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Influence of Biomass Characters of Different Grafted Scion on the Rootstock of Mango (*Mangifera indica* L.) under Shade Net Condition of Prayagraj Region, India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The experiment was conducted during the year 2019-20 & 2021-22, at Department of Horticulture, Naini Agricultural Institute, SHUATS, Prayagraj with the object to study the success and initial Biomass characters of the grafts of some important varieties of mango under net house condition. The experiment consists of ten different varieties of mango Amrapali, KishanBhog, Gulabkhas,

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Kesar, Totapuri, Dasheri, Malgoa, Himsagar, Nisar Pasand & Bombay Green as treatments and replicated thrice in Completely Randomized Design (CRD). The results of present investigation clearly showed that, grafts of different mango varieties studied had a significant influence on the maximum values of biomass characters like Length of tap root (25.97 cm), No. of secondary roots (37.73) was recorded in kesar. Fresh shoot weight (19.37 g) , Dry shoot weight (g) (11.19 g), Fresh root weight (9.66 g), Dry root weight (5.04 g) was found maximum in Dasheri. Shoot root ratio (Fresh on weight basis) (2.75g) and Shoot root ratio (Dry on weight basis) (2.77 g) was maximum in Amrapali.

Keywords: Mango; rootstock; scion; grafting; monoembryonic.

1. INTRODUCTION

Mango grows well practically everywhere from sea level to an altitude of 1400 meters and is particularly well adapted to tropical and subtropical climates. Rainfall and excessive humidity during blooming and fruit development during the mango tree's hardiness and ability to withstand temperatures as high as 48 °C limit fruit yield. It is widely cultivated and prefers a warm, frost-free environment with well-drained soil with a pH between 5.5 and 7.5, a dry winter, and temperatures between 24 and 27 °C. The annual rainfall ranges from 400 to 3600 mm (16-142 inch). Beyond a pH of 7.5, it struggles.

Mango grafts are frequently grown on unknown seedling rootstocks, which results in variation between individual grafts. Standardizing the rootstocks for different mango cultivars in different agroclimatic zones is essential to ensure uniform development, high yield, good quality fruits, and diminutive stature of plants for high density planting [1-3]. This is possible if the rootstocks are developed asexually or with the aid of polyembryonic rootstocks, which are real types because they were developed from nucellar tissues [4-6]. It is also well known that the growth, subsequent fruit-bearing behaviours, and fruit quality of the majority of fruit crops were significantly influenced by rootstocks. Therefore, it is necessary to choose the appropriate rootstocks from the available varieties locally. Since these are used as rootstock for grafting and budding, raising of rootstocks and proper use of rootstocks is equally important [7-9].

Mango is mostly vegetatively multiplied for commercial plantations by side grafting and wedge grafting, which are more efficient and inexpensive methods than other types of vegetative multiplication [10-13]. As opposed to a year with side grafting, mango trees grown using wedge grafting are ready for planting in around six months. A compound horticultural tree's performance is influenced by both the rootstock and the scion [14]. Mango trees are grafted trees for the most part, and they are often grown in kitchen gardens or commercial orchards. Each tree is made up of two components: the scion, which creates the tree canopy, and the rootstock, which provides the root system [15-16]. These two elements are equally critical to a tree's life. For mango trees, grafting is a popular and favored vegetative growth technique [17]. Additionally, Pina and Errea [18] suggested that the effectiveness of the graft could be affected by the scion and rootstock cambium tissues' appropriate alignment.

There are definite advantages to softwood grafting over other vegetative propagation techniques. It is efficient, affordable, rapid, and can generate grafts in as little as a year. Softwood grafting hence leads to better and more consistent orchard installations, early success, and a lower danger of passing away.

Graft healing and acclimation during the grafting procedure are essential for grafted plants to thrive. As a result, for the scion and rootstock to successfully join, callus tissue must first grow, then vascular tissues must join. The type of scion used, the materials used for the rootstock, and the current environmental circumstances all play a role in how well a graft takes and the following growth and development of the scion shoot Hartmann et al. [19].

Rootstocks are fundamentally always seedlings, whether they are zygotic or nucellar. Particularly in India, monoembryonic non-descriptive seedlings are often used. Monoembryonic seedlings exhibit huge variability in germination and vigour depending on where they are duplicated and the environment. Only available in dry and semi-arid regions from April to June, mango stones have a detrimental effect on the vigour and germination rates in these regions. The month of September is said to be a busy

time for graft in these areas. The rootstocks grown in September will not grow to the desired girth and size for grafting, which will decrease the success of graft take and further decrease the survivability of grafted plants (Kumar et al. 2008a).

There are definite advantages to softwood grafting over other vegetative propagation techniques. It is efficient, affordable, rapid, and can generate as soon as a year after the transplant. Softwood grafting thus leads to better and more consistent orchard installations, early success, and a lesser risk of demise. The most important need is that the rootstock be robust when being grafted.

