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Mahesh SSNM
Department of Horticulture, Dr. YSRHU - COH, V.R Gudem, Andhra Pradesh, India

Ramanandam G
Principal Scientist (Hort.) & Head, Dr. YSRHU - HRS, Kovvur, Andhra Pradesh, India

Vinaya Kumar Reddy P
Assistant Professor (Hort.), Dr. YSRHU – COH, V.R Gudem, Gudem, Andhra Pradesh, India

Ravindra Kumar K
Senior Scientist (Hort.), Dr. YSRHU - HRS, Kovvur, Andhra Pradesh, India

Umakrishna K
Professor, Dr. YSRHU - COH, V.R Gudem, Andhra Pradesh, India

Salomi Suneetha DR
Dean of Student Affairs, Dr. YSRHU, V.R Gudem, Andhra Pradesh, India

Corresponding Author:
Mahesh SSNM
Department of Horticulture, Dr. YSRHU - COH, V.R Gudem, Andhra Pradesh, India

Effect of different growth media and containers on *ex vitro* hardening in banana cultivar Karpura Chakkera Keli (AAB)

Mahesh SSNM, Ramanandam G, Vinaya Kumar Reddy P, Ravindra Kumar K, Umakrishna K and Salomi Suneetha DR

Abstract
Banana cv. Karpura Chakkera keli (AAB) is choicest table variety in Godavari districts of Andhra Pradesh. Poor *ex vitro* survival are the major hindrance for its large scale commercial production. Therefore, the objective of present investigation was to develop an efficient growth media and different containers for *ex vitro* performance. In which different potting mixtures M_1-red earth (2) + FYM (1) + coco peat (1), M_2- red earth (2) + FYM (1) + rice husk (1), M_3- red earth (2) + FYM (1) + sand (1), M_4-vermicompost (1) + coco peat (1), M_5-vermicompost (1) + rice husk (1), M_6 –vermicompost (1) + sand (1) and two different containers C_1- Poly bags and C_2- Disposable plastic glass tested, among the 12 treatments *ex vitro* the maximum shoots length (15.60 cm), diameter of shoots (7.15 mm), number of leaves (6.00) and leaf area (73.78) was recorded in M_1 x C_1 treatment interaction to be the best treatment which is considered.

Keywords: Growth media, containers, vegetative characters, Karpura Chakkera keli

Introduction
Banana is economically most important crop in India and fetching more foreign money in international trade. It is consumed by more than 400 million people in the world and in terms of consumption it is next to rice, wheat and maize. Musa spp. are large perennial herbs belongs to the monocotyledonous family Musaceae, order Zingiberales. It is originated from South Asia to South-East Asia and Polynesia. It is referred as “Kalpatharu”, a plant of all virtues, with each and every part of the plant is being used for various purposes. It is believed to be one of the oldest fruits which have originated from Malaysia through a complex hybridization process. Cultivated banana is a triploid (2n = 3x = 33) derived from diploid species that is Musa acuminata (Malaysia) and Musa balbisiana (India). Triploid cultivars are the most widely cultivated clones of commerce due to their vigorous growth and higher yield than diploids. Most of the banana cultivars are specific to the regions in different parts of India.
India ranks first in the world banana production, with a total annual production of 33.83 million tons and it contributes to a huge share of 38.4% of the total fruit production from an area of 9.16 lakh ha with productivity of 36.93 t/ha. Andhra Pradesh is one of the leading producers of banana in India and is grown in an area of 90.52 thousand ha with production and productivity of 7.32 million tons and 79.91 t/ha, respectively.
Triploid cultivars are the most widely cultivated clones of commerce due to more vigorous growth and higher yield than diploids. There are many varieties of banana popular to India. South India and ‘Poovan’ (AAB) is one among them. The variety is locally known as ‘Karpura’ in andhra, ‘Rasthali’ in Tamil Nadu and ‘Rasabale’ in Karnataka. The plant has moderately vigorous and robust growth with crop duration of 15 to 16 months. The fruit is very sweet with pleasant apple flavour. The plant is highly susceptible to infection by *Fusarium oxysporum*.
Poovan banana fruits are normally recommended for children and age old peoples for their easy digestion and energy. The plant is highly susceptible to panama wilt and leaf spot diseases. Hence cultivation of the variety is shrinking in A.P. The major constraints in the ‘Poovan’ banana production system are the non-availability of disease free planting material.

