Biological Forum – An International Journal **14(2a): 325-328(2022)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Standardization of Time of Grafting and Age of Rootstock in Custard Apple (*Annona squamosa* L.)

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(Received 30 April 2022, Accepted 23 June, 2022)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: The germination of custard apple through seed took long time and with very poor germination percentage due to seed dormancy and hard seed coat hence the softwood grafting is a most vital factor which determines the days of grafting. To standardize the vegetative propagation and time of operation of grafting in custard apple the present study was carried out. The grafting was do neat four different time (3rd week of January, 1st week of February, 3rd Week of February, 1st Week of March) having 4 different ages of rootstock *i.e.*, seven months, eight months, nine months and ten months rootstock. The results from three consecutive years of investigation revealed that rootstock age and grafting time significantly influences on the grafting success per cent. Seven-month-old rootstock grafting during 3rd week of January (95.11%) showed highest grafting success. The pooled mean analysis showed maximum height of rootstock *i.e.*, 64.22 cm on ten-month-old rootstock grafted during 1st week of march. Significantly maximum number of leaves and diameter of rootstock were recorded in ten-month-old rootstock *i.e.*, 17.89 and 1.06cm grafted during 1st week of March.

Keywords: Custard apple, Age of rootstock, Time of Grafting.

INTRODUCTION

In India there are number of minor fruit crops which has significant role in human health having very nutritious, medicinal and health properties. Among which Custard apple (*Annona squamosa* L.) a well-balanced dryland fruit crop rich in carbohydrate in the form of sugar (23.64%), protein (2.06%), calcium (24.0mg/100g), phosphorus (32.0mg/100g) and iron (0.6mg/100g) having excellent source of Vitamin C (36.3mg/100g), a good source of dietary fibre (4.4g/100g), a useful source of Vitamin B6 (0.2mg/100g), magnesium (21.0mg/100g) and potassium (247.0mg/100g), and with some B2 (0.113mg/100g). The custard apple of India, the sitaphal or sugar apple introduced from tropical America and found in wild form in many parts of the country. It is common in China, Philippines, Egypt and Central Africa. Custard apple growing regions in India include Assam, Bihar, Madhya Pradesh, Maharashtra, Odisha, Rajasthan, and Uttar Pradesh, Andhra Pradesh, Telangana and Tamil Nadu. In India, it occupies area 46 thousand ha with production 401 thousand ha (Annonymous, 2017-18 http://agricoop.nic.in). Maharashtra and Gujarat are another large custard apple growing state. However, the germination of custard apple through seed took long time and with very poor percentage germination because of seed dormancy and hard seed coat hence the softwood grafting is a most vital factor which determines the days of grafting and it is the easiest and cheapest method of propagation results in giving maximum success percentage in fruit crops like jamun (*Syzygium cumini* L. Skeel), tamarind (*Tamrindus indica* L.), and custard apple (*Annona squamosa* L) (Chovatia and Singh 2000; Awasthi and Shukla 2003; Ghosh *et al.,* 2004). The soft wood grafting has huge advantages over the other methods of propagation Pawar *et al*. (2018). In order to standardize the suitable grafting time and age of rootstock the present investigation on 'Study on propagation of custard apple' were studied to find out maximum success.

MATERIALS AND METHODS

An Investigation on Propagation of custard apple to find out suitable grafting time and age of root stock has been carried out at nursery of Regional Fruit Research Station, Katol District Nagpur during 2017 to 2020 under shed net condition. The treatment comprised of 4 different grafting time (3rd week of January, 1st week of February, 3rd Week of February, 1st Week of March) and 4 different ages of rootstock *i.e.*, seven months, Eight months, nine months and Ten Months rootstock. The experiment was laid out in (Factorial Randomized Block Design) FRBD with sixteen treatment combinations and three replications. The grafting was employed in custard apple, thirty seedlings of local cultivar having different age were used as rootstock was selected for performing grafting. The statistical analysis was followed as suggested by Panse and Sukhatme

(1996). The percentage of graft success was calculated by following given formula

