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Effect of Size of Polybag on Survival and Growth of Mango Grafts

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Abstract

Mango is the most important fruit crop of India's western coast. Mango is commercially propagated by epicotyl grafting. Presently, epicotyl grafts are prepared in 6" × 8" poly bags which restrict root growth and such grafts take longer time for establishment in the field and growth is reduced. Hence, experiment was conducted for optimizing the size of poly bag for cv. Alphonso and Kesar for vigorous growth of epicotyl grafts. The investigation was undertaken in Randomized Block Design with four treatments viz. T_1-10" × 14" bags (Alphonso grafts), T_2-10" × 14" bags (Kesar grafts), T_3-6" × 8" bags (Alphonso grafts), T_4-6" × 8" bags (Kesar grafts) replicated five times with a unit of 200 grafts per treatment per replication. The sprouting and survival percentage was not affected by size of bags. Among all the treatments, the larger size bags of T_1 and T_2 improved the vigour of grafts remarkably by producing longer tap root, greater root spread and more number of secondary roots with increased plant height, girth at collar, number of leaves per graft and plant spread over the small sized bags in treatment T_3 and T_4. The RGR recorded in T_1 and T_2 was better than that of T_3 and T_4.

Keywords: Mango (*Mangifera indica* L.), polybag, Alphonso, Kesar, sprouting, survival, roots, vegetative growth, relative growth rate

1. Introduction

Mango is the most important fruit crop in India established on 22,97,000 ha in almost eleven states. Maharashtra is one of the leading states in India, contributing for 20.96 percent area. In Maharashtra, Konkan region is known for mango cultivation. Konkan region of Maharashtra is unique owing to its agro climatic conditions viz. moderate temperatures, high relative humidity, assured rainfall and lateritic to medium black soils. These conditions are favorable for cultivation of Alphonso which is a choicest variety of mango. It is also the earliest variety in the region and possess unique flavor which retains even after processing. At present, it is established on 1,82,000 ha and its further expansion is expected on 1,00,000 ha. However, it is a shy bearing variety having very low average production of 1.5 t/ha as compared to the national average of 6.6 t/ha (Anonymous, 2011). Apart from Alphonso, Kesar variety is also preferred for cultivation in konkan region. This variety is famous for its specific flavor, sweet taste and uniform light yellow color. It is a moderate bearer and its demand is increasing in recent years. In India, mango is commercially propagated by epicotyl grafting (Gunjate & Limaye, 1977) which is also known as stone grafting. In this grafting technique, fresh mango stones are sown immediately after harvest and grafts are prepared on tender epicotyl. Annually, about 50,00,000 grafts are sold through public and private sector nurseries of konkan region. These grafts are prepared in 6" × 8" poly bags having thickness of 200 gauge (Anonymous, 2013). Mango is deeply tap rooted and fast growing fruit crop (Ranjit Singh, 1969). By the time of the sale of grafts, many times the roots are penetrated through the plastic bags. Further, such grafts take longer time for establishment in the field after transplanting and subsequent growth remains slow. However, healthy grafts with strong undisturbed root system establish quickly in the field and can be trained early for canopy development. In countries like Israel, preparations of grafts in larger sized bags help for proper root development and better establishment of graft in field. Hence, investigation was under taken to study the effect of performance of mango grafts of cv. Alphonso and Kesar in various sized poly bags.

2. Material and Methods

2.1 Methodology

The experiment was conducted in plot No. 10, Department of Horticulture, College of Agriculture, Dapoli (MS), India, during 2011-12. The experiment was conducted in Randomized Block Design with treatments viz. T_1- 10" X 14" bags (Alphonso grafts), T_2 – 10" × 14" bags (Kesar grafts), T_3 – 6" × 8" bags (Alphonso grafts), T_4 – 6" X 8" bags (Kesar grafts). These treatments were replicated five times with a unit of 200 grafts per treatment per replication. The bags used for experiment were of black polythene with 200 gauge thickness. These bags were punched at bottom for provision of drainage. Potting mixture of soil: sand: compost (1:1:1) was used for filling the experimental bags. Ripe mango fruits were selected for extraction of stones. The extracted stones were thoroughly washed with water and immersed in carbendazim (0.2%) for 10 minutes. The raised beds of 100 cm long, 60 cm wide and 30 cm in height were prepared and farm yard manure @ 5 kg per bed was mixed in the upper layer of soil. The stones were sown on these beds and covered with fine soil. Sprouted stones having 20 days old epicotyls were used for grafting. Such stones were uprooted from the bed with appropriate care. The mother plants of cv. Alphonso and Kesar were marked in budwood nursery for collection of scion sticks. The scions of 5 months maturity, 15-20 cm length having deep green colour and pencil size thickness with swollen apical bud were selected for grafting from mother plants. The grafts were prepared by wedge grafting method (Majumdar & Rathore, 1970). These prepared grafts were planted in previously filled bags as per the treatment details. These bags were kept under poly tunnels and were watered regularly as per requirement. The observations viz. sprouting of grafts, survival of grafts (after 180 days) were recorded. After survival, 20 grafts per treatment per replication were randomly selected for recording growth observations viz. height (cm), girth at collar (cm), number of leaves and plant spread (cm). After one year of preparation, 10 grafts per treatments per replication were randomly selected to record the root parameters viz. length of tap root (cm), root spread (cm) and number of secondary roots.

