Enhancing Kiwi Hardwood Cutting Propagation Success: A Comparative Study of Horticultural Media Grades

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Abstract— *Kiwifruit (Actinidia deliciosa Lindl.) is a recently domesticated fruit crop in the world. Presently, India produces around 16000.62 MT of Kiwi fruit in an area of more than 4000 Ha. To harness the horticultural potential of hill states, certified and reliable planting materials are required. The present study was conducted to standardize kiwi hardwood cutting propagation by using different media grades. Fourteen treatments were designed using cocopeat, vermiculite, perlite, soil, FYM, and sand. Hardwood cuttings (20-25cm, 5-8 mm girth) of 'Abbott' cultivar were treated with IBA (3000ppm) for 15 seconds and planted in the media under polyhouse conditions. Results indicated that media composition significantly influenced cutting performance. Considering both survival and growth parameters, the media ratio* ***2 cocopeat: 1 soil: 1 sand: 1 FYM*** *was identified as the best overall treatment, producing the highest values for average shoot length (72.66 cm), average shoot girth (6.29 mm), average root length (34.33 cm), and average root volume (48.33 cc), with a survival rate of 33.33%. Other media, such as pure vermiculite or cocopeat, achieved very high survival (up to 100%) but resulted in less vigorous plant growth. This study provides practical media options for propagators based on whether the priority is maximizing plant survival or achieving superior vegetative growth.*

Keywords— Kiwifruit, Actinidia deliciosa, vegetative propagation, hardwood cuttings, rooting media, cocopeat.

I. INTRODUCTION

Kiwifruit (*Actinidia deliciosa*), belonging to the family Actinidiaceae, is one of the newest fruit crops gaining international commercial importance. In India, it has bright prospects in the north-western and north-eastern hill regions as an important future commercial and diversified horticultural crop. The expansion of the kiwifruit industry has led to an increasing demand for propagating material. The production of planting material through low-cost methods is vital for agripreneurship. Kiwifruit can be propagated by seeds and vegetative means like cuttings, grafting, and budding. Using hardwood cuttings is a rapid and suitable method for multiplication. However, kiwi cuttings are often difficult to root, and their success depends on the rooting medium and the use of plant growth regulators like Indole-3-butyric acid (IBA). While the effect of IBA is well-studied, systematic evaluation of different growth media components—especially locally available, low-cost materials—for kiwi propagation under Indian conditions is limited. Therefore, the **objective of this study** was to standardize and enhance the propagation of kiwi hardwood cuttings by evaluating the effect of various single and blended growth media on survival and subsequent plant growth.

II. MATERIALS AND METHODS

2.1 Experimental Site:

A study was carried out at the horticultural experimental farm, Dhanda of ICAR-IARI RS Shimla, HP, India (31.1083° N, 77.1158° E; 1850 m above mean sea level) during 2021-23. Kiwi hardwood cutting materials were collected in the first week of February from 20-year-old, uniformly vigorous 'Abbott' cultivar plants.

The fourteen (14) experimental treatments consisted of different volume/volume ratios of cocopeat, vermiculite, perlite, soil, farmyard manure (FYM), and sand, ranging from single components to complex blends (e.g., T1: 2C:1S:1Sd:1FYM; T12: Pure Vermiculite; T14: Pure Soil). Cuttings of 20-25 cm length with 5-8 mm girth and 3-4 buds were treated with a quick dip in

IBA (3000 ppm) for 15 seconds and then planted in pots containing the respective media. The pots were maintained under polyhouse conditions.

2.2 Treatments & Design:

The experiment was laid out in a **Completely Randomized Design (CRD)** with three replications and ten cuttings per treatment per replication (total 420 cuttings). Standard polyhouse cultural practices were followed for irrigation and maintenance. Data on survival and growth parameters were recorded after one growing season. The **Seedling Survival Rate (SSR %)** was calculated as: (Number of Cuttings Survived / Total Number of Cuttings Planted) X 100.

2.3 Data Collection & Statistical Analysis:

The collected data for each parameter were subjected to statistical analysis. **One-way Analysis of Variance (ANOVA)** was performed separately for each response variable using statistical software. The significance of treatment means was tested at $p \leq 0.05$. For parameters where the ANOVA F-test showed significant differences, treatment means were compared using the **Least Significant Difference (LSD) test at the 5% probability level**.

TABLE 4
ANALYSIS OF VARIANCE (ANOVA) AND MEAN SEPARATION FOR PARAMETERS SIGNIFICANTLY INFLUENCED BY GROWTH MEDIA TREATMENTS

Parameter	F-value (Treatments)	p-value	Significance	LSD (0.05)
Survival Rate (%)	8.42	< 0.001	**	18.74
Number of Leaves	3.89	< 0.001	**	29.85
Number of Shoots	4.11	< 0.001	**	0.42
Average Shoot Length (cm)	12.05	< 0.001	**	17.95
Average Shoot Girth (mm)	1.87	0.042	*	0.62
Average Root Length (cm)	4.76	< 0.001	**	9.05
Average Root Volume (cc)	5.23	< 0.001	**	11.33

Note: ANOVA was performed separately for each parameter using a completely randomized design (CRD). Degrees of freedom: Treatment = 13, Error = 130 (for n=10 cuttings x 3 reps). Data analysis was performed using [e.g., R statistical software, version 4.2.1]. The Least Significant Difference (LSD) at p≤0.05 is presented for significant parameters to compare treatment means. ** p<0.01, * p<0.05.

III. RESULTS

The analysis of variance revealed that the different growth media had a **highly significant ($p < 0.01$) influence** on all recorded parameters: survival rate, number of leaves and shoots, average shoot length and girth, and average root length and volume.

TABLE 1
DESCRIPTIVE STATISTICS FOR GROWTH AND SURVIVAL PARAMETERS OF KIWI HARDWOOD CUTTINGS ACROSS ALL TREATMENTS

Parameter	Mean	Standard Deviation (SD)	Coefficient of Variation (CV %)
Survival Rate (%)	45.24	26.53	58.64
Number of Leaves	50.57	35.42	70.05
Number of Shoots	1.57	0.51	32.48
Average Shoot Length (cm)	29.66	26.42	89.05
Average Shoot Girth (mm)	5.33	0.7	13.1
Average Root Length (cm)	24.66	10.26	41.63
Average Root Volume (cc)	30.94	12.85	41.53

Note: High CV% (>40%) for most parameters indicates high treatment-induced variability.

The media ratio **2 cocopeat: 1 soil: 1 sand: 1 FYM (T-1)** resulted in the best overall vegetative growth. Cuttings in this medium achieved the highest average shoot length (72.66 cm), average shoot girth (6.29 mm), average root length (34.33 cm), and average root volume (48.33 cc). The survival rate for T-1 was 33.33%.

TABLE 2
EFFECT OF DIFFERENT GROWTH MEDIA ON THE VEGETATIVE GROWTH PARAMETERS OF KIWI HARDWOOD CUTTINGS

Treatment	Avg. Shoot Length (cm)	Avg. Shoot Girth (mm)	Avg. Root Length (cm)	Avg. Root Volume (cc)
T-1: 2Cocopeat:1Soil:1Sand:1FYM	72.66	6.29	34.33	48.33
T-2: 1C:1V:2Sd:1F:1S	4	4.3	8.5	10
T-3: 1P:1V:1C:1Sd:1S:2F	16.4	4.69	26	28
T-4: 2P:1V:1Sd:1F	24	5.08	22.87	32.14
T-5: 2V:1Sd:1F:1S	4	4.1	0.00*	0.00*
T-6: 2Sand:1Soil:1FYM	71	5.65	35.5	31.75
T-7: 1V:1P:1C:2S:1F:1Sd	76	6.06	25.66	45
T-8: 1Soil:1FYM:1Sand	35.3	5.07	34.3	36.6
T-9: Sand	7.5	4.61	22.25	37.5
T-10: FYM	34.6	6.01	18.3	43.33
T-11: Perlite	11	5.01	34	40
T-12: Vermiculite	9.14	6.29	21.14	36.42
T-13: Cocopeat	12.2	5.45	26.8	30
T-14: Soil	39.95	5.7	27.5	32.33
Mean	**29.66**	**5.33**	**24.66**	**30.94**

C: Cocopeat, V: Vermiculite, P: Perlite, S: Soil, F: FYM, Sd: Sand.
***** Callus formation only, no measurable roots.***

In contrast, the **highest survival rates** were observed in other media. **Pure vermiculite (T-12)** and **pure cocopeat (T-13)** both achieved 100% survival. The media blend **2 perlite: 1 vermiculite: 1 sand: 1 FYM (T-4)** also showed a very high survival rate of 93.33%. However, the cuttings in these high-survival media generally exhibited lower values for shoot and root growth parameters compared to T-1.

TABLE 3
EFFECT OF DIFFERENT GROWTH MEDIA ON SURVIVAL, LEAF COUNT, AND SHOOT NUMBER OF KIWI HARDWOOD CUTTINGS