Percentage of graft success (%)

$$= \frac{\text{Number of success grafts}}{\text{Total number of grafts done}} \times 100$$

RESULT AND DISCUSSION

The data presented in Table 1 showed the height of rootstock at the time of grafting. The local rootstock was selected for grafting and the trial was conducted for 3 successive years starting from 2017-18 to 2019-2020. The rootstock age significantly influences the height of rootstock. During the year 2017-18 the maximum height of rootstock was recorded on ten months old seedling *i.e.,* 64.00cm during 1st week of March followed by 3rd week of February *i.e.* 63.33cm. During 2018-19, the same results were found while the minimum height of rootstock was recorded in 7 months old rootstock on 3rd week of January *i.e.,* 50.33 cm. While, during 2019-20, the maximum height of rootstock was recorded on ten-month-old seedling (64.67cm) during 1st week of March. In pooled analysis the significantly maximum height was recorded in ten-month-old rootstock (64.22cm) followed by nine-month-old rootstock (63.11cm) and eight-month rootstock (61.22cm). However, minimum height of rootstock was obtained in seven-month-old rootstock (50.78cm) during 3rd week of January. Interaction effect was also found significant. Significantly maximum height was recorded in ten-month-old rootstock with the grafting time 1st week of March (61.52cm). The results are in conformity with the findings of Mane *et al*. (2018); Dhutraj *et al.* (2018) who observed maximum height during grafting on 1st January.

Table 1: Effect of age of rootstock and grafting time onheight (cm)of root stock.

Age of root stock	Grafting time												Pooled Mean			
	3rd week of January (cm)			1st week of February (cm)			3rd week of February (cm)			1st week of March (cm)			3rd week of January (cm)	1st week of February (cm)	3rd week of February (cm)	1st week of March (cm)
	2017-18	2018-19	2019-20	2017-18	2018-19	2019-20	2017-18	2018-19	2019-20	2017-18	2018-19	2019-20				
Seven months	51.00	50.33	51.00	60.00	59.00	59.33	59.67	59.67	59.67	62.33	58.67	62.00	50.78	57.67	55.56	57.56
Eight months	57.67	58.67	56.67	58.67	55.67	58.67	60.00	59.33	59.00	59.33	60.33	59.33	59.44	57.67	60.00	61.22
Nine months	55.33	56.33	55.00	60.33	60.00	59.67	60.33	59.00	60.33	62.00	62.33	61.67	59.67	59.44	59.89	63.11
Ten months	57.00	59.00	56.67	61.00	62.00	60.67	63.33	63.00	63.00	64.00	64.00	64.67	61.00	59.67	62.00	64.22
Mean	**55.25**	**56.08**	**54.84**	**60.00**	**59.17**	**59.59**	**60.83**	**60.25**	**60.50**	**61.91**	**61.33**	**61.92**	**57.72**	**58.61**	**59.36**	**61.52**

	2017-18	2018-19	2019-20	2017-18	2018-19	2019-20	2017-18	2018-19	2019-20	Pooled mean		
	Factor A			Factor B			Interaction			Factor A	Factor B	Interaction
F Test	**Sig.**	**Sig.**	**Sig.**	**Sig.**	**Sig.**	**Sig.**	**Sig.**	**Sig.**	**Sig.**	**Sig.**	**Sig.**	**Sig.**
SE m+	0.61	0.92	0.51	0.61	0.92	0.51	1.23	1.84	1.01	0.50	0.50	1.00
CD 5%	1.77	2.66	1.46	1.77	2.66	1.46	3.54	5.32	2.92	1.45	1.45	2.89

The results pertaining in Table 2 was about the number of leaves at different age of rootstocks during the time of grafting and the pooled results showed that the maximum number of leaves were recorded in ten-month-old rootstock (17.89) followed by nine (15.00) and eight (13.33) month old rootstock during 1st week of March. The results are in agreement with Kudmulwar *et al*. (2008); Mane *et al*. (2018).

