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Studies on the effect of tipping, capping and root pruning in Chinese guava seedlings for attaining graftable stage under Allahabad conditions

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ABSTRACT

The experiment was conducted with a view to find out invigorating factors and their interaction in attainment of graftable seedling in open under Allahabad conditions. Bold seeds of extracted from Chinese guava fruits of winter season crop were sown. After four months tipping, capping and root pruning operations were done in 27 treatment combinations. Non-perforated polythene tube capping was better over perforated capping. Shoot tipping at 10 cm was suppressive to vigour, while light pruning (5 cm) was invigorating. Root pruning for one time was found positive, while pruning twice had negative effect on vigour of the sapling. Highest length of sapling (55.67 cm) was recorded in treatment $T_1C_1P_1$, *i.e.* shoot tipping (5 cm) + non perforated polythene tube capping + once root pruning. Higher values for stem perimeter (2.0 cm), number of leaves per sapling (46.60), leaf area (3489 cm^2), stem internode length (3.79 cm) and graftable saplings (79.49%) were also recorded in the same treatment. Seedling mortality was greater due to double root pruning, which was further aggravated with deeper pruning. Highest (47%) seedling mortality was observed in $T_2C_0P_2$, *i.e.* deep tipping + no shoot capping + twice root pruning. Growth parameters like plant fresh weight, shoot fresh weight, root fresh weight, plant dry weight, Shoot and root dry weight were also found significantly greater in treatment $T_1C_1P_1$. About 80% graftable Chinese guava seedlings of sound vigour could be obtained after four month of sowing, with 5 cm shoot tipping followed by non-perforated wide mouthed polythene tube capping and subsequently 18 cm deep root pruning once after 6 month of sowing.

Key words: Guava, seedlings, vigour, graftable quality.

INTRODUCTION

Guava falls under the category of shrub to small tree and has profuse suckering ability. This uniqueness makes it recoup and survive in adverse edaphic conditions. Once established, *i.e.* after 10-15 years of planting, trees face certain unique problems like wilt and decline. Shoot drying coupled with profuse branch suckering and poor crotch angle are another problems associated with poor plant development. Tipping not only breaks apical dominance but also invigorates side shoot development. Severe pruning caused universal dwarfism. Capping of green young shoot changed micro-environment of the plant, which reset growth and development pace of the plant. Root pruning is a very sensitive operation to be performed hence judicious root pruning make plant healthy and vigorous. Keeping above facts in view the present investigation was carried out to find out effect of tipping, capping and root pruning on vigour of guava seedlings under open conditions for initiating the grafting.

MATERIALS AND METHODS

The experiment was carried out at the Post Graduate Department of Horticulture, KAPG College Allahabad during 2008 & 2009. Well ripened Chinese guava fruits of winter season crop were taken for seed collection. The seeds were sown immediately after extraction (15 January) in well prepared nursery. Before sowing seed were soaked in water for 12 h. Nursery soil was sterilized with 0.2% copper oxycloride and then *Trichoderma* culture (inoculated compost) @ 5 kg/ m^2 was spread and forked into the soil. Seeds were sown in line at 15 cm × 15 cm distance, in 2 cm depth. Weeding and irrigation was done timely. No sucker or side shoot sprout was allowed during the growth and as and when found were nipped off immediately.

Three factors at three levels each, *i.e.* T_0, T_1, T_2 for shoot tipping; C_0, C_1, C_2 for seedling capping and P_0, P_1, P_2 for root pruning were taken to study vigour of saplings to be used as rootstock. The design was used 3×3×3 factorial CRD with three factors thus making 27 treatment combinations. Details of treatment are as T_1 ($T_0C_0P_0$) = No tipping + No capping + No root pruning; T_2($T_0C_0P_1$) = No tipping + No capping + Once root pruning; T_3 ($T_0C_0P_2$) = No tipping + No capping + Twice root pruning; T_4($T_1C_0P_0$) = 5 cm long tipping + No capping + No root pruning; T_5($T_1C_0P_1$) = 5 cm long tipping + No capping + Once root pruning; T_6($T_2C_0P_2$) = 5 cm long tipping + No capping + Twice root pruning; T_7($T_2C_0P_0$) = 10 cm long tipping + No capping + No root

