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Effect of media and age of rootstock on epicotyl grafting of mango (*Mangifera indica* L.) cv. amrapali

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Abstract

A field experiment entitled "Effect of Media and Age of Rootstock on Epicotyl Grafting of Mango (*Mangifera indica* L.) cv. Amrapali" was conducted at the Agriculture Research Station, ARSS, Banswara in June, 2016-17. The result revealed that effect of growing media were statistically significant on following parameters, minimum days taken for seed germination, maximum germination per cent and survival per cent of rootstock, maximum stock length and girth, minimum time to shoot sprouting of graft, highest success per cent of graft union at 30 and 60 DAG, minimum mortality per cent of graft union at 30, 60 and 90 DAG and maximum survival per cent at the end of experiment, maximum shoot length, total number of leaves, scion height at 30, 60 and 90 DAG, maximum scion height and girth at 30, 60 and 90 DAG, maximum length and girth of tap root, maximum fresh and dry weight of tap root were recorded in M₅ [soil + FYM + sand (1:1:1)]. In second factor the age of rootstock at different levels were statistically significantly on following parameters, maximum stock length and stock girth at D₃ (16 days after germination) while, Minimum time taken for shoot sprouting was recorded in D₁ (8 days after grafting) and highest success per cent, lowest mortality per cent at 30 and 60 DAG and maximum survival percent of graft union at the end of experiment was recorded in D₂ (12 days after grafting), Maximum shoot length, total number of leaves at 30, 60 and 90 DAG recorded in age of rootstock of D₂ (12days after germination), scion height and girth at 30, 60 and 90 DAG were recorded in age of rootstock of D₂ (12 days after germination), maximum length, girth, fresh weight and dry weight of tap root were recorded under D₂ (12 days after germination).

Keywords: Effect, media, age rootstock epicotyl grafting mango (*Mangifera indica* L.) cv.

Introduction

Mango (*Mangifera indica* L.) is one of the foremost among the fruits of India. It's cultivation in India is estimated more than 4000 years old. Mango belong to the family Anacardiaceae and it's native of Indo- Burma region. It is an excellent source of vitamin 'A' and 'C' carbohydrate and minerals content. Mango occupies a pre-eminent place amongst the fruits crop grown in India and is acknowledged as the "The King of fruits" of the country. Mango is very well adopted to tropical to sub- tropical climate and it thrives well almost from sea level to an altitude of 1500 m. Mango can be grown at a temperature between 24^o C to 27^o C and it can be grown successfully in low rain fall areas of as low as 25 cm and as high as 375 cm.

Mango fruit is utilized at all the stages of it's development both in immature and mature form. Raw fruits are used making chutney, pickles and drinks. The ripe fruit besides being used as dessert and also utilize for preparing several products like squash, syrup, nectar, jam and jelly. The mango kernels contain 8 to 10 per cent good quality fat, which can be used as a substitute for cocoa in confectionery.

Materials and Methods

The experiment consisted of 18 treatment combinations comprising six media M₁ [Orchard Soil (Control)], M₂ [Soil + FYM (1:1)], M₃ [Soil + Sand (1:1)], M₄ [Soil + Vermicompost (1:1)], M₅ [Soil + FYM + Sand (1:1:1)], M₆ [Soil + FYM + Vermicompost (1:1:1)] and three levels of age of rootstock D₁ [8 days after germination], D₂ [12 days after germination], D₃ [16 days after germination] laid out in factorial completely randomized design and replicated thrice. The statistical analysis of the data for individual character was carried out by using analysis of variance technique (Panse and Sukhatme, 1967) [12]. It was situated at 23.55^o N latitude and 74.45^o E longitudes with an altitude of 302 metre above the mean sea level, it has

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the southern end of the Aravali mountains and also southern part of the Rajasthan. The region falls under agro-climatic zone IV a (Sub- humid Southern Plain and Aravalli Hills) of Rajasthan.

Result and Discussion

Effect on germination of rootstock

The effect of growing media on germination parameters (days to germination, germination per cent and survival per cent) of seed for rootstock are presented in Table-1.