The data presented in Table 3 was regarding the diameter of rootstock which plays an important role in the success of grafts. The grafts of custard apple were grafted at four different time *i.e.,* 3rd week of January, 1st week of February, 3rd Week of February, 1st Week of March) on 7, 8, 9, and 10 months old rootstocks. Significantly the maximum diameter was noticed in ten months old rootstock (1.06 cm) and nine months old rootstock (0.99cm). However, minimum diameter was obtained in seven (0.86cm) and eight months old rootstock (0.89cm). Based on three-year data the interactive effect of age of rootstock at the time of grafting was found non-significant. The results were found in conformity with the findings of Patil *et al.* (2017). The results on grafting success % study was predicted in Table 4, the age of rootstock and growth parameters of rootstock plays a significantly influenced on grafting success. During the year of 2015-16, the maximum grafting success % was noticed on seven-month-old rootstock grafted during 3rd week of January (95.00%). While, minimum success percentage was observed on ten-month-old rootstock grafted during 1st week of March *i.e.* (79.00%) The same trend was observed during 2016-17 and 2017-18. The pooled results showed that seven months old root stock was significantly superior over all other treatments (95.11%) and it was followed by eight months old root stock (94.67%) during 3rd week of January. Significantly minimum success of grafting was observed in ten months old root stock (79.11%) during 1st week of March. The interaction was found to be non-significant. The results are in supported with Hartman and Kestar (1972); Shinde *et al*. (1966); Kulkarni (1990); Dhutraj *et al*. (2018); Dhutraj and Baghat (2019) who observed January to February was the period for the maximum success of grafting in custard apple. The results pertaining in Table 2 was about the number of leaves at different age of rootstocks during the time of grafting. The pooled results showed that the maximum number of leaves were recorded in ten-month-old rootstock (17.89) followed by nine (15.00) and eight (13.33) month old rootstock during 1st week of March.

Table 2: Effect of age of rootstock and grafting time on number of leaves at the time of grafting.

Age of root stock	Grafting time												Pooled Mean			
	3rd week of January (cm)			1st week of February (cm)			3rd week of February (cm)			1st week of March (cm)			3rd week of January (cm)	1stweeek of February (cm)	3rd week of February (cm)	1st week of March (cm)
	2017-18	2018-19	2019-20	2017-18	2018-19	2019-20	2017-18	2018-19	2019-20	2017-18	2018-19	2019-20				
Seven months	11.00	11.67	10.67	12.00	11.67	12.00	12.33	13.67	13.33	13.33	13.33	14.33	11.11	12.22	13.78	12.56
Eight months	12.33	12.33	12.00	12.00	11.67	12.00	14.00	15.00	14.00	17.00	18.00	17.00	11.89	11.89	13.11	13.33
Nine months	14.00	13.33	14.00	13.00	13.33	13.00	14.67	15.00	15.00	17.00	18.00	16.67	13.11	14.33	14.89	15.00
Ten months	12.33	13.00	12.33	13.33	13.67	13.00	15.00	14.67	15.33	17.67	18.00	18.00	13.67	17.33	17.22	17.89
Mean	**12.41**	**12.58**	**12.25**	**12.58**	**12.59**	**12.50**	**14.00**	**14.59**	**14.42**	**16.25**	**16.83**	**16.50**	12.45	13.94	14.75	14.70

	2017-18	2018-19	2019-20	2017-18	2018-19	2019-20	2017-18	2018-19	2019-20	Pooled mean		
	Factor A			Factor B			Interaction			Factor A	Factor B	Interaction
F Test	**Sig.**	**Sig.**	**Sig.**	**Sig.**	**Sig.**	**Sig.**	**NS**	**NS**	**NS**	**Sig.**	**Sig.**	**NS.**
SE m+	0.53	0.62	0.48	0.53	0.62	0.48	-	-	-	0.46	0.46	-
CD 5%	1.54	1.78	1.38	1.54	1.78	1.38	-	-	-	1.32	1.32	-

Table 3: Effect of age of rootstock and grafting time on diameter of root stock at the time of grafting.