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pruning; $T_8(T_2C_0P_1)$ = 10 cm long tipping + No capping + Once root pruning; $T_9(T_2C_0P_2)$ = 10 cm long tipping + No capping + Twice root pruning; $T_{10}(T_0C_1P_0)$ = No tipping + Non-perforated polythene tube capping + No root pruning; $T_{11}(T_0C_1P_1)$ = No tipping + Non perforated polytthene tube capping + Once root pruning; T_{12} $(T_0C_1P_2)$ = No tipping + Non perforated polythene tube capping + Twice root pruning; $T_{13}(T_1C_1P_0)$ = 5 cm long tipping + Non perforated polythene tube capping + No root pruning; $T_{14}(T_1C_1P_1)$ = 5 cm long tipping + Non perforated polythene tube capping + Once root pruning; T_{15} $(T_1C_1P_2)$ = 5 cm long tipping + Non perforated polythene tube capping + Twice root pruning; $T_{16}(T_2C_1P_0)$ = 10 cm long tipping + Non perforated polythene tube capping + No root pruning; $T_{17}(T_2\ C_1P_1)$ = 10 cm long tipping + Non perforated polythene tube capping + Once root pruning; T_{18} $(T_2$ $C_1P_2)$ = 10 cm long tipping + Non perforated polythene tube capping + Twice root pruning; $T_{19}(T_0C_2P_0)$ = No tipping + perforated polythene tube capping + No root pruning; $T_{20}(T_0C_2P_1)$ = No tipping + perforated polythene tube capping + Once root pruning; $T_{21}(T_0C_2P_2)$ = No tipping + perforated polythene tube capping + Twice root pruning; $T_{22}(T_1C_2P_0)$ = 5 cm long tipping + perforated polythene tube capping + No root pruning; $T_{23}(T_1C_2P_1)$ = 5 cm long tipping + perforated polythene tube capping + once root pruning; $T_{24}(T_1C_2P_2)$ = 5 cm long tipping + perforated polythene tube capping + Twice root pruning; $T_{25}(T_2C_2P_0)$ = 10 cm long tipping + perforated polythene tube capping + No root pruning; $T_{26}(T_2C_2P_1)$ = 10 cm long tipping + perforated polythene tube capping + once root pruning; and $T_{27}(T_2C_2P_2)$ = 10 cm long tipping + perforated polythene tube capping + twice root pruning. The treatment factors and levels are as T_0 = no shoot tipping, T_1 shoot removed 5 cm from tip, T_2 = shoot removed 10 cm from tip, Co = no polythene capping C1 = capping with non-perforated polythene tube, C_2 = perforated polythene tube capping and P_0= no root pruning, P_1 = root pruning, once after six month of sowing P_2 = twice root pruning, *i.e.,* 6 and 7 month after sowing. For capping 100 gauge thick white polythene tube was loosely tied with sapling stem just to leak out vapour. In other case same quality perforated tube was taken to allow freely movement of air in and out.