2. MATERIALS AND METHODS

The approach and materials utilized during the experiment are described in depth in this chapter. At the Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture Technology and Sciences, Prayagraj, the investigation was carried out in the academic years 2019–2020 and 2021–2022.

2.1 Materials

The Central Institute of Subtropical Horticulture (CISH), Lucknow, has provided the scion, while Patel Nursery (in front of Chaka Block, Prayagraj), has provided the rootstock. There will be 10 different Scion kinds, each of which will have 30 plants, and they will be grafted onto Mango's polyembryony rootstock.

2.2 Selection of Scion Materials

The mother plant that was used was chosen because it was disease-free and between 6 and 12 months old. The scion branches, which were 25 to 30 cm long and had three to four healthy buds, were used for grafting. About 5–7 days before detachment, chosen scion shoots on the mother plant underwent defoliation and beheading of the apical growth part, which assisted in causing the latent buds to enlarge.

2.3 Raising of Rootstock

Fully ripe desi mango fruits and stones were gathered from disease-free, healthy, well-maintained, and actively expanding mango trees to build the rootstock nursery. The native rootstocks were donated by one of the region's well-known model farmers, who also cared for them in accordance with advised cultural practices. Because they are adapted to their local environments and are disease resistant, local kinds are frequently used as rootstocks. Stones were gathered, washed in clean water, and treated with 10 grams of carbendazim dissolved in 10 liters of water. Stones were sown in elevated beds with a vertical spacing of 10 cm and 5 cm in the month of August. The seeds and stones were transplanted to nursery beds after germination, when the leaves had gone brown and had enlarged to a fourth of their original size. The stones germinated in two to three weeks. These seedlings' tap roots were clipped at the time of transplantation while keeping the majority of their fibrous roots. During the winter, these transplanted seedlings received regular waterings and protection from the frost. Beginning around the end of February or the beginning of March, seedlings continued growing, and starting in March, they were graftable.

2.4 Softwood Grafting Technique

With a sharp knife, the top new growth—bronze-colored shoots—that had grown on the rootstock was severed. After that, the terminally trimmed shoot received a longitudinal cut that measured 5 cm in length. The rootstock's top had a "V"-shaped appearance. Below the 'V' cut, the leaves were left whole. It was decided to use a scion that was almost the same thickness as the rootstock's severed shoot. The scion that was used was about 12 cm long. The bottom end of the scion was made into a slightly sloping wedge of about 5 cm by shaving off the bark and a little bit of wood from the two opposing edges.. On the remaining two sides, care was taken to preserve the bark. A 1.5 cm wide by 45 cm long, 200 gauge thickness white translucent polythene tape was used to tightly fasten the wedge-shaped scion that had been manufactured in the manner described above. The scion on newly made graft was covered with small transparent polythene covers to avoid the desiccation of scions, by creating humidity near and above the graft union region.

2.5 After Care of the Graft

The grafted mango plants were kept in plastic bags, which were shaded. Care was taken when watering the plants on a regular basis to prevent water from getting near the graft union area. The translucent polythene covers that had been put

on the scion after grafting were taken off as sprouts started to appear. Sprouts that developed on the rootstock beneath the graft union were frequently removed when they were seen. Spraying prophylactic pesticides on a regular basis was also used to prevent insect attacks.

3. RESULTS AND DISCUSSION

The results of the investigation regarding the influence of scion varieties and rootstock on growth of mango have been presented in tables, graphically illustrated through bar-diagrams, wherever required, and discussed in the light of the findings reported by earlier researchers. The findings have been divided into the following sub-headings:

3.1 Length of Tap Root (cm)

The maximum length of tap root (cm) grafted plant (25.97 cm) was recorded in kesar followed by Himsagar, Nisar Pasand, Bombay Green and Dasheri. Whereas the minimum length of tap root (cm) grafted plant (19.73 cm) was found in Amrapali.

3.2 No. of Secondary Roots

The maximum secondary roots grafted plant (37.73) was recorded in kesar followed by Dasheri, Totapuri, Kishanbhog and Malgoa. Whereas the minimum secondary roots grafted plant (29.17) was found in amrapali.

3.3 Fresh Shoot Weight (g)

The maximum Fresh shoot weight (g) grafted plant (19.37 g) was recorded in Dasheri followed by Bombay Green, Malgoa and Gulabkhas. Whereas the minimum Fresh shoot weight (g) grafted plant (15.11 g) was found in kesar. . The similar results regarding fresh weight of shoots in sapota grafts has been reported by aonla Choudharys et al., [20].

3.4 Dry Shoot Weight (g)

The maximum dry shoot weight (g) grafted plant (11.19 g) was recorded in dasheri followed by Totapuri, Bombay Green, NisarPasand and Gulabkhas. Whereas the minimum dry shoot weight (g) grafted plant (8.36 g) was found in kesar. The similar results regarding dry weight of shoots in sapota grafts has been reported by Choudharys et al., [20].