The result presented in Table-1 reveals that minimum days taken for stone germination (9.47 DAS) in M₅ compared to M₁. The maximum germination per cent (92.22) and survival per cent (97.55) of rootstock was obtained in M₅ [Soil + FYM + Sand (1:1:1)] as compared to other media. This might be due to mixture of sand and FYM which provide high amount of organic matter and sand responsible for improving the

water holding capacity as well as porosity of media. Kaur and Malhi (2004) [9] reported that organic matter also possibly helped in maintaining relative high temperature, which further seems to have assisted in the stone coat weakening and absorption of water for improving germination in mango. In addition, organic matter decomposition also releases acids thus, more availability of moisture and the acids produce might have helped in softening of the hard stone coat which leads to early germination in mango. This result is in agreement with the finding of Bisla *et al.* (1984) [5] that early germination, germination per cent and survival per cent of ber seed in the mixture of soil: sand: organic manure (1:1:1) was observed. Likewise, the maximum seed germination, rate of seed germination and lowest seed mortality per cent in Aonla was observed by Bihari *et al.*, (2009) [4] that seeds sown with different media mixture of soil, sand and FYM in equal ratio (1:1:1).

Table 1: Effect of growing media on days to germination, germination percentage and survival percentage of mango stock

Treatments	Days to germination	Germination percentage	Survival Percentage
Growing media			
M ₁ : Orchard Soil (Control)	11.78	79.44	88.15
M ₂ : Soil + FYM (1:1)	9.73	79.99	93.68
M ₃ : Soil + Sand (1:1)	10.50	87.22	97.42
M ₄ : Soil + Vermicompost (1:1)	10.21	84.44	94.73
M ₅ : Soil + FYM + Sand (1:1:1)	9.47	92.22	97.55
M ₆ : Soil + FYM + Vermicompost (1:1:1)	10.33	80.66	94.35
SEm.±	0.11	0.47	0.52
C.D. (P =0.05)	0.33	1.34	1.51

Effect on Growth of Rootstock

The effect of growing media and age of rootstock on growth parameter (length and girth) of rootstock are presented in Table-2.

Growing media

Considerable differences were found on growth parameters due to different media. The maximum stock length (17.37 cm) recorded under M₅ [Soil + FYM + Sand (1:1:1)] followed by M₃ treatment and maximum stock girth (4.74 mm) was also recorded in M₅ treatment followed by M₃ treatment. Potting medium is the most important input for containerized rootstock production. Potting media ingredients, their proportion and physical and chemical properties plays significant role in the growth and development of rootstock. High amount of soil along with sand and FYM in small proportion maintain porosity of potting mixture favoured growth contributing characters and overall growth of the seedling (Shrivastava *et al.*, 1998) [18]. The study also collaborated the finding of Ali *et al.*, (2010) [2] that maximum seedling growth of Peruvian ground cherry grown in potting mixture of soil, sand and FYM at 1:1:1 ratio.

Age of rootstock

The length of stock and girth were significantly influenced by different age of rootstock. The maximum stock length (19.02 cm) and stock girth (5.22 mm) were observed in maximum age of rootstock D₃ (16 days after germination). Due to increasing the age of rootstock increased growth and development of rootstock.

Effect on Sprouting of Graft

Effect of growing media and age of rootstock on days taken to shoot sprouting of mango graft are given in Table-2.

Effect of growing media

The result reveals that the effect of growing media and age of rootstock was found significant with respect to days taken to shoot sprouting of grafts. The M₅ [soil + FYM + Sand (1:1:1)] media has significantly took minimum time to shoot sprouting (9.48 days) of graft. This result is in agreement with the finding of Kaur and Malhi (2006) [10] that less time taken to sprouting in epicotyl grafting of mango with the combination of soil, sand and FYM in 1:1:1 ratio.