The practice of capping was just to create stimulative microclimate congenial for sapling invigoration. Tipping was done just before capping, *i.e.* four month after sowing. In one case 5 cm shoot tip of sapling and in other case 10 cm tip was removed. The purpose of tipping was to break apical dominance and enhance stem girth to get more graftable seedlings on time. Root pruning was done after 6 months of sowing and as per treatment and the next pruning was done 7 month after sowing. About 18 cm below soil roots were removed, just after root removal deep irrigation was applied. Pruning was undertaken to encourage root feathering and hence rhizosphere area, which ultimately will affect shoot vigour of the sapling. After 12 months, plant height, stem perimeter number of leaves, leaf area, steam internode length, seedling mortality, graftable seedling, plant fresh weight, stem fresh weight, root fresh weight, plant dry weight, stem dry weight and root dry weight were recorded. Plant height was measured in cm. from collar region to shoot tip length; Stem perimeter was taken 3 cm above the collar region. Green leaves per sapling were counted, length and width of each of leaves sapling measured and total leaf area was calculated. Seedlings attaining 2.5 cm perimeter was taken as graftable seedling. Other growth parameters were recoded as per standard procedures. Data for two years were pooled and statistically analyzed.

RESULTS AND DISCUSSION

A critical examination of data presented in Table 1 indicated that all the three factors, *i.e.* tipping, capping and pruning have significantly influence on the vigour of the seedlings. Parameters, *viz.*, plant height, stem perimeter, number of leaves per plant, leaves area, stem Internode length and graftable seedlings were gave better with respect to tipping, capping and pruning. Deeper shoot tipping and twice root pruning gave adverse effect with respect to sapling vigour. Tipping, *i.e.* light (5 cm) reduced the load of rhizosphere to supply water and nutrient uptake reduced reduced photosynthetic rate and disturbed the root / shoot ratio of the sapling. Plant height was positively related with capping. Non perforated polythene capping was better (45 cm) over perforated (41.67 cm). Five cm shoot tipping after 4 month of sowing invigorate the sapling (41.37 cm), while 10 cm tipping reduced plant vigour (37.93 cm) significantly. Once root pruning after 6 month of sowing found to encourage plant vigour (42.33 cm), while twice pruning 1st at 6 and 2nd at 7 month after showing reduced plant vigour (33.47 cm) drastically.

Interaction effects were far better as compared to singe treatment and maximum sapling height (55.67 cm) was noticed in $T_1C_1P_1$ treatment. Minimum height (29.67 cm) was observed in $T_2C_0P_2$ treatment, which indicates that deeper shoot tipping (10 cm) and twice roots pruning significantly reduced plant height of sapling. Twice root pruning was most detrimental followed by deeper shoot tipping (10 cm) in respect to sapling vigour, which caused dwarfism to the saplings. Light tipping along with once root pruning gave augmenting effect on the sapling vigour. Polythene tube capping was found to generate congenial atmosphere for better growth of the sapling. Even undisturbed plant (control, $T_0C_0P_0$) was vigorous in stature as compared to deeper shoot tipped and root pruned.

Table 1. Effect of shoot tipping capping and root pruning on vigour, mortality and graftable attainment of Chinese guava seedlings.