Objectives

1. To study the effect of growth media and containers on *ex vitro* hardening (CEVRH) of micro shoots in banana cv. Karpura Chakkera Keli (AAB)
2. To optimize the hardening strategies for enhancing the growth of rooted plantlets.

Observations recorded

1. Shoot length (cm)
2. Diameter of shoot (mm)
3. 3- Number of leaves
4. Leaf area

Results and Discussion

Shoot length (cm)

Effect of growing medium, containers and their combinations significantly influenced shoot length during the hardening period in micro propagated banana plantlets is depicted in the (Table 1). The data regarding length of shoot length revealed that among growing medium used, significantly shoot length (14.45 cm) was recorded in red earth, FYM and coco peat (2:1:1)(M_1), followed by (12.14 cm) read earth, FYM and sand(2:1:1) (M_3) while shortest length of the shoot (8.43 cm) was recorded in vermicompost and sand (1:1)(M_6) medium. The interactions between growing medium and containers (M×C), the highest length of longest root (15.60 cm) was recorded read earth, FYM and cocopeat (2:1:1) and poly bags (M_1C_1), which was followed by read earth, FYM and cocopeat (2:1:1) and disposable plastic glass (M_1C_2) (13.30 cm), whereas the minimum length of longest root (8.22 cm) was recorded in vermicompost and sand (1:1)and disposable plastic glass (M_6C_2). Hardening pseudo stem height was significantly highest in potting media containing coco peat, red earth and FYM mixed in 2:1:1 ratio. This might be due to the fact that coco peat has ability to absorb and retain not only water but also air, due primarily to their microporous nature (Fornes *et al.*, 2003) [5] allowing internal retention of both water and air. Enhanced height of plants due to coco peat was reported by Ameri *et al.* (2012) [2] in strawberry, Uzaribara *et al.* (2015) [12] in banana.

Diameter of shoot (mm)

Among growing medium used, significantly higher shoot diameter (7.27 mm) was recorded in red earth, FYM and coco peat (2:1:1)(M_1), followed by (5.80 mm) red earth, FYM and sand (2:1:1) (M_3), while the shortest length of the shoot (4.60 mm) was noticed in vermicompost and sand (1:1) (M_6) medium. Among the factor containers, the maximum diameter of shoot (5.63 mm) was recorded in plastic glass (C_2) and minimum was in polybags (C_1) (5.37 mm). The combination red earth: FYM : cocopeat (2:1:1) + disposable plastic glass (M_1C_2) recorded the highest diameter of psudostem (7.51 mm), followed by red earth : FYM : cocopeat (2:1:1) + poly bags (M_1C_1) (7.02 mm). Similar reports were given by Ali *et al.* (2011) [1] The enhanced pseudo stem diameter in potting media containing cocopeat might be due to good physical properties like high total pore space, high water content, low shrinkage, low bulk density and slow biodegradation (Evans *et al.*,1996; Prasad, 1997) [4, 11].

Number of leaves

Different growing medium, containers, and their combinations non significantly with respect number of leaves during the hardening period in micro propagated banana plantlets is depicted in the table 1.

Leaf area (cm^2)

Different growing medium, and their combinations significantly influenced leaf area during the hardening period in micro propagated banana plantlets is depicted in the (table 1). The data regarding maximum leaf area revealed that among growing medium used, significantly leaf area (72.97 cm2) was recorded in red earth, FYM and coco peat (2:1:1)(M1), followed by (64.15 cm2) read earth, FYM and rice husk(2:1:1) (M_2) while lowest leaf area (58.24 cm2) was recorded in vermicompost and sand (1:1)(M_6) medium.