Age of root stock	Grafting time												Pooled Mean			
	3rd week of January (cm)			1st week of February (cm)			3rd week of February (cm)			1st week of March (cm)			3rd week of January (cm)	1stweeek of February (cm)	3rd week of February (cm)	1st week of March (cm)
	2017-18	2018-19	2019-20	2017-18	2018-19	2019-20	2017-18	2018-19	2019-20	2017-18	2018-19	2019-20				
Seven months	0.81	0.82	0.80	0.85	0.84	0.84	0.94	0.94	0.94	1.04	1.03	1.04	0.81	0.81	0.84	0.86
Eight months	0.82	0.81	0.81	0.84	0.83	0.84	0.95	0.95	0.95	1.04	1.03	1.04	0.85	0.84	0.87	0.89
Nine months	0.84	0.84	0.84	0.88	0.87	0.87	0.97	0.99	0.96	1.05	1.06	1.05	0.94	0.95	0.97	0.99
Ten months	0.86	0.88	0.84	0.89	0.90	0.88	0.99	0.99	0.99	1.06	1.05	1.06	1.04	2.08	1.05	1.06
Mean	**0.83**	**0.84**	**0.82**	**0.86**	**0.86**	**0.86**	**0.96**	**0.97**	**0.96**	**1.04**	**1.04**	**1.05**	**0.91**	**1.17**	**0.93**	**0.95**

	2017-18	2018-19	2019-20	2017-18	2018-19	2019-20	2017-18	2018-19	2019-20	Pooled mean		
	Factor A			Factor B			Interaction			Factor A	Factor B	Interaction
F Test	**Sig.**	**Sig.**	**Sig.**	**Sig.**	**Sig.**	**Sig.**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS.**
SE m+	0.01	0.01	0.01	0.01	0.01	0.01	-	-	-	-	-	-
CD 5%	0.02	0.03	0.02	0.02	0.03	0.02	-	-	-	-	-	-

Table 4: Effect of age of rootstock and grafting time on Grafting success (%).

Age of root stock	Grafting time												Pooled Mean			
	3rd week of January			1st week of February			3rd week of February			1st week of March			3rd week of January	1stweeek of February	3rd week of February	1st week of March
	2017-18	2018-19	2019-20	2017-18	2018-19	2019-20	2017-18	2018-19	2019-20	2017-18	2018-19	2019-20				
Seven months	95.00 (77.12)	95.00 (77.12)	95.33 (77.54)	94.67 (76.70)	94.67 (76.70)	95.00 (77.12)	91.67 (73.26)	91.67 (73.26)	90.67 (72.25)	90.33 (71.89)	90.33 (71.89)	89.67 (71.28)	95.11 (77.26)	93.67 (75.47)	88.11 (69.89)	86.00 (68.07)
Eight months	93.33 (75.05)	93.33 (75.05)	94.67 (76.73)	93.67 (75.43)	93.67 (75.43)	93.67 (75.43)	90.00 (71.62)	90.00 (71.62)	90.00 (71.62)	90.00 (71.66)	90.00 (71.66)	90.00 (71.66)	94.67 (76.68)	93.78 (75.56)	86.78 (68.71)	85.67 (67.82)
Nine months	88.00 (69.80)	88.00 (69.80)	88.00 (69.80)	86.67 (68.60)	86.67 (68.60)	86.67 (68.60)	87.00 (68.88)	87.00 (68.88)	84.67 (66.96)	81.00 (64.16)	81.00 (64.16)	81.00 (64.16)	90.89 (72.47)	90.22 (71.83)	86.56 (68.49)	81.89 (64.84)
Ten months	86.33 (68.34)	86.33 (68.34)	86.00 (68.05)	85.67 (67.80)	85.67 (67.80)	85.67 (67.80)	81.67 (64.67)	81.67 (64.67)	81.33 (64.44)	79.00 (62.73)	79.00 (62.73)	79.33 (62.98)	89.89 (71.47)	89.67 (71.34)	81.11 (64.25)	79.11 (62.81)
Mean	**91.00 (72.57)**	**91.00 (72.57)**	**91.00 (73.03)**	**90.25 (72.13)**	**90.25 (72.13)**	**90.25 (72.24)**	**86.67 (69.60)**	**86.67 (69.60)**	**86.67 (68.82)**	**85.00 (67.71)**	**85.00 (67.71)**	**85.00 (67.52)**	**92.64 (74.47)**	**91.83 (73.55)**	**85.64 (67.83)**	**83.17 (65.88)**