Treatment	Symbol	Sapling height (cm)	Stem perimeter (cm)	Internode length (cm)	No. of leaves/ sapling	Leaf area/ sapling (cm^2)	Sapling mortality (%)	Graftable sapling (%)
T_1	$T_0 C_0 P_0$	39.60	0.87	2.86	32.60	2570	1.30	44.00
T_2	$T_0 C_0 P_1$	42.33	1.01	2.89	34.39	2653	1.31	49.40
T_3	$T_0 C_0 P_2$	33.47	0.79	2.47	30.09	2286	43.94	37.40
T_4	$T_1 C_0 P_0$	41.37	1.02	2.85	33.39	2593	1.21	45.39
T_5	$T_1 C_0 P_1$	41.67	1.52	3.59	37.80	2612	1.39	62.00
T_6	$T_1 C_0 P_2$	37.73	0.84	2.40	31.39	2365	41.94	38.40
T_7	$T_2 C_0 P_0$	37.01	0.83	2.75	32.49	2320	1.29	45.39
T_8	$T_2 C_0 P_1$	37.93	0.84	2.63	34.03	2377	1.55	50.44
T_9	$T_2 C_0 P_2$	29.67	0.75	2.39	24.53	1860	47.00	36.00
T_{10}	$T_0 C_1 P_0$	45.00	0.96	3.04	35.40	2821	1.21	49.00
T_{11}	$T_0 C_1 P_1$	46.39	1.63	3.11	37.91	2908	1.23	70.00
T_{12}	$T_0 C_1 P_2$	39.71	0.82	2.50	33.14	2489	41.38	38.49
T_{13}	$T_1 C_1 P_0$	41.11	0.99	3.06	36.44	2877	1.32	71.00
T_{14}	$T_1 C_1 P_1$	55.67	2.00	3.76	46.60	3489	1.19	79.49
T_{15}	$T_1 C_1 P_2$	38.03	0.81	2.69	33.50	2384	40.39	39.49
T_{16}	$T_2 C_1 P_0$	40.23	0.82	2.86	34.88	2522	1.19	46.33
T_{17}	$T_2 C_1 P_1$	41.34	0.84	2.94	35.03	2599	1.21	53.91
T_{18}	$T_2 C_1 P_2$	32.67	0.77	2.49	30.00	2048	46.89	38.31
T_{19}	$T_0 C_2 P_0$	41.67	0.84	2.90	33.20	2612	1.23	46.33
T_{20}	$T_0 C_2 P_1$	42.02	0.81	2.83	33.81	2634	1.21	48.44
T_{21}	$T_0 C_2 P_2$	34.91	0.78	2.55	29.34	2125	45.49	37.99
T_{22}	$T_1 C_2 P_0$	40.13	0.82	2.77	36.44	2515	1.28	48.92
T_{23}	$T_1 C_2 P_1$	46.33	1.81	3.81	39.40	2904	1.27	68.33
T_{24}	$T_1 C_2 P_2$	35.39	0.77	2.51	31.19	2093	43.48	36.66
T_{25}	$T_2 C_2 P_0$	41.41	0.84	2.69	33.44	2595	1.53	43.29
T_{26}	$T_2 C_2 P_1$	42.49	0.85	2.82	38.19	2663	1.30	61.43
T_{27}	$T_2 C_2 P_2$	30.34	0.76	2.40	28.80	1902	46.03	37.33
$CD_{0.05}$		4.12	2.33	1.93	3.61	3.981	1.87	4.01

Pruning is a dwarfing process, which depresses the plant height when performed. To avoid tipping effect polythene capping was done just to sooth out the effect of pruning but it was up to certain level (5 cm) and deeper shoot pruning nullified the impact of capping hence dwarfism does occur. Root pruning caused feathering effect and hence rhizosphere was. These findings are in conformity with the earlier findings of Visen *et al.* (7) in guava, Malik and Dadlani (3) in rose, Benz and Wolpert (1), and Man Bihari and Surya Narayan (4) in other crops. Stem perimeter, stem internode length, number of leaves/sapling, leaf area/sapling and attainment of graftable was found to follow similar pattern as plant height. Most effective treatments recorded in $T_1C_1P_1$/ $T_2C_0P_2$ treatments, respectively. Sapling mortality was very much higher with twice root pruning treatment which was further aggravated with the deep shoot tipping.

Plant vigour was directly proportional with the plant length. This finding was corroborated with the findings of Malik and Dadlani (3) in rose, and Lang (2) in sweet cherry. Data related to fresh and dry weights of plant, shoot and root shown in Table 2 clearly depicted the significant effect of treatment. Parameters like plant height, stem perimeter, number of leaves/plant and leaf area/ plant the fresh and dry weight was also found

Table 2. Effect of shoot tipping, capping, and root pruning on fresh and dry weight of Chinese guava seedlings.