3.5 Fresh Root Weight (g)

The maximum fresh root weight (g) grafted plant (9.66 g) was recorded in dasheri followed by Amarpali, Malgoa, NisarPasand, Bombay Green and Totapuri. Whereas the minimum fresh root weight (g) grafted plant (7.01 g) was found in kesar. The production of the most fresh shoot weight in the variety Dasheri may be attributed to the high diameter of the graft, which suggests better compatibility with the rootstock and has assisted for better movement of solutes from roots to shoots and from shoot to roots, resulting in optimum growth of the grafts and higher accumulation of carbohydrates in plant body, which may have contributed to higher shoot weight Bobade et al., [21].

3.6 Dry Root Weight (g)

The maximum dry root weight (g) grafted plant (5.04 g) was recorded in dasheri followed by Amarpali, Gulabkhas, Totapuri, Himsagar and NisarPasand. Whereas the minimum dry root weight (g) grafted plant (3.49 g) was found in kesar. The production of the most fresh shoot weight in the variety Dasheri may be attributed to the high diameter of the graft, which suggests better compatibility with the rootstock and has helped for better movement of solutes from roots to shoots and from shoot to roots resulting in optimum growth of the grafts and higher accumulation of carbohydrates in plant body, which may have contributed to higher shoot weight Bobade et al., [21].

3.7 Shoot Root Ratio (Fresh on Weight Basis)

The maximum Shoot root ratio (Fresh on weight basis) (2.75 g) was recorded in Amarpali followed by Gulabkhas, Kishanbhog, Dasheri and Bombay Green. Whereas the minimum Shoot root ratio (Fresh on weight basis) (1.79 g) was found in NisarPasand. The vigorous vegetative development and greater adaptability of variety Amrapali to the existing environmental circumstances are indicated by the high shoot: root ratio on a fresh weight basis. Due to its ability to adapt to the semi-arid environments of Marathwada, the Amrapali variety may have produced grafts with a high shoot-to-root ratio and demonstrated promising performance in these settings Bobade et al [21].

Table 1. Different biomass characters of grafted scion on the rootstock of mango (*Mangifera indica* L.) under shade net condition of Prayagraj region

Varieties	Varieties name	length of tap root (cm)	No. of secondary roots	Fresh shoot weight (g)	Dry shoot weight (g)	Fresh root weight (g)	Dry root weight (g)	Shoot root ratio (Fresh on weight basis)	Shoot root ratio (Dry on weight basis)
V_1	Amarpali	19.73	29.17	18.17	9.72	8.47	4.66	2.75	2.77
V_2	Kishanbhog	21.19	32.97	17.53	9.96	7.32	3.92	2.40	2.47
V_3	Gulabkhas	22.52	31.43	18.23	10.99	7.38	4.06	2.54	2.60
V_4	Kesar	25.97	37.73	15.11	8.36	7.01	3.49	1.99	2.23
V_5	Totapuri	22.55	35.86	16.68	9.82	8.66	4.25	1.97	2.11
V_6	Dasheri	24.75	33.95	19.37	11.19	9.66	5.04	2.14	2.51
V_7	Malgoa	23.85	32.55	18.66	9.69	8.41	4.47	2.19	2.13
V_8	Himsagar	25.31	26.30	16.42	10.45	8.03	4.60	1.90	1.83
V_9	NisarPasand	24.54	28.33	17.49	9.55	8.59	4.99	1.79	1.85
V_{10}	Bombay Green	24.45	30.31	18.22	10.59	8.01	4.19	2.31	2.54
	F-Test	S	S	S	S	S	S	S	S
	C.D. 0.5%	0.61	2.14	1.73	1.49	0.42	0.20	0.25	0.38
	S.Ed (+)	0.29	1.02	0.82	0.71	0.20	0.09	0.12	0.18

3.8 Shoot Root Ratio (Dry on Weight Basis)

The maximum Shoot root ratio (dry on weight basis) (2.77 g) was recorded in Amarpali followed by Gulabkhas, Kishanbhog, Dasheriand Bombay Green. Whereas the minimum Shoot root ratio (dry on weight basis) (1.83 g) was found in NisarPasand and Himsagar.

4. CONCLUSION

The current analysis indicated that, at the nursery stage, the performance of grafts of the varieties Dasheri, Malgoa, Nisar Pasand, and Amrapali was superior since these grafts required a relatively high survival percentage. These kinds had the highest shoot:root ratio and graft diameter growth metrics. Moreover, grafts of stated kinds showed noticeably improved root and biomass characteristics. The scion wood of the varieties Dasheri, Malgoa, Amrapali, and Nisar Pasand may thus be used to propagate mango plants on a large scale using wedge grafting, as these grafts have shown the greatest performance and have the highest growth parameter values.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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