Performance of mango (*Mangifera indica* L.) grafts cv. Alphonso raised in soilless media in various types of containers

Abstract:

In world, Konkan region is famous for cultivation of king of mangoes 'Alphonso'. Along with production, export and processing of Alphonso, this coastal belt is famous for supply of best quality planting material producing more than one crore grafts every year. Mango grafts are raised in polybag of size 6" x 8" weighing 1.5 kg available for sale after 9 months. In recent years, it was reported by farmers that polybags produced seedlings having spiralled and deformed root system reduce outplanting survival and performance of mango grafts within few years after plantation. Use of discarded plastic water bottles as root trainer could be a feasible alternative for seedling propagation. An experiment entitled "Performance of mango (*Mangifera indica* L.) grafts cv. Alphonso raised in soilless media in various types of containers" was carried out during the period 2023 at Department of Fruit Science, College of Horticulture, Dapoli, Dist. Ratnagiri in randomized block design with four replications and six treatments *viz.* T_1-Nursery bag (6×8 Inch), T_2-Green bottle (2.25 lit), T_3-Transparent bottle (2.25 lit), T_4-Transparent bottle (1 lit), T_5-Black root trainer (0.5 lit), T_6-Nursery bag (6×8 Inch) (with soil:FYM 3:1 as control). Mango grafts raised in transparent bottle (2.25 lit) with media cocopeat + leaf manure + vermicompost (1:1:2) recorded the highest sprouting (98.13 %), height (29.33 cm), girth (12.32 mm), leaf area (523.48 cm^2), root length (25.50 cm), dry root weight (11.00 g) and survival (98.13 %) at 180 days after grafting with 1.84 benefit: cost.

Keywords: Mango, Container, Soilless, Grafts.

1. Introduction:

Mango (*Mangifera indica* L.) belongs to the family Anacardiaceae and originated in the continental region of Burma or Indo-Myanmar origin, Thailand, Indo-China and Malaysia peninsula. It is considered as one of the best fruits of the world by virtue of its flavour, delicious taste, delicate fragrance, attractive colour, so it is also known as "King of fruit". In Maharashtra, Konkan region is known for mango cultivation. Konkan region is unique owing to its agro-climatic conditions viz. moderate temperatures, high relative humidity, assured rainfall and lateritic to medium black soils. Potting medium is most important input for healthy, uniform and better seedling production. Different growing media other than soil like cocopeat, leaf manure and compost are light in weight and are having good porous structure so easily transported from one place to other. Mango is ever green crop and need to be transfered intact with media along the root ball, otherwise it will cause defoliation leads to death of graft. Polybags are a common container type for seedling propagation. However, polybags produce seedlings with spiraled and deformed root systems that reduce outplanting survival and performance. Use of discarded plastic water

bottles could be a feasible alternative as a container type for seedling propagation. The root trainer is a specially designed cylindrical containers made up of opaque material with two open ends of which the lower and tapers gradually with a smaller open end, to provide favourable condition for the root development. The area under mango in India is increasing rapidly particularly of Alphonso variety and Konkan belt is considered as one of the major supplier of good quality diseased free planting material. Soilless media can play a significant role in the successful grafting of mangoes for several reasons. This media allows for precise control over nutrient levels, ensuring that the grafts receive the optimal balance of nutrients required for healthy growth. Containers provide a confined space for root growth, encouraging the development of a healthy root system. This is particularly important for mango grafts as it helps in establishing strong roots that can support vigorous growth and withstand transplanting. The combination of soilless media and different container types will influence the growth patterns and development of mango grafts. So, research on performance of mango (*Mangifera indica* L.) grafts cv. Alphonso raised in soilless media in various types of containers is important to study the container size, material and design which will interact with the properties of the soilless media to affect the growth outcomes of the mango grafts.