Effect of age of rootstock

Data presented in Table-2 clearly shows that the age of rootstock significantly influenced on days to shoot sprouting of mango graft. The minimum time taken for sprouting (9.20 days) of graft was recorded in D₁ (8 days after grafting). The reason behind that the better performance of the young rootstock producing early and number of sprouted grafts seems to be high meristematic activity in just germinating and higher reserved food material in the cotyledon. Padma and Reddy (1997) [11] also reported that age of rootstock also influence the time required for sprouting of mango graft and this could be due to enormous food supply by the rootstocks to sprouted growth.

Effect on Success, Mortality and Survival Per Cent of Grafts Union

Growing media

Effect of growing media on success, mortality and survival per cent of graft union are presented in Table-3. It was recorded that media M₅ [Soil + FYM + Sand (1:1:1)] gave highest success percent (88.23 and 81.46) at 30 and 60 DAG, minimum mortality per cent (11.77, 7.66 and 5.40) at 30, 60 and 90 DAG and maximum survival per cent (76.15) at the end of experiment. Higher success and survival of grafts union might be due to better aeration, temperature, humidity,

drainage and porosity in M₅ media. The results are also confirmed with Sharma and Dhuria (1981) in Walnut and Savani (2006) in mango.

Age of rootstock

Result presented in Table-3 shows that the highest success per cent (88.28 and 79.17), lowest mortality per cent (11.72, 9.87 and 9.28) at 30, 60 and 90 DAG and maximum survival per cent (71.75) of graft union at the end of experiment was recorded in D₂ (12 days after grafting). That might be due to the younger age of tissues which have maximum capacity to form callus resulting in better and quicker union. In addition the younger seedlings have more reserve food material in the

cotyledons compared to old seedling by which minimum mortality was found after grafting. The result on similar line was reported by Patil *et al.* (1979)^[12], Singh and Srivastava (1998)^[18], Chakrabarti and Sadhu (1984)^[6] in mango.

Apart from the reasons mentioned earlier, highest success which might be due to the accumulation of greater amount of food material in the stone and higher meristematic activity of the newly emerged seedling. Younger tissues have maximum capacity to supply water and nutrient from callus and consequently graft union. This result also conformity by Ratan *et al.*, (1987)^[15], Padma and Reddy (1997)^[11] and Jha and Brahmachari (2002)^[9] in mango.

Table: 2 Effect of growing media and age of rootstock on length, girth of mango stock, days taken to shoot sprouting success per cent and mortality per cent of mango grafts

Treatments	Length of stock (cm)	Girth of stock (mm)	Days to shoot sprouting	Success per cent 30 DAG	Success per cent 60 DAG	Mortality per cent		
						30 DAG	60 DAG	90 Days
Growing media								
M ₁ : Orchard Soil (Control)	14.51	4.50	10.25	80.14	70.43	19.86	13.69	16.79
M ₂ : Soil + FYM (1:1)	15.46	4.54	9.78	81.64	72.02	18.37	11.86	16.55
M ₃ : Soil + Sand (1:1)	17.06	4.71	9.69	87.83	78.66	12.17	10.39	7.57
M ₄ : Soil + Vermicompost (1:1)	15.61	4.61	9.77	82.47	74.11	17.53	9.96	6.48
M ₅ : Soil + FYM + Sand (1:1:1)	17.37	4.74	9.48	88.23	81.46	11.77	7.66	5.40
M ₆ : Soil + FYM + Vermicompost (1:1:1)	15.74	4.49	9.57	81.63	70.48	18.35	13.29	12.55
SEm.±	0.10	0.02	0.06	0.56	0.57	0.57	0.97	0.76
C.D. (P=0.05)	0.29	0.06	0.18	1.64	1.64	1.64	2.82	2.20
Age of rootstock								
D ₁ : 8 Days after germination	12.84	4.04	9.20	80.27	70.14	19.73	12.78	13.21
D ₂ : 12 Days after germination	16.02	4.54	9.79	88.28	79.17	11.72	9.87	9.28
D ₃ : 16 Days after germination	19.02	5.22	10.28	82.41	74.27	17.59	10.28	10.18
SEm.±	0.07	0.01	0.04	0.40	0.40	0.40	0.692	0.54
C.D. (P=0.05)	0.21	0.04	0.13	1.16	1.16	1.16	2.000	1.55

Effect on Growth Parameter of Grafts

The effect of growing media and age of rootstock on growth parameters (shoot length, number of leaves, scion height and scion girth) are presented in Table-3.