2.2 Statistical Analysis

The statistical analysis was performed as per the Annova suggest by Panse and Sukhatme (1997). The "P" value of percentage data for sprouting and survival of mango grafts were estimated by statement square test. Standard Deviation was calculated as per the procedure advocates by Rangaswami (1995).

3. Results and Discussion

Table 1. Effect of size of bags on sprouting and survival of epicotyls grafts Cv. Alphonso and Kesar

Sr. No.	Treatments	Sprouting (%)	Survival after 180 days (%)
1.	T_1- 10" X 14" bags (Alphonso grafts)	78.30[a] (78.30±3.38)	61.50[a] (61.50±1.80)
2.	T_2 – 10" X 14" bags (Kesar grafts)	78.40[a] (78.40±2.53)	59.50[a] (59.50±1.73)
3.	T_3 – 6" X 8" bags (Alphonso grafts)	77.30[a] (77.30±2.82)	60.00[a] (60.00±0.79)
4.	T_4 – (6" X 8" bags Kesar grafts)	76.80[a] (76.80±3.19)	60.40[a] (60.40±1.85)
	Range	78.40-76.80	61.50-59.50
	S.Em±.	2.44	0.74
	C.D. at 5 %	5.17	2.22
	P- Value	0.79679	0.13982

The sprouting percentage ranged between 76.80 (T_4) to 78.40 (T_2) for various treatments. However, the difference in sprouting percentage among various treatments was non significant. The percentage survival of grafts ranged between 59.50% (T_2) to 61.50% (T_1). However, the difference in survival percentage among the treatments after 180 days was also non significant.

The sizes of polybag do not influence the sprouting and survival of mango grafts. Stone graft is prepared on tender mango epicotyls of about 20 days (Anonymous, 2013). During the initial period of growth the adequate food is provided by fleshy cotyledons. Further, the reserved assimilates in scion stick helps for its sprouting. A

successful union of rootstock and scion contribute for survival hence there was no effect of size of polybag on sprouting and survival of mango grafts.

Table 2. Effect of size of bag on root length (cm), root spread (cm) and number of secondary roots of mango grafts variety Alphonso and Kesar

Treatment	Length of tap root (cm)	Root spread (cm)	No. of secondary roots
T_1	54.00 [a]	51.40 [a]	67.40 [a]
	(54.00 ±21.09)	(51.40±11.93)	(67.40±9.74)
T_2	46.00 [a]	48.40 [a]	75.00 [a]
	(46.00±4.47)	(48.40±6.77)	(75.00±5.96)
T_3	25.00 [b]	23.80[b]	29.20 [b]
	(25.00±5.61)	(23.80±4.02)	(29.20±3.70)
T_4	33.60[ab]	28.60 [b]	25.20 [b]
	(33.60±7.86)	(28.60±6.07)	(25.20±5.50)
Range	54.00-25.00	51.40-23.80	75.00-25.20
S.Em±.	5.45	5.04	3.13
C.D. at 5 %	16.33	15.12	9.38

The mango grafts of T_1 (54.00 cm) had longest tap root which was at par with T_2 (46.00 cm) and significantly superior T_3 and T_4 (Table 2). The shortest tap root was observed in T_3 (25.00 cm) which was followed by T_4 (33.60 cm), both were at par with each other. The number of secondary roots were maximum in T_2 (75.00) followed by T_1 (67.40). The minimum secondary roots were in T_4 (25.20) which were at par with T_3 (29.20). Larger size bags provided greater space for root expansion and development. The availability of more potting mixture in bigger bags ensured continuous moisture supply to developing grafts which helped in better root growth. Large bag also provide additional nutrients than the small bag. It resulted in the longer tap root, better root spread and higher number of secondary roots in treatment T_1 and T_2. Prawoto (1984), Matin and Banik (1993), and Gera, Sharma, Bhandari and Srivastava (1996) recorded similar findings in cocoa, teak and *Dalbergia sissoo* respectively.