2. Material and Methods:

The present experiment entitled "Performance of mango (*Mangifera indica* L.) grafts cv. Alphonso raised in soilless media in various types of containers" was carried out during the period 2023 at Department of Fruit Science, College of Horticulture, Dapoli, Dist. Ratnagiri.The experiment was carried out in Randomized Block Design (RBD) with four replications and six treatments.T_1-Nursery bag (6×8 Inch), T_2-Green bottle (2.25 lit), T_3-Transparent bottle (2.25 lit), T_4-Transparent bottle (1 lit), T_5-Black root trainer (0.5 lit), T_6-Nursery bag (6×8 Inch) (with soil:FYM 3:1 as control). The experimental material used for the study was different media components *viz.*, soil, leaf manure, cocopeat and vermicompost as a potting media. Leaf manure, cocopeat and vermicompost were added to all the treatments in 1:1:2 proportion except T6. Trichoderma 500 g was also added in all the treatments during mixing at initial stage except control. Fertilizer 19:19:19 5g was added in all the above treatments 180 DAG at 30 days interval for 6 months. A group of 40 grafts formed a unit. In this experiment sprouting, survival, morphological parameters and other observations like volume of root trainer and weight of root trainer influenced by various types of containers were recorded at 30 days interval up to 180 days and were analyzed by standard method of analysis of variance as given by Panse and Sukhatme (1995).

3. Result and Discussion:

At the end of the sixth month after grafting, all the parameters i.e. sprouting, survival and morphological parameters were significantly influenced by various size of containers.

3.1 Effect of various types of containers using soilless media on sprouting (%) and survival (%) of mango grafts cv. Alphonso

The data related to effect of various size of containers on per cent sprouting of mango grafts recorded at 0, 7, 14, 21, 28, 35 and 42 days after grafting (DAG) are presented in Table 1. The sprouting (%) of graft showed increasing trend irrespective of treatments till 21 days after grafting (DAG) and then subsidised till 42 DAG. At 42 DAG, the highest per cent sprouting (98.13) was recorded in T_3 (Transparent plastic bottle 2.25 lit) which was at par with T_2 (97.5). T_5 (Black root trainer 0.5 lit) recorded minimum per cent sprouting (87.5). Use of soilless media like leaf manure, vermicompost and cocopeat assisted for increasing porosity, low shrinkage, water holding capacity, low bulk density and slow biodegradation of the medium which led to higher sprouting per cent (Ragaji, 2017). Similar findings were reported by Khapare (2019) she observed 100 percent sprouting in mango in soil + SSP + rice husk + organic mill (55:15:15:15) and leaf manure (100%) media.

Table 1: Effect of various types of containers using soilless media on sprouting (%) and survival (%) of mango grafts cv. Alphonso

Treatment	Per cent sprouting at 42 DAG	Per cent survival at 180 DAG
T_1	92.50 (74.11)	48.75 (44.28)
T_2	97.50 (80.90)	60.63 (51.14)
T_3	98.13 (82.14)	63.13 (54.61)
T_4	93.13 (74.80)	52.50 (46.43)
T_5	87.50 (69.30)	21.25 (27.45)
T_6	91.25 (72.79)	32.50 (34.76)
MEAN	**93.33**	**46.46**
F-test	SIG	SIG
S.Em.±	1.13	1.46
CD @ 5%	3.39	4.39

(Figures in parenthesis indicate arcsine transformed values)

After 180 DAG, all the treatment showed significant effect on survival percentage of grafts. The highest survival percentage was recorded by treatment T_3 (Transparent bottle 2.25 lit) (63.13%) and was at par with T_2 (60.63%). T_5 recorded minimum survival percentage (21.25%). The water bottle container showed higher percentage of survival. In this container, the availability of nutrients and moisture together with balanced aeration in the root zone accelerated

photosynthesis in the grafts leaves. It caused the graft to develop well. Similar results were reported by Lad *et al*. (2020) in epicotyl grafts of mango cv. Alphonso and observed that highest survival percentage (82.67%) was obtained in media Cocopeat + Leaf manure + Compost (1:1:1) at 180 DAG.