Growing media

Considerable differences were found on growth parameters due to different media. The maximum shoot length (19.55, 23.81 and 28.48 cm) at 30, 60 and 90 days respectively in M₅ [Soil + FYM + Sand (1:1:1)] media, total number of leaves (10.71, 15.25, 21.19) at 30, 60 and 90 days respectively in M₅ [Soil + FYM + Sand (1:1:1)] media, scion height (15.71, 19.64, 24.36 cm) at 30, 60 and 90 days respectively in M₅ [Soil + FYM + Sand (1:1:1)] media and scion girth (4.76, 5.78 and 7.04 mm) recorded under M₅ [Soil + FYM + Sand (1:1:1)] media,

This may be attributed to general improvement in the physical and chemical properties of the rooting medium, so increased absorption of nutrition may also have accelerated the process of cell division, differentiation and better nutrient availability leading to higher production of photo synthetically functional leaves and growth of plant by media. The results are in line with Savani (2006)^[16] and Parasana and Ray (2013)^[13] in mango *cv.* Kesar. The maximum growth of grafts was due to better drainage aeration in M₅ media. However, the FYM

released the nutrients and sand provided the porosity to the soil and improved the physical status of soil. Similar trends in maximum growth parameters (plant height, number of leaves and diameter of scion) due to treatment with Soil + FYM + Sand (1:1:1) were reported by Das *et al.*, (2006)^[7] in sapota.

Age of rootstock

The stock length, number of leaves, scion height and scion girth of graft were significantly influenced by different age of rootstock. The maximum shoot length (19.26, 22.71, 26.58 cm) at 30, 60 and 90 DAG, respectively in D₂ (12days after germination), total number of leaves (11.02, 14.83, 18.96) at 30, 60 and 90 DAG, scion height (15.75, 18.44 and 22.42 cm) and scion girth (4.85, 5.65 and 6.81 mm) at 30, 60 and 90 DAG were observed in age of rootstock of D₂ (12 days after germination).

The rootstock was able to supply water in required amount to the new growth. Scion and rootstock at this stage had enough food materials and other metabolism which helped in growth and develop of epicotyl grafting. The above results are collaborated with the findings of Jha and Brahmachari (2002)^[8] in stone grafting in mango and Alam *et al.*, (2006)^[1] was also observed that the age of rootstock influence the growth of mango graft in epicotyl grafting.

Table 3: Effect of growing media and age of rootstock on leaves on graft, scion height and scion girth in mango

Treatments	Leaves on graft			Scion height (cm)			Scion girth (cm)		
	30 DAG	60 DAG	90 DAG	30 DAG	60 DAG	90 DAG	30 DAG	60 DAG	90 DAG
A. Growing media									
M ₁ : Orchard Soil (Control)	9.38	11.65	15.35	14.00	15.69	19.31	4.43	5.17	6.35
M ₂ : Soil + FYM (1:1)	10.20	13.12	15.45	14.76	16.85	20.99	4.54	5.28	6.41
M ₃ : Soil + Sand (1:1)	10.70	14.74	20.69	15.21	18.53	23.14	4.70	5.64	6.77
M ₄ : Soil + Vermicompost (1:1)	10.27	13.98	19.25	14.96	18.46	21.26	4.55	5.32	6.51
M ₅ : Soil + FYM + Sand (1:1:1)	10.71	15.25	21.22	15.71	19.64	24.36	4.76	5.78	7.04
M ₆ : Soil + FYM + Vermicompost (1:1:1)	9.73	12.12	15.49	14.95	17.17	19.55	4.51	5.30	6.39
S.Em.±	0.06	0.09	0.10	0.09	0.11	0.14	0.04	0.03	0.04
C.D. (P =0.05)	0.18	0.27	0.30	0.26	0.32	0.39	0.10	0.09	0.12
B. Age of rootstock									
D ₁ : 8 days after germination	9.59	12.70	17.20	14.04	17.27	20.82	4.34	5.25	6.42
D ₂ : 12 days after germination	11.02	14.83	18.96	15.75	18.44	22.42	4.85	5.65	6.81
D ₃ : 16 days after germination	9.91	12.90	17.57	15.00	17.47	21.07	4.56	5.35	6.50
S.Em.±	0.04	0.07	0.07	0.06	0.08	0.10	0.02	0.02	0.03
C.D. (P =0.05)	0.13	0.19	0.21	0.18	0.23	0.28	0.07	0.07	0.08