Table 3. Effect of size of bag on plant height, RGR for plant height, girth at collar and RGR for girth at collar of epicotyls grafts Cv. Alphonso and Keshar

Sr. No.	Treatments	plant height (cm)			RGR of plant height (cm/cm/day)		Girth at collar(cm)			RGR of girth at collar (cm/cm/day)	
		210 days	**270 days**	**330 days**	**210-270 days**	**270-330 days**	**210 days**	**270 days**	**330 days**	**210-270 days**	**270-330 days**
1.	**T_1**	24.91 [ab] (24.91±1.29)	37.96 [a] (37.96±1.95)	51.15 [a] (51.15±2.52)	0.007019 [a]	0.004972 [b]	2.38 [a] (2.38±014)	4.78 [a] (4.78±0.20)	5.91 [a] (5.91±0.20)	0.011672 [a]	0.003511 [c]
2.	**T_2**	26.44 [a] (26.44±3.81)	33.74 [a] (33.74±4.50)	48.10 [a] (48.10±3.77)	0.006435 [c]	0.006299 [a]	2.17 [a] (2.17±0.12)	4.41 [ab] (4.41±0.16)	5.69 [a] (5.69±0.20)	0.011742 [a]	0.004272 [b]
3.	**T_3**	21.40 [b] (21.40±1.49)	26.00 [b] (26.00±1.97)	32.30 [c] (32.30±2.56)	0.003239 [d]	0.003613 [c]	2.18 [a] (2.18±0.13)	4.07 [b] (4.07±0.19)	4.90 [b] (4.90±0.19)	0.010451 [b]	0.003076 [d]
4.	**T_4**	22.38 [b] (22.38±1.30)	32.90 [ab] (32.90±1.31)	39.00 [b] (39±5.26)	0.006741 [b]	0.002415 [d]	2.26 [a] (2.26±0.20)	3.26 [c] (3.26±0.31)	4.50 [c] (4.50±0.18)	0.006111 [c]	0.005425 [a]
5.	**Range**	26.44-21.40	37.96-26.00	51.15-32.30	0.007019-0.003239	0.006299-0.002415	2.38-2.17	4.78-3.26	5.91-4.50	0.011742-0.006111	0.005425-0.003076
6.	**S.Em±.**	1.27	1.59	1.88	0.00053	0.00039	0.09	0.13	0.11	0.00056	0.00047
	C.D. at 5 %	3.80	4.78	5.64	0.00160	0.00120	0.27	0.39	0.34	0.00170	0.00150

The height of mango graft seven months after preparations recorded significant variation among the treatments. The maximum plant height (cm) was recorded in T_2 (26.44) followed by T_1 (24.91) which were at par with each other after 210 days of grafting. The minimum height (cm) was noticed in T_3 (21.40). The significant difference in height of mango grafts persisted throughout the period of experimentation during 8^{th}, 9^{th}, 10^{th} month. At

eleventh month, the tallest grafts were found in T_1 (51.15 cm) which was at par with T_2 (48.10) and significantly superior over T_3 and T_4. The continuous increase in height was noted irrespective of treatments. The relative growth rate differed among treatment. The maximum relative growth rate (RGR) was recorded in T_1 (0.007019 cm/cm/day) during 210-270 days after graft preparation which was significantly superior over rest of the treatments. The minimum RGR was recorded in T_3 (0.003239). The RGR for plant height was higher during 210-270 days after grafting in T_1 and T_2 and T_4 which gradually reduced in subsequent period.

The girth at collar region varied between 2.38 cm (T_1) to 2.17 cm (T_2) at 7 month after preparation of graft. It expanded to 5.91 cm (T_1) to 4.50 cm (T_4) at 11th month. The variation recorded among different treatments was significant throughout the experimental period. The growth rate recorded in T_1 and T_2 was higher as compared to T_3 and T_4. The maximum RGR for girth at collar region was observed at 210-270 days after preparation of grafts which showed a decreasing trend in subsequent period up 330 days after graft preparation.