3.2 Effect of various types of containers using soilless media on morphological characters of mango grafts cv. Alphonso

The data pertaining to the effect of various types of containers using soilless media at 180 days after grafting on morphological characters are presented in the Table 2. At 0 and 30 DAG results regarding height of grafts were found non-significant whereas from 60 to 180 DAG results were found significant. At 180 DAG, the highest plant height of grafts was recorded by treatment T_3 (Transparent bottle 2.25 lit) (29.33 cm) and was at par with T_2 (Green bottle 2.25 lit) (27.68 cm) and T_1 (Nursery bag 6 x 8 Inch) (25.85 cm).Thelowest plant height was recorded by T_5 (29.33 cm). T_3(Transparent bottle 2.25 lit) and T_2 (Green bottle 2.25 lit) have big size of container with volume around 1750 ml and because of this it contained high amount of media compared to other treatments. So, due to high nutrient availability graft height increased. Similar results were reported by Khurram (2015) in walnut plant where observed that water bottle container type showed good result with 23.7 cm seedling height of walnut plant at 120 days after sowing. Also, the highest plant height (29.77 cm) in media Cocopeat + Leaf manure + Compost (1:1:2) at 180 DAG was recorded by Lad *et al*. (2020) in epicotyl grafts of mango cv. Alphonso. At 180 DAG, highest girth of grafts was recorded by treatment T_3 (12.32 mm) and was significantly superior over others. T_6 recorded minimum girth of grafts (10.17 mm). The maximum girth in T_3 might be due to big size of container containing soilless media having aeration and moisture. The percentage of girth of grafted plants increases as a result of its support for cell division, cell elongation, and an appropriate water supply (Ragaji, 2017).

At 180 DAG, highest number of nodes of grafts were recorded by treatment T_3 (Transparent bottle 2.25 lit) (3.40) and was at par with T_2 (3.38). T_5 recorded minimum number of nodes of grafts (2.45). Similar results were reported by Lad *et al*. (2020) and Khapare (2019) in mango grafts. At 180 DAG, highest number of shoots of grafts were recorded by treatment T_2 (1.43) and was at par with T_3 (1.40), T_4 (1.38), T_1 (1.38) and T_5 (1.30), whereas T_6 recorded minimum number of shoots of grafts (1.25). Similar findings were reported by Lad *et al*. (2020) in mango and Sharath and Bhoomika (2018) in Black pepper.

At 180 DAG, maximum number of leaves of grafts was recorded by treatment T_3 (Transparent bottle 2.25 lit) (25.20) and was significantly superior over others. T_5 recorded minimum number of leaves of grafts (15.71). Similar results were reported by Lad *et al*. (2020),

Table.2 Effect of various types of containers using soilless mediaon morphological character of softwood grafts at end of experiment at 180 DAG

Treatments	Graft height (cm)	Girth of graft (mm)	Number of nodes	Number of shoots	Number of leaves	Total leaf area (cm^2)	Root length (cm)	Dry weight of root (g)	B:C
T_1	25.85	10.31	2.70	1.38	16.43	434.58	18.13	6.40	1.46
T_2	27.68	10.55	3.38	1.43	22.38	506.88	25.38	9.00	1.79
T_3	29.33	12.32	3.40	1.40	25.20	523.48	25.50	11.00	1.84
T_4	23.47	10.83	2.80	1.38	19.08	416.70	22.00	7.40	1.49
T_5	21.68	10.31	2.45	1.30	15.71	222.66	21.00	4.06	0.54
T_6	21.78	10.17	2.50	1.25	17.45	312.40	18.38	5.01	1.06
Mean	**24.96**	**10.75**	**2.87**	**1.35**	**19.37**	**402.78**	**18.72**	**7.15**	-
F-test	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	-
S.E.±	1.39	0.36	0.41	0.05	0.69	8.43	0.70	0.08	-
C.D. @ 5 %	4.20	1.09	1.23	0.14	2.08	25.42	2.11	0.24	-

Ragaji (2017) and Khapare (2019) in mango grafts. At 180 DAG, highest leaf area of grafts was recorded by treatment T_3 (Transparent plastic bottle 2.25 lit) (523.48cm^2) and was at par with T_2 (506.88cm^2). T_5 recorded minimum total leaf area (222.66 cm^2). Similar findings were reported by Lad *et al.* (2020) in epicotyl grafts of mango cv. Alphonso where found that maximum leaf area (721.87 cm^2) was recorded by media cocopeat + FYM (1:1) at 180 DAG.

