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Response of Apple Cultivars to Graft Take Success on Apple Rootstock

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ABSTRACT

An experiment entitled "Response of apple cultivars to graft take success on apple rootstocks" was conducted at Agricultural Research Station (North), Mingora Swat, Pakistan in 2012. Scion wood of five apple cultivars (Royal gala, Mondial gala, Treco gala, Gala must and Spartan) were bench grafted on rootstocks MM-111, 106, M-9,26 and Crabapple. Increase in graft take success (91.10%), plant height (107.97 cm), scion diameter (9.38 mm), number of leaves plant^{-1} (116.57) were noted in cultivar Gala must with rootstock Crab apple. Since Crab apple rootstock and cultivar Gala must interaction showed significant result among most of the parameters observed hence for increased graft take success and resultant growth Cultivar Gala must with rootstock Crab apple recommended.

Keywords: Graft success, Rootstocks, Scion diameter, Rootstocks

INTRODUCTION

Apple, *Malus sylvestris*, is a deciduous fruit plant which belongs to the family Rosaceae and sub family *pomoidea* with a basic chromosome number 17. The botanical name of apple is used as *pyrus malus* L. *Malus sylvestris* and *Malus malus*. But the most common name is *pyrus malus* L. (Chaudhry, 1996). The apple has been cultivated in Europe for over two thousand years. Seeds and grafted trees of the better European cultivars were taken to North America and planted by the earlier settlers. Seeds from these trees were disseminated westward by the Indians, traders, missionaries and the well known Johnny Apple seed (Childers, 1983). Apple trees are budded on crab apple, on various East Malling types, and on seedling of some commercial apple varieties. Crab apple is propagated through seed and stooling. Trees grafted on this rootstock are vigorous. In apples the vegetative propagation is done by grafting or budding. Budding is done during the active growth stage, while grafting is done during dormancy in winter or early spring. Some important methods of grafting of apples are whip or tongue grafting and cleft grafting, for budding, the ring and T-budding techniques are often practiced (Chaudhry, 1996). chip budding produced larger and more uniform one-year-old trees, with more and longer lateral branches, compared with those raised by traditional shield budding using an upright T incision in the rootstock (Howard *et al.* 1974). Hirsch and Ferre (1995) grafted Gala and Triple Red Delicious scion onto M-9, MM-106, MM-111 and B-118 (Gala only) in a green house. It was found that root stock exerted more influence than cultivar on total growth of the tree. Branch density, however, was primarily under scion control. Apple cultivars 'Golden Resistant' and 'Starkrimson' were monitored on seedling and some clonal rootstocks. The onset of the morphological differentiation of the buds was observed during the period from the weakening of the shoot growth until their full growth termination. The rootstocks, irrespective of their characteristics regarding the growth and fruiting, did not influence the time of cessation of the shoot growth and the onset of the morphological differentiation of flower buds on the spurs (Koutinas *et al*. 2009).

MATERIALS AND METHODS

An experiment entitled "Response of apple cultivars to graft take success on apple rootstocks" was carried out at Agricultural Research Station (North), Mingora Swat, Pakistan in 2012. The experiment was laid down in Randomized Complete Block Design (RCBD) with two factors factorial arrangement. There were 25 treatments replicated three times.

The details of the experiment are as follow.

Rootstocks:

S_1 = MM-111
S_2 = MM-106
S_3 = M-26
S_4 = M-9

S_5 = Crab apple

Cultivars:
C_1 = Royal gala
C_2 = Mondial gala
C_3 = Treco gala
C_4 = Gala must
C_5 = Spartan
The Scion woods were obtained from healthy plants. The rootstocks and cultivars used were of the same size. The rootstocks were benched grafted with the selected cultivars in open field. Plant to plant distance was kept 30 cm while row to row 60 cm accordingly. Fifteen rootstocks were grafted in each treatment with a total number of 1125 plants for the whole experiment.

Parameters
Data was recorded on the following parameters.

Graft take success

After complete sprouting and successful growth of scion the percent graft take success were calculated at the end of the growing season by the following formula.

$$\% \text{ Graft take success} = \frac{\text{Number of grafted plants survived}}{\text{Total number of plants budded}} \times 100$$

Sapling growth

The length of scion growth of five randomly selected plants was taken with the help of measuring tape from the basal portion of the scion to the tip of the scion and their means were calculated.

Scion diameter

Scion diameter was calculated at a height of 3 cm from the base of the scion with the help of Varnier caliper for each treatment in each replication of five randomly selected plants and the average was calculated.

Number of leaves plant^{-1}

The number of leaves plant^{-1} of each treatment in each replication of five randomly selected plants was counted and then the mean was calculated.

Statistical procedure

The data collected on different parameters was subjected to analysis of variance (ANOVA) technology to observe the difference, between different treatments as well as their interactions. In case where the difference was significant the mean was further assist for differences through least significant difference (LSD) test. Statistical computer software, MSTATC (Michigan state university, USA), was applied for computing both ANOVA and LSD. (Steel and Torrie, 1980).

