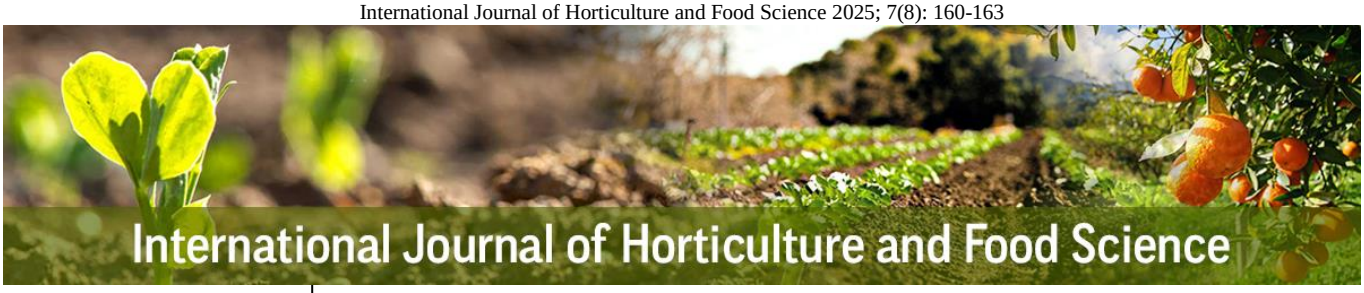

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Effect of age of scion and age of rootstock on saddle grafting in mango (*Mangifera indica* L.)

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Abstract
The present study was carried out at Fruit Research station and ICAR-AICRP on Fruits, Navsari Agricultural University, Gandevi during 2024-25. The experiment was laid out in Completely Randomized Design with Factorial concept and repeated thrice with twelve treatment combinations. The experiment comprising with two factors (1) effect of age of scion (4, 5, 6 and 7 month old) and (2) effect of age of rootstock (4, 5 and 6 month old). The result of present investigation revealed that among different age of scion and rootstock, 4 month old scion used for grafting on 4 month old rootstock in saddle grafting resulted maximum survival, maximum growth of the graft and highest graft survival percentage.

Keywords: *Mangifera indica* L, Gandevi, saddle grafting, rootstock, large-scale propagation

Introduction
Mostly, mango is propagated by a variety of grafting techniques are used across different regions, including veneer grafting, epicotyl grafting, softwood grafting, inarching, saddle grafting and cleft grafting, each showing varying degrees of success depending on local conditions. Saddle grafting ensures excellent cambial contact, resulting in a strong and stable graft union. The rootstock used in saddle grafting is typically 3 to 6 months old, making it more economical and easier to handle than the younger, more delicate rootstocks used in epicotyl grafting. It is also less mature than the rootstocks required for inarch grafting, thereby reducing production costs and space requirements (Kashyap *et al*., 1972) [1]. A major advantage of saddle grafting is its flexibility in timing, it can be performed almost year-round, offering greater convenience and scheduling flexibility to nurserymen. This adaptability, combined with its efficiency, makes it a valuable technique for large-scale propagation.

In saddle grafting, the success rate is influenced by several critical factors, foremost among them being the age of both the scion and the rootstock. Scion age plays a vital role in graft success as it directly affects callus formation, vascular differentiation and compatibility with the rootstock. Younger scions typically exhibit higher metabolic activity, which promotes faster healing and stronger graft union development. In contrast, older scions may have diminished regenerative capacity, resulting in lower graft success rates. The rootstock serves as the foundational support for the grafted plant, responsible for water and nutrient absorption, disease resistance and contributing to overall tree vigour. The age of the rootstock significantly affects graft success by determining the availability of essential carbohydrates, auxins and other growth regulators that facilitate callus proliferation and graft healing. While younger rootstocks generally display greater physiological activity, accelerating callus development, excessively young rootstocks may lack adequate lignification and structural strength, making them susceptible to environmental stresses. Conversely, older rootstocks possess more developed vascular systems but may show reduced growth vigour, potentially slowing graft union formation.

Material and Methods
The present study was carried out at Fruit Research station and ICAR-AICRP on Fruits, Navsari Agricultural University, Gandevi during 2024-25 to investigate the “Effect of age of scion and age of rootstock on saddle grafting in mango (*Mangifera indica* L.)”.

The experiment was laid out in Completely Randomized Design with Factorial concept and repeated thrice with twelve treatment combinations. The experiment comprising with two factors (1) effect of age of scion (4, 5, 6 and 7 month old) and (2) effect of age of rootstock (4, 5 and 6 month old). The effect of this treatment on incremental girth at union, incremental length of sprouted scion, incremental rootstock girth, number of shoots, incremental number of leaves and graft success perentage were studied.

