.56	0.16	0.25	0.21	0.18	0.24	0.21
S_1M_2	6.26	13.79	10.02	6.12	13.64	9.88	0.18	0.27	0.23	0.18	0.26	0.22
S_1M_3	7.02	14.15	10.58	6.00	14.54	10.27	0.18	0.29	0.23	0.18	0.26	0.23
S_1M_4	7.70	15.98	11.84	7.28	14.79	11.04	0.21	0.33	0.27	0.23	0.32	0.27
S_1M_5	8.84	16.12	12.48	8.38	16.63	12.51	0.25	0.39	0.32	0.27	0.36	0.32
S_2M_1	6.53	13.64	10.09	6.36	13.72	10.04	0.18	0.28	0.23	0.20	0.27	0.23
S_2M_2	6.90	14.23	10.57	7.29	14.88	11.08	0.20	0.31	0.26	0.19	0.33	0.26
S_2M_3	7.05	14.73	10.89	7.33	15.22	11.28	0.21	0.33	0.27	0.22	0.32	0.27
S_2M_4	8.19	17.25	12.72	7.87	16.83	12.35	0.23	0.39	0.31	0.26	0.37	0.32
S_2M_5	9.40	18.89	14.15	9.62	20.05	14.84	0.29	0.41	0.35	0.30	0.38	0.34

(b) Rootstock × condition, method × condition

Treatments	2010-11			2011-12			2010-11			2011-12		
Rootstocks	C_1	C_2	Mean	C_1	C_2	Mean	C_1	C_2	Mean	C_1	C_2	Mean
L-49 (S_1)	7.09	14.51	10.80	6.76	14.54	10.65	0.20	0.31	0.25	0.21	0.29	0.25
Local (S_2)	7.61	15.75	11.68	7.69	16.14	11.92	0.22	0.34	0.28	0.23	0.33	0.28
Methods of budding or grafting												
Shield budding (M_1)	6.08	13.09	9.58	6.18	13.42	9.80	0.17	0.27	0.22	0.19	0.25	0.22
Patch budding (M_2)	6.58	14.01	10.29	6.70	14.26	10.48	0.19	0.29	0.24	0.19	0.29	0.24
Veneer grafting (M_3)	7.03	14.44	10.74	6.67	14.88	10.77	0.20	0.31	0.25	0.21	0.29	0.25
Wedge grafting (M_4)	7.94	16.61	12.28	7.57	15.81	11.69	0.22	0.36	0.29	0.25	0.34	0.29
Wedge grafting with polycap (M_5)	9.12	17.51	13.32	9.00	18.34	13.67	0.27	0.40	0.34	0.29	0.37	0.33
Mean	7.35	15.13		7.22	15.34		0.21	0.33		0.22	0.31	

ANOVA

Particulars	2010-11		2011-12		2010-11		2011-12	
	SEm±	CD at 5%	SE m±	CD at 5%	SEm ±	CD at 5%	SEm±	CD at 5%
Rootstock (S)	0.09	0.25	0.09	0.27	0.002	0.006	0.003	0.007
Method of budding/grafting (M)	0.14	0.39	0.15	0.42	0.003	0.009	0.004	0.012
Conditions (C)	0.09	0.25	0.09	0.27	0.002	0.006	0.003	0.007
Rootstock (S) × method (M)	0.19	0.55	0.21	0.60	0.004	NS	0.006	NS
Rootstock (S) × condition (C)	0.12	0.35	0.13	0.38	0.003	0.008	0.004	0.010
Method (M) × condition (C)	0.19	0.55	0.21	0.60	0.004	0.013	0.006	0.017
Rootstock (S) × method (M) × condition (C)	0.27	0.78	0.30	0.85	0.006	0.018	0.008	0.023

Results obtained from above experiments, indicate that treatment combination $S_2M_5C_2$ (local + wedge grafting with polycap + polyhouse) was best in respect of days taken for sprouting of

bud, sprouting per cent, success per cent and sprout related characters *viz.,* length and girth of sprout. Polycap over wedge grafted plant has great advantage as higher success rate (more than 70 %) can be achieved even at low temperature (winter months) in open condition. Polyhouse condition positively influenced the success rate and growth parameter under study.

Acknowledgements

The authoress is grateful to Indian Council of Agricultural Research (ICAR) for providing Senior Research Fellowship and also thankful to Department of Science and Technology for providing financial assistance in the form of DST-INSPIRE fellowship during the course of experimentation.

References

Bajpai PN, Singh AR, Yatti V and Chaturvedy O P 1989. Effect of cultivars and age of rootstocks on the performance of veneer grafting in mango. Acta Hort. **231**: 259-262.

Hartman HT, Kester DE and Davies FT 1993. Plant propagation, principles and practices. Sixth Edn. Prentice Hall of India Private Limited, New Delhi: 389-407.

Keskar BG, Dhawle BC and Karale AR 1991. Propagation techniques in aonla. J. Maharashtra Agril. Univ. **16** (2): 282-283.

Pandey VK, Dwivedi SK, Pandey A. and Sharma HG 2004. Low cost polyhouse technology for vegetable cultivation in Chhattisgarh Region. Plant Arch. **4**(2): 295-301.

Panse V. C. and Sukhatme P. V. 1987. Statistical methods for agricultural workers, Indian Council of Ag. Res., New Delhi.

Samiullah Hussain SA, Rab A and Mohammad H 2004. Side grafting and various scion parts interaction in guava. Pakistan J. Biol. Sci. **7**(7): 1127-1129.

Singh G and Pandey D 1998. Effect of time and method of budding on propagation of guava (*Psidium guajava* L.). Ann. Agril. Res. **19** (4): 445-448.

Singh G, Gupta S, Mishra R and Singh G P 2005. Wedge grafting in guava- a novel vegetative propagation technique, Pub. Central Insti. for Subtrop. Hort., Lucknow. p. 12.

Singh G, Gupta S, Mishra R, Singh A 2007. Technique for rapid multiplication of guava (*Psidium guajava* L.). Acta Hort. **735**: 177-183.

(Manuscript received on 30 December, 2014; revised on 28 February, 2016)