Non-significant difference was observed among the containers with respect leaf area.

Among the interactions between growing medium and containers (M×C), the highest leaf area (73.78 cm2) was recorded read earth, FYM and cocopeat (2:1:1) and poly bags (M_1C_1), which was followed by read earth, FYM and cocopeat (2:1:1) and disposable plastic glass (M_1C_2) (72.15 cm2), whereas the minimum leaf area (55.16 cm2) was recorded in vermicompost and sand (1:1)and disposable plastic glass (M_6C_2).

Leaf area parameter is used to predict the photosynthetic primary compound production, evapotranspiration, and also as a reference tool for crop growth. Leaf area plays an essential role in theoretical production ecology (Lakshmikanth *et al.*, 2020) [7]. There by promote plant growth and effects leaf development. Similar findings were also reported by Popescu *et al.* (2017) [10] in grape, Mayi *et al.* (2014) [9] in olive, Kumari *et al.* (2017) [6] in strawberry, Mathews *et al.* (2003) [8], Uzaribara *et al.* (2015) [12] and Bharati *et al.* (2018) [3] in banana.

Table 1: Effect of growing media and containers on ex vitro growth parameters of banana cv. Karpura Chakkera Keli (AAB).

	Shoot length (cm)			Diameter of shoot (mm)			Number of leaves			Leaf area (cm^2)		
Treatments	**C_1: Polybag**	**C_2: Disposable Plastic glass**	**Mean M**	**C_1: Polybag**	**C_2: Disposable Plastic glass**	**Mean M**	**C_1: Polybag**	**C_2: Disposable Plastic glass**	**Mean M**	**C_1: Polybag**	**C_2: Disposable Plastic glass**	**Mean M**
M_1	15.60	13.30	14.45	7.15	7.02	7.27	6.00 (2.54)	5.50 (2.44)	5.75	73.78	72.15	72.97
M_2	12.44	11.77	12.10	4.86	4.91	4.88	3.50 (1.99)	4.50 (2.23)	4.00	62.30	66.00	64.15
M_3	12.31	11.97	12.14	5.76	5.84	5.80	4.00 (2.11)	4.50 (2.23)	4.25	64.27	60.09	62.18
M_4	8.82	11.08	9.95	4.80	5.89	5.34	4.50 (2.23)	4.00 (2.11)	4.25	57.87	60.58	59.22
M_5	9.31	10.47	9.89	5.32	4.89	5.10	5.00 (2.33)	5.00 (2.33)	5.00	60.82	62.06	61.44
M_6	8.64	8.22	8.43	4.44	4.76	4.60	5.00 (2.33)	3.50 (1.99)	4.25	61.32	55.16	58.24
Mean C	11.19	11.14	11.65	5.37	5.63	5.50	4.67	4.50	4.58	63.39	62.67	63.03
Factors	SEm+	CD at 5%		SEm +	CD at 5%		SEm +	CD at 5%		SEm +	CD at 5%	
Factor (M)	0.10	0.32		0.07	0.22		--	N/S		0.38	1.20	
Factor (C)	0.06	N/S		0.04	0.12		--	N/S		0.22	N/S	
Factor (M X C)	0.14	0.45		0.10	0.31		--	N/S		0.54	1.69	

	M_1- Red earth (2) + FYM (1) + Coco peat (1)	M_2- Red earth (2) + FYM (1) + Rice husk (1)	M_3- Red earth (2) + FYM (1) + Sand (1)	M_4-Vermicompost (1) + Coco peat (1)	M_5-Vermicompost (1) + Rice husk (1)	M_6 -Vermicompost (1) + Sand (1)
C_1- Poly bags ddcc1 C_1- Poly bags						
C_2- Disposable plastic glass in portrays						

Conclusion

The best treatment was noticed in the treatment combination M_1C_1 (red earth, FYM and cocopeat (2:1:1) and poly bags), on maximum plant length, girth, number of leaves production and leaf area and also good rooting characters during hardening period in banana cv. Karpura Chakkara keli (AAB).

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