Results and Discussion

Incremental girth at union

The data presented in Table 1 clearly revealed that incremental girth at union clearly revealed significant difference by age of scion and age of rootstock at 30, 45 and 60 DAD. Significantly higher incremental girth at union was recorded in 4 month old scion while, lowest incremental girth at union was recorded in 7 months old scion. It might be due to the presence of highly active cambium with thin, flexible tissues that allow rapid and uniform callus growth in younger scion. Younger scions have higher metabolic activity and better sap flow, enhancing early growth and success. Among the different age of rootstock maximum incremental girth at union was recorded in 4 month old rootstock while, lowest incremental girth at union was recorded in 6 month old rootstock. It might be due to the highly responsive cambial region with flexible tissues, which promote quick and even callus bridge formation in younger scion (Singh *et al*., 2014) [3]. The high moisture content and cell elasticity of juvenile tissues allow for close contact with the scion's cambium, speeding up the union establishment.Consistent results have been documented by Islam *et al.* (2004) [4] in jackfruit and El-Rouby *et al.* (2009) [5] in mango.

Incremental length of sprouted scion

In the present investigation maximum length of sprouted scion observed when 4 month old scion grafted with 4 month old rootstock at 30, 45 and 60 DAD. Significantly higher incremental length of sprouted scion was observed in 4 month old scion while, lower was found in 7 month old scion. This may be due to the young age of the scion. Physiologically active yet juvenile tissues promoted early callus formation and union compatibility (Sharangi, 2000) [6] High levels of auxin in young scions encourage cell elongation and the formation of vascular strands. Their soft tissues help establish vascular connections, ensuring a steady nutrient flow. This outcome aligns with previous finding of Kumawat (2021) [7] in mango; Parvin and Nasrin (2013) in Burmese grape and Patil *et al.* (2012) [9] in sapota.
Maximum girth obtained in 4 month old rootstock while, minimum girth was noted in 6 month old rootstock. Younger rootstocks may have betterhydraulic conductivity and nutrient transport efficiency. This helps scions grow more vigorously. They can produce and transport cytokinin more effectively, which encourages growth at the tip of the scion. The quick establishment of xylem continuity provides a steady supply of water and minerals to the shoot tip (Yadav *et al.*, 2019) [10].

Incremental rootstock girth

The observations on incremental rootstock girth revealed significant difference by different age of scion and age of rootstock at 30, 45 and 60 DAD. Maximum incremental rootstock girth was observed in 4 month old scion while, minimum was noted in 6 month old scion which could be a consequence of the increased auxin flow from the scion to the cambial zone of the rootstock. This flow stimulates cell division in the rootstock, leading to radial growth.Young tissues retained high meristematic activity; better healing at graft union (Patil *et al*., 2012) [9] which cause rapid increased incremental rootstock girth. A comparable result was also found by Kumawat (2021) [7] in mango. Among the different age of rootstock, maximum girth was noted in 4 month old rootstock while, minimum girth was observed in 6 month old rootstock. Which may be a result of the high cell growth rate in young rootstocks promotes steady radial growth after grafting. Their active cambial layer quickly thickens in response to hormones from both the root and the scion (Yadav *et al*., 2019) [10]. Similar result was also found by El-Rouby *et al*. (2009) [5] in mango.

Incremental number of leaves

The data in terms of number of leaves per graft at 30, 45 and 60 DAD clearly indicated the significant effect of scion age and rootstock age. Significantly higher incremental number of leaves was observed in 4 month old scion while, lowest was noted in 7 month old scion which may be potentially caused by the fast development of vascular connections in younger scions allows for steady nutrient and hormone flow. This supports frequent leaf growth. High ratios of cytokininto auxins encourage multiple leaf primordia to form from the apical meristem (Nimbalkar, 2011) [11]. Among the different age of rootstocks, maximum incremental number of leaves was recorded in 4 month old rootstock while, minimum was noted in 6 month old rootstock which is possibly as a result of rapid scion establishment on young rootstocks encourages early shoot branching and leaf production. The steady flow of nutrients and lack of water stress create a great environment for ongoing leaf primordia development. A comparable result was observed by Yadav *et al.* (2019) [10] and Kumar *et al.* (2022) in mango

Number of shoots

It is evident that number of shoots per graft was significantly affected by age of scion and age of rootstock at 60 DAD. Maximum number of shoots were recorded in 4 month old scion while, minimum was recorded in 7 month old scion.). It might be because younger scions have lower apical dominance and better axillary bud viability. This encourages multiple shoots to develop (Puli, 2015) [14]. Such findings were also recorded by Tanuja and Thippesha (2017) in sapota. Significant effect of age of rootstock observed on number on shoots. Maximum number of shoots observed in 4 month old while, minimum was noted in 6 month old rootstock. Possibly resulting from vigorous nutrient movement and hormonal balance that favours cytokinin help form callus quickly. This supports the earlier establishment of shoot-conducting tissues. The physiological strength of the rootstock keeps turgidity and metabolic activity high, which is necessary for shoot emergence (Mannan *et al.* 2006) [16]. This supports the findings of and Maheshwari and Nivetha (2015) [17] in jackfruit.