	2017-18	2018-19	2019-20	2017-18	2018-19	2019-20	2017-18	2018-19	2019-20	Pooled mean		
	Factor A			Factor B			Interaction			Factor A	Factor B	Interaction
F Test	**Sig.**	**Sig.**	**Sig.**	**Sig.**	**Sig.**	**Sig.**	**NS**	**NS**	**NS**	**Sig**	**NS**	**NS.**
SE m+	0.61	0.01	0.65	0.61	0.01	0.65	-	-	-	0.61	0.61	-
CD 5%	1.75	0.03	1.87	1.75	0.03	1.75	-	-	-	1.77	1.77	-

*fig. in parenthesis are arcs in transformed values

The results are in agreement with Kudmulwar *et al*. (2008); Mane *et al*. (2018).

The data presented in Table 3 was regarding the diameter of rootstock which plays an important role in the success of grafts. The grafts of custard apple were grafted at four different time *i.e.,* 3rd week of January, 1st week of February, 3rd Week of February, 1st Week of March) on 7, 8, 9, and 10 months old rootstocks. Significantly the maximum diameter was noticed in ten months old rootstock (1.06 cm) and nine months old rootstock (0.99cm), However, minimum diameter was obtained in seven (0.86cm) and eight months old rootstock (0.89cm). Based on three-year data the interactive effect of age of rootstock at the time of grafting was found non-significant. The results were found in conformity with the findings of Patil *et al.* (2017).

The results on grafting success % study was predicted in Table 4, the age of rootstock and growth parameters of rootstock plays a significantly influenced on grafting success. During the year of 2015-16, the maximum grafting success % was noticed on seven-month-old rootstock grafted during 3rd week of January (95.00%). While, minimum success percentage was observed on ten-month-old rootstock grafted during 1st week of March *i.e*. (79.00%) The same trend was observed during 2016-17 and 2017-18. The pooled results showed that seven months old root stock was significantly superior over all other treatments (95.11%) and it was followed by eight months old root stock (94.67%) during 3rd week of January. Significantly minimum success of grafting was observed in ten months old root stock (79.11%) during 1st week of March. The interaction was found to be non-significant. The results are in supported with Hartman and Kestar (1972); Shinde *et al*. (1996); Kulkarni (1990); Dhutraj *et al*. (2018); Dhutraj and Baghat (2019) who observed January to February was the period for the maximum success of grafting in custard apple.

CONCLUSION

The critical study on standardization of grafting period and age of rootstock in custard apple indicated that, regarding the overall performance of success seven-month-old rootstock grafted during 3rd week of January showed the maximum success and hence based on three-year data this period is recommended for the grafting in custard apple for Vidarbha region of Maharashtra.

FUTURE SCOPE

In Vidarbha region of Maharashtra maximum area covered by citrus, banana and other miner fruit crops but due diverse climatic conditions the farmers diverted for the rainfed and dry land horticulture crops. So, coming a day there is lot of scope of plantation of custard apple, considering this fact a large number of grafts and seedlings is to be needed hence, this techniques of propagation of custard apple will be helpful.

Acknowledgement. Authors acknowledged Regional Fruit Research Station, Katol for providing all facilities and planting material with financial support.

Conflict of Interest. None.

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How to cite this article: Y.B. Dharmik, Ekta D. Bagde, H.B. Goramnagar, P.N. Dawaneand and S.P. Patinge (2022). Standardization of Time of Grafting and Age of Rootstock in Custard Apple (*Annona squamosa* L.). *Biological Forum – An International Journal*, *14*(2a): 325-328.