Effect on Root Growth Parameter of Graft

Effect of media and age of rootstock on graft root growth parameters (length, girth, fresh weight and dry weight of root) of graft roots are given in Table-4.

Growing media

The maximum girth (6.67 mm), fresh weight (19.85 g) and dry weight (9.64 g), maximum length (18.67 cm) of tap root were recorded in M₅ [Soil + FYM + Sand (1:1:1)] media. The increase in root length and girth was a result of a favorable rooting media for better growth of a root. The possible reason of this is the presence of sand and FYM in M₅ media, sand may provide porous and well aerated soils with adequate moisture whereas, FYM provide nutrients to the plant. These results were supported by finding of Baghel and Sarawat (1989) [3], in pomegranate. This may be attributed to general

improvement the physical and chemical properties of the rooting medium, which improved the fresh weight and dry weight.

The above results with the findings of Parasana and Ray (2013) [13] in mango and Das *et al.* (2006) [7] in cashew nut grafted with different media mixture (soil, sand, FYM, sawdust and river sand).

Age of rootstock

It was observed from the data in Table-4 that age of rootstock significantly influenced length, girth, fresh weight and dry weight of root. The considerably maximum length (18.02 cm), girth (6.54 mm), fresh weight (18.48 g) and dry weight (9.71 g) of graft were recorded under D₂ (12 days after germination).

Table 4 Effect of growing media and age of rootstock on survival per cent of mango graft union and length, girth, fresh and dry weight of mango tap root at end of the experiment

Treatments	Survival per cent	Length of tap root (cm)	Girth of tap root (mm)	Fresh weight of tap root (m)	Dry weight of tap root (g)
A. Growing media					
M ₁ : Orchard Soil (Control)	58.48	14.42	6.00	8.59	3.18
M ₂ : Soil + FYM (1:1)	60.01	16.03	6.08	10.03	5.20
M ₃ : Soil + Sand (1:1)	72.68	18.98	6.38	18.64	9.13
M ₄ : Soil + Vermicompost (1:1)	70.17	16.62	6.21	13.63	5.37
M ₅ : Soil + FYM + Sand (1:1:1)	76.15	18.67	6.67	19.85	9.64
M ₆ : Soil + FYM + Vermicompost (1:1:1)	62.13	15.78	6.33	16.83	7.94
S.Em.±	0.41	0.15	0.05	0.13	0.17
C.D. (P =0.05)	1.195	0.43	0.16	0.38	0.49
Age of rootstock					
D ₁ : 8 days after germination	61.30	15.99	6.10	13.16	5.66
D ₂ : 12 days after germination	71.75	18.02	6.54	18.48	9.71
D ₃ : 16 days after germination	66.75	16.24	6.20	13.66	5.85
S.Em.±	0.29	0.10	0.04	0.09	0.12
C.D. (P =0.05)	0.84	0.30	0.11	0.27	0.34

Conclusion

It can be concluded that media and age of rootstock significantly influenced the growth and development of mango rootstock and graft. The better growth of rootstock was found in media Soil + FYM + Sand (1:1:1) and age of rootstock 12 days after germination was better for all the morphological parameters *viz.*, success per cent, mortality per cent, Shoot length, total number of leaves, scion height, scion girth, survival percentage, length and girth of graft's root and fresh and dry weight of graft's root. So, the epicotyl grafting

of mango should be done on 12 days old rootstock with media mixture of Soil + FYM + Sand (1:1:1).

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