Graft success percentage

The data regarding graft survival percentage at 90 DAD

clearly revealed significant difference on different age of scion. Maximum graft success percentage was observed in 4 month old scion while, minimum graft success percentage was noted in 7 month old scion which could be attributed to efficient graft healing and lower oxidative stress come from younger scion. Their thin, tender tissues form callus tissue more quickly, sealing the wound before dehydration or infection can occur. Increased ant oxidative enzyme activity protects against cellular damage during the union process (Nimbalkar, 2011) [11]. Among the different rootstock age, maximum graft success percentage was recorded in 4 month old scion while, minimum graft success percentage was noted in 6 month old scion. It may be because younger rootstock provides a lively base for the scion. This leads to quicker healing and less tissue rejection. Their less woody, actively growing tissues connect more easily with the scion cambium, allowing for faster formation of vascular bridges (Chaudhary *et al*, 2017).

Table 1: Effect of age of scion and age of rootstock on saddle grafts of mango var. Sonpari

Treatment	Incremental girth at union (mm)			Incremental length of sprouted scion (cm)			Incremental rootstock girth (mm)			Incremental number of leaves		
	30 DAD	45 DAD	60 DAD	30 DAD	45 DAD	60 DAD	30 DAD	45 DAD	60 DAD	30 DAD	45 DAD	60 DAD
Age of scion (S)												
S_1, 4 months	1.51	2.07	2.53	1.16	1.69	2.18	1.51	1.98	2.44	1.63	2.16	2.59
S_2, 5 months	1.31	1.86	2.36	1.10	1.59	2.02	1.34	1.79	2.25	1.59	2.02	2.51
S_3, 6 months	1.37	2.01	2.44	1.11	1.56	2.07	1.28	1.73	2.22	1.59	2.14	2.56
S_4, 7 months	1.20	1.76	2.21	1.08	1.52	2.01	1.35	1.78	2.27	1.52	2.01	2.46
S.E.M. ±	0.02	0.02	0.02	0.02	0.03	0.03	0.02	0.02	0.02	0.02	0.04	0.03
C.D. at 5%	0.07	0.07	0.07	0.05	0.07	0.08	0.06	0.05	0.05	0.06	0.11	0.08
Age of rootstock (R)												
R_1, 4 months	1.43	2.00	2.47	1.25	1.78	2.26	1.40	1.87	2.34	1.66	2.19	2.57
R_2, 5 months	1.33	1.90	2.37	1.11	1.53	1.99	1.39	1.86	2.33	1.55	2.06	2.55
R_3, 6 months	1.29	1.87	2.32	0.98	1.46	1.97	1.32	1.73	2.21	1.54	1.99	2.46
S.E.M. ±	0.02	0.02	0.02	0.01	0.02	0.02	0.02	0.02	0.01	0.01	0.03	0.02
C.D. at 5%	0.06	0.06	0.06	0.04	0.06	0.06	0.05	0.05	0.04	0.05	0.09	0.06
Interaction effect (S x R)												
S.E.M. ±	0.04	0.04	0.04	0.03	0.04	0.05	0.04	0.03	0.03	0.04	0.07	0.04
C.D. at 5%	0.13	0.11	0.12	0.08	0.13	0.14	0.10	0.09	0.08	0.11	0.20	0.13
C.V. %	4.24	3.51	3.05	4.61	4.84	3.95	4.47	2.99	2.13	3.96	5.59	3.08

Treatment	Number of shoots	Graft success percentage
	60 DAD	90 DAD
Age of scion (S)		
S_1, 4 months	1.61	87.22
S_2, 5 months	1.60	82.78
S_3, 6 months	1.48	78.33
S_4, 7 months	1.46	77.78
S.E.M. ±	0.03	1.30
C.D. at 5%	0.09	3.80
Age of rootstock (R)		
R_1, 4 months	1.58	85.00
R_2, 5 months	1.56	81.67
R_3, 6 months	1.48	77.92
S.E.M. ±	0.02	1.12
C.D. at 5%	0.07	3.31
Interaction effect (S x R)		
S.E.M. ±	0.05	2.26
C.D. at 5%	0.15	6.62
C.V. %	5.85	4.79

Conclusion

The study clearly demonstrated that the age of scion and rootstock plays a pivotal role in the success of saddle grafting in mango. Younger scions (4 months old) and rootstocks (4 months old) consistently outperformed older ones, showing higher incremental girth, shoot growth, leaf number, and graft success percentage. This can be attributed to their greater metabolic activity, responsive cambial tissues, and efficient nutrient transport. Practically, adopting younger planting materials ensures higher success rates, reduced costs, and better orchard establishment. Future research may focus on integrating hormonal treatments and environmental manipulations to further enhance graft success and explore the scalability of these findings across diverse mango cultivars and agro-climatic zones.

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