Table 4. Effect of size of bag on number of leaves RGR for number of leaves, plant spread and of RGR for plant spread of epicotyls grafts Cv. Alphonso and Keshar

Sr. No.	Treatments	Number of leaves			RGR of no. of leaves		Plant spread (cm)			RGR of plant spread (cm/cm/day)	
		210 days	**270 days**	**330 days**	**210-270 days**	**270-330 days**	**210 days**	**270 days**	**330 days**	**210-270 days**	**270-330 days**
1.	**T_1**	14.88^{b} (14.88±0.90)	27.57^{a} (27.57±1.67)	37.21^{b} 37.21±1.82)	0.010277^{a}	0.005007^{b}	17.89^{b} (17.89±1.20)	28.01^{a} (28.01±0.48)	34.35^{b} (34.35±1.89)	0.007495^{a}	0.003387^{c}
2.	**T_2**	18.13^{a} (18.13±3.46)	28.65^{a} (28.65±1.91)	41.39^{a} (41.39±2.52)	0.007844^{b}	0.006136^{a}	23.21^{a} (23.21±1.75)	27.91^{a} (27.91±5.77)	43.03^{a} (43.03±4.76)	0.006302^{c}	0.003942^{a}
3.	**T_3**	14.45^{b} (14.45±0.53)	20.86^{b} (20.86±1.84)	26.67^{c} (26.67±1.79)	0.0006076^{c}	0.004114^{c}	19.70^{b} (19.70±1.43)	27.88^{a} (27.88±0.83)	31.68^{b} (31.68±1.57)	0.005815^{d}	0.002012^{d}
4.	**T_4**	13.95^{b} (13.95±0.66)	18.52^{b} (18.52±1.71)	22.47^{d} (22.47±2.19)	0.004682^{d}	0.003220^{d}	18.26^{b} (18.26±1.19)	27.35^{a} (27.35±2.39)	34.85^{b} (34.85±2.37)	0.006718^{b}	0.004027^{a}
5.	**Range**	18.13-13.95	28.65-18.52	41.39-22.47	0.010277-0.004682	0.006136-0.003220	23.21-17.89	28.01-27.35	43.03-31.68	0.007495-0.005815	0.004027-0.002012
6.	**S.Em±.**	1.02	1.09	1.18	0.00077	0.00031	0.61	2.83	1.91	0.00063	0.00045
	C.D. at 5 %	3.05	3.26	3.55	0.00240	0.00100	1.83	8.48	5.71	0.00190	0.00140

The number of leaves recorded in T_2 was maximum from 7 to 11 months of graft preparation followed by T_1 (Table 4). The minimum leaves were produced in T_4 (22.47) during entire growth period. It was also apparent that relative growth rate in T_2 and T_1 was faster as compared to T_3 and T_4. The maximum leaves were found in T_2 (41.39) up to 330 days after graft preparation. It was followed by T_1 (37.21). The RGR for production of leaves was high in T_1 and T_2 as compare to T_3 and T_4. It was faster during 210-270 days as compare to subsequent period.

The plant spread recorded in T_2 was maximum during 7th, 8th, 10th and 11th month after preparation of graft. The maximum plant spread was recorded in T_2 (43.03 cm) after 11th month which was significantly superior over rest of the treatments. All other treatments were at par with each other.

A well developed root system contribute for better uptake of nutrients and water from the soil, increased formation of amides, amino acids, proteins, lipids, hormones and other organic substances (Amar Singh, 2003). In the present investigation, the vegetative growth parameters viz. plant height, girth at collar, number of leaves and plant spread as well as RGR of vegetative parameters was significantly superior in T_2 and T_1. Larger bag size, greater volume of soil with more nutrients helped for vigorous growth of grafts. Increase in plant height and increased number of leaves also improved the rate of photosynthesis which might have contributed in better growth. The differences in the root length in the various polythene bag sizes are due to differences in leaf growth and supply of photosynthate to the roots (Adu-Berko, Idun, & Amoah, 2011). Ridge (1991) also reported that the leaves produced in plant are directly proportional to photosynthate produced. Gera, Sharma, Bhandari and Pant (2000), Singh (1998) and Dhakal (1979) also reported similar findings in albizia, bhalia and mango respectively.

4. Conclusion

Thus, the experiments concluded that polybag size has no significant effect on sprouting and survival of epicotyls grafts of mango. However, it has significant effect on length of tap root (cm), root spread as well as number of secondary roots. Similarly, the important growth parameters like plant height (cm), girth at collar (cm),

number of leaves per plant and plant spread differed significantly due to size of polybag. Bigger size polybags produced healthier grafts as compared to small size polybags.

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