At the end of experiment, the maximum root length was recorded in the treatment T_3 (Transparent bottle 2.25 lit) (25.50 cm) which was at par with T_2 (32.92 cm). The minimum root length was recorded in T_1 (18.13 cm). Mango grafts grown in water bottle container (T_3 and T_2) showed maximum root length. At end of experiment, the maximum dry weight of roots was recorded in the treatment T_3 (Transparent bottle 2.25 lit) (11.00 g) which was significantly superior over others. The minimum dry weight of roots was recorded in T_5 (4.06 g). Bottle container (T_3) (Transparent bottle 2.25 lit) recorded the maximum dry weight of roots. This may be due to ideal growth of roots in straight direction in water bottle container which helped in steady absorption nutrient and moisture from the root zone, proper drainage and aeration resulted in root respiration and other metabolic activities led to maximum root development. Similar findings were reported by Khurram (2015) in walnut plant reported that longest length of tap root (14.9 cm) was recorded by modern container type (root trainer) at 120 days after sowing in walnut seedlings. Also, he reported that highest dry root weight (5.9 g) was recorded by modern container type (root trainer) and was at par with water bottle container type (4.5 g) in walnut seedling at 120 DAS.

The cost of production for mango grafts raised in different size of containers was calculated. The highest net profit (Rs. 5561.49/-) was recorded in T_3 with highest B:C ratio (1.84). In T_2 recorded net profit (Rs. 5141.49/-) with B: C ratio (1.79). The lowest net profit (Rs. -2591.43/-) and B: C ratio (0.54) was reported in T_5.

4. Conclusion:

From the present investigation it is concluded that, the treatment T_3 (Transparent bottle - 2.25 lit) is found to be most effective among all other treatments in terms of most of the parameters such as sprouting (%) height, girth, number of nodes, number of leaves, total leaf area, absolute growth rate, survival (%), root length, dry weight of root. The treatment T_2 (Green bottle - 2.25 lit) is found second best in terms of most of the parameters such as sprouting (%), height, number of nodes, total leaf area, survival (%), dry weight of root. Thus, it can be concluded that T_3 (Transparent bottle - 2.25 lit) with soilless media cocopeat + leaf manure + vermicompost (1:1:2) is found excellent with highest (1.84) benefit: cost.

Option 1:

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

Option 2:

Author(s) hereby declare that generative AI technologies such as Large Language Models, etc. have been used during the writing or editing of manuscripts. This explanation will include the name, version, model, and source of the generative AI technology and as well as all input prompts provided to the generative AI technology

Details of the AI usage are given below:

1.

2.

3.

References:

Khapare, M. S. (2019).Survival and growth of mango (*Mangifera indica* L.) grafts cv. Alphonso in different potting mixtures. M. Sc. (Hort.) thesis submitted to Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri (M.S.)

Khurram, S. (2015). Use of plastic bottles as an alternative container type for propagation of forest tree seedlings in restoration programs. Open Access Theses. 486.

Lad, O. A., Kulkarni, M. M., Gavankar, M. S., Burondkar, M. M., Gokhale, N. B., Pawar, C. D.,Khandekar, R. G., Martal, P. B., Mali, P. R. and Bhuwad, A. V. (2020). Effect of different potting mixture on sprouting, survival and growth of softwood grafts of mango cv. Alphonso. *International Journal of Current Microbiology and Applied Sciences*, 11:1569-1574.

Panse, V. G. and Sukhatme, P. V. (1985). *Statistical methods for agricultural workers*. 4th Ed. Indian Council of Agricultural Research, New Delhi, pp. 97-156.

Ragaji, S. (2017). Effect of different potting media on survival and growth of mango (*Mangifera indica* L.) stone grafts cv. Alphonso. M.Sc. (Agri.) thesis submitted to Dr. B. S. Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri (M.S.)

Sharath, H. R. and Bhoomika, H. R. (2018). Influence of root trainer and rooting media on root and shoot growth of black pepper (Piper nigrum L.). Journal of Pharmacognosy and Phytochemistry, 7(3): 400-403.