Treatment	Symbol	Plant fresh weight (g)	Shoot fresh weight (g)	Root fresh weight (g)	Plant dry weight (g)	Shoot dry weight (g)	Root dry weight (g)
T_1	$T_0 C_0 P_0$	191.67	115.00	76.67	86.25	46.00	38.33
T_2	$T_0 C_0 P_1$	218.33	131.00	87.33	98.25	52.40	43.67
T_3	$T_0 C_0 P_2$	181.66	109.00	72.67	82.75	44.60	31.34
T_4	$T_1 C_0 P_0$	208.33	125.00	83.33	93.75	50.00	41.67
T_5	$T_1 C_0 P_1$	235.00	141.00	94.00	105.75	56.40	47.00
T_6	$T_1 C_0 P_2$	198.33	110.00	79.33	89.25	47.60	39.67
T_7	$T_2 C_0 P_0$	190.00	114.00	76.00	85.67	45.60	38.00
T_8	$T_2 C_0 P_1$	216.66	130.00	86.67	97.50	52.00	43.34
T_9	$T_2 C_0 P_2$	180.00	108.00	69.00	81.00	43.20	36.00
T_{10}	$T_0 C_1 P_0$	216.67	132.00	88.00	99.00	52.80	44.00
T_{11}	$T_0 C_1 P_1$	246.66	148.00	98.67	111.00	59.20	49.33
T_{12}	$T_0 C_1 P_2$	203.33	126.00	84.00	94.50	50.40	42.00
T_{13}	$T_1 C_1 P_0$	236.66	142.00	94.67	106.50	56.80	47.34
T_{14}	$T_1 C_1 P_1$	261.67	158.00	105.33	118.50	63.20	52.67
T_{15}	$T_1 C_1 P_2$	226.66	133.00	90.67	102.00	54.40	45.34
T_{16}	$T_2 C_1 P_0$	228.33	131.00	87.34	98.25	52.40	43.67
T_{17}	$T_2 C_1 P_1$	245.00	147.00	98.00	110.25	58.80	49.00
T_{18}	$T_2 C_1 P_2$	208.67	121.00	83.33	93.75	50.00	41.67
T_{19}	$T_0 C_2 P_0$	201.67	125.00	80.66	90.75	48.40	40.33
T_{20}	$T_0 C_2 P_1$	228.33	137.00	91.34	102.75	54.80	45.67
T_{21}	$T_0 C_2 P_2$	191.67	113.00	76.67	86.25	46.00	38.34
T_{22}	$T_1 C_2 P_0$	218.33	131.00	87.34	98.25	52.40	43.67
T_{23}	$T_1 C_2 P_1$	245.00	147.00	98.00	110.25	58.80	49.00
T_{24}	$T_1 C_2 P_2$	208.33	131.67	83.34	93.75	50.00	41.67
T_{25}	$T_2 C_2 P_0$	208.33	120.00	80.00	90.00	48.00	40.00
T_{26}	$T_2 C_2 P_1$	226.67	142.67	90.70	102.00	54.40	45.34
T_{27}	$T_2 C_2 P_2$	190.00	109.00	70.00	81.95	43.90	36.94
$CD_{0.05}$		21.81	19.93	11.45	12.11	9.78	8.10

to follow same trend and maximum /minimum values for plant fresh weight, shoot fresh weight, root fresh weight, plant dry weight, shoot dry weight and root dry weight were recorded. In no case luxuriant growth was observed hence according to vigour dry weight was recorded. Shoot portion was found to affect root vigour and *vice-versa*. Since guava sapling is woody in nature, hence no overgrowth due to treatment was noticed. Data of both the years showed similar trend in relation to different parameters. Similar, results were also observed by Vasishth *et al.* (8) in *Acacia catechu*, Lang (2) in sweet cherry, Benz and Wolpert (1) in guava, Man Bihari *et al.* (6) in rose, and Man Bihari and Narayan (5) in potato. Of the different treatments tried treatment $T_1C_1P_1$, *i.e.* shoot tipping (5 cm) + non perforated polythene tube capping + once root pruning was found to be most effective as about 80% graftable seedlings could be made ready for grafting.

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