RESULTS AND DISCUSSIONS

Graft take success (%)

Mean values pertaining graft take success is presented in Table I. While the ANOVA is presented in table Ia. Analysis of variance shows that graft take success were significantly affected by different apple rootstocks. whereas the interaction was found non-significant. More graft take success (95.55%) was obtained from apple rootstock MM-106, followed by M-26(89.77%), M-9(88.88%) and MM-111 (86.66%). while the lowest graft success (75.10%) was recorded in crab apple rootstock. Apple cultivars also showed significant difference where the highest graft success (91.10%) was obtained from apple cultivar Gala Must, closely followed by Royal Gala (87.55%) and Mondial Gala (85.77%). While Spartan cultivar of apple showed the lowest graft take success (83.55%).

Table I: ***Graft take success as affected by Cultivars and Rootstocks***

	Root stocks					
Cultivars	**MM111**	**MM106**	**M26**	**M9**	**Crabapple**	**Mean**
Treco Gala	84.44	95.55	88.88	82.22	68.88	83.99b
Spartan	88.88	91.11	82.22	86.66	68.88	83.55b
MondialGala	75.55	97.77	88.88	91.11	75.55	85.77ab
Royal Gala	86.66	97.77	93.33	86.66	73.33	87.55ab
Gala Must	97.77	95.55	95.55	97.77	68.88	91.10a
Mean	86.66b	95.55a	89.77b	88.88b	75.10c	

LSD Value for rootstocks and cultivars at 5% level of probability = 5.5767
Means of the same category followed by different letters are statistically different at 5% level of probability

Table I (a): ***Analysis of variance of Graft take success***

SOV	**DF**	**SS**	**MS**	**F-Value**	**Prob**
Rep	2	331.57	165.79		
Variety(V)	4	566.59	141.65	2.66	0.0440
Rootstock(RS)	4	5029.54	1257.39	23.58	0.0000
Var*Rs	16	1140.26	71.27	1.34	0.2150
Error	48	2559.16	53.32		
Total	74	9627.14			

Sapling growth

Mean data for sapling growth is presented in Table II and analysis of variance (ANOVA) in Table II (a). Analysis of variance revealed that rootstocks and cultivars and their interaction showed significant effect on sapling growth. More sapling growth (108.85 cm) was obtained from apple rootstock crab apple, followed by MM-111(102.38 cm). While the lowest sapling growth (80.97) was recorded in rootstock M-9. Apple cultivars also showed significant difference where more sapling growth (107.97 cm) was obtained from apple cultivar Gala Must, followed by Treco Gala (105.43 cm) and Mondial Gala (101.71 cm). While Spartan cultivar of apple showed the lowest sapling growth (71.48 cm). As concerned interaction more sapling growth (122.65 cm) was recorded in apple cultivar Gala Must grafted on crab apple rootstock of apple. While the graftage of apple cultivar Spartan on M-9 rootstock gave the least sapling growth (58.68 cm).

Table II: ***Sapling Growth as affected by Cultivars and Rootstocks***

	Root stocks					
Cultivars	**MM111**	**MM106**	**M26**	**M9**	**Crabapple**	**Mean**
Treco Gala	107.69	106.7	100.05	96.5	116.195	105.43b
Spartan	76.20	73.17	66.34	58.68	83.02	71.48e
Mondial Gala	107.71	104.9	94.33	88.15	113.44	101.71c
Royal Gala	102.03	101.27	89.01	79.55	108.96	96.17d
Gala Must	118.25	116.28	100.71	81.94	122.65	107.97a
Mean	102.38b	100.46c	90.09d	80.97e	108.85a	

LSD Value for rootstock and variety at 5% level of probability = 0.9024
LSD Value for interaction at 5% level of probability = 2.0178
Means of the same category followed by different letters are statistically different at 5% level of probability.

Table II (a): ***Analysis of variance of Sapling growth***

SOV	**DF**	**SS**	**MS**	**F-Value**	**Prob**
Rep	2	1.1	0.56		
Variety(V)	4	12963.1	3240.77	2145.18	0.0000
Rootstock(RS)	4	727.91	1819.77	1204.57	0.0000
Var*Rs	16	742.1	46.38	30.70	0.0000
Error	48	72.5	1.51		
Total	74	21057.9			

Scion diameter

Data regarding scion diameter is presented in Table III and analysis of variance is placed in Table III (a). Analysis of variance (ANOVA) showed that cultivar and rootstock has significant effect on scion diameter. The interaction between the cultivars and rootstock was also significant. The data regarding scion diameter indicated that maximum scion diameter (9.88 mm) was in apple rootstock crab apple followed by rootstock MM-111 (9.11 mm), MM-106 (9.00 mm), and M-26(8.26 mm). Whereas M-9 rootstock showed minimum scion diameter (7.76 mm). As concerned apple cultivars, Gala Must attain maximum sapling growth (9.38 mm) which significantly varied from the rest of the treatment followed by Mondial Gala (8.88 mm), Treco Gala (8.86 mm) where as the minimum sapling growth (8.19 mm) was observed in apple cultivar Spartan. As concerned interaction more scion diameter (11.04 mm) was recorded in apple cultivar Gala Must grafted on crab apple rootstock of apple. While the graftage of apple cultivar Spartan on M-9 rootstock attain the least scion diameter (7.76 mm). This results confirmed the previous study of Omer and Ismail (2011), who reported the same result of maximum sapling thickness in vigorous rootstock.

Table III: ***Scion diameter as affected by Cultivars and Rootstocks***

	Root stocks					
Cultivars	**MM111**	**MM106**	**M26**	**M9**	**Crabapple**	**Mean**
Treco Gala	9.45	9.24	7.97	7.33	10.34	8.86b
Spartan	8.35	8.24	7.87	7.76	8.77	8.19d
Mondial Gala	9.08	9.03	8.32	8.14	9.86	8.88b
Royal Gala	9.08	9.01	8.52	7.47	9.41	8.70c
Gala Must	9.59	9.51	8.76	8.03	11.04	9.38a
Mean	9.11b	9.00c	8.26d	7.76e	9.88a	

LSD Value for rootstocks and cultivar at 5% level of probability = 0.0743
LSD Value for interaction at 5% level of probability = 0.1662
Means of the same category followed by different letters are statistically different at 5% level of probability.

Table *III* (a): ***Analysis of variance of Scion diameter***

SOV	**DF**	**SS**	**MS**	**F-Value**	**Prob**
Rep	2	0.0761	0.03807		
Variety(V)	4	10.9233	2.73084	266.42	0.0000
Rootstock(RS)	4	39.9902	9.99754	975.36	0.0000
Var*Rs	16	7.0334	0.43959	442.87	0.0000
Error	48	0.4920	0.01025		
Total	74	58.5151			

Number of leaves Plant^{-1}

The number of leaves plant^{-1} is presented in Table IV and analysis of variance is placed in Table IV (a). The analysis of variance showed that cultivar and rootstock significantly affected number of leaves plant^{-1}**.** The interaction between the cultivars and rootstock was also significant. The data regarding number of leaves plant^{-1} indicates that maximum number of leaves plant^{-1} (114.82) was noted in apple rootstock crab apple followed by rootstock MM-111 (105.32). Whereas M-9 rootstock, had less number of leaves plant^{-1} (81.81). As concerned apple cultivars, Gala Must attain maximum number of leaves plant^{-1}(116.57) which is significantly varied from the rest of the treatment followed by Treco Gala (110.42), where as the minimum number of leaves plant^{-1}(73.99) was observed in apple cultivar Spartan. As concerned interaction more number of leaves plant^{-1} (138.45) was recorded in apple cultivar Gala Must grafted on crab apple rootstock of apple. While the graftage of apple cultivar Spartan on M-9 rootstock produced the least number of leaves plant^{-1} (54.03). These results confirmed the previous study of Micheal *et al*. (2006) who reported that dwarfing apple rootstocks reduced the formation of nodes during shoot growth.

Table IV: ***number of leaves plant^{-1} as affected by Cultivars and Rootstocks***

	Root stocks					
Cultivars	**MM111**	**MM106**	**M26**	**M9**	**Crabapple**	**Mean**
Treco Gala	120	114.43	99.62	89.9	128.13	110.42b
Spartan	81.72	78.9	66.72	54.03	88.58	73.99e
Mondial Gala	108.56	105.90	93.80	88.06	114.31	102.13c
Royal Gala	98.47	94.25	87.9	78.91	104.9	92.83d
Gala Must	123.34	119.81	108.57	98.15	138.45	116.57a
Mean	105.32b	102.66c	91.32d	81.81e	114.82a	

LSD Value for rootstocks and cultivars at 5% level of probability = 1.7023
LSD Value for interaction at 5% level of probability = 3.8066
Means of the same category followed by different letters are statistically different at 5% level of probability.

Table *IV* (a): ***Analysis of variance of Scion diameter number of leaves plant^{-1}***

SOV	**DF**	**SS**	**MS**	**F-Value**	**Prob**
Rep	2	25.0	12.52		
Variety(V)	4	16682.9	4170.72	775.75	0.0000
Rootstock(RS)	4	9865.7	2466.42	458.75	0.0000
Var*Rs	16	523.5	32.72	6.09	0.0000
Error	48	258.1	5.38		
Total	74	27355.2			

CONCLUSIONS

Based on the current research work, it is concluded that:

- Maximum graft take success was observed for cultivar Gala Must on Rootstock MM106.
- On other hand maximum growth parameters i.e. sapling growth, Scion diameter, number of leaves plant^{-1} was observed for Gala Must on Crab.

RECOMMENDATIONS

- From the above mentioned conclusions, following recommendations are made. For maximum graft take success in nursery line, cultivar Gala Must is recommended to be grafted on rootstock MM-106 in areas where there is no problem of root rot disease as MM-106 is susceptible to root rot disease in humid temperate regions. In humid temperate region rootstock MM-111 is recommended for better graft take success with Gala varieties to avoid the problem. On the basis of this study cultivar Gala Must on crabapple rootstock is recommended for maximum vegetative growth in the nursery line and increase income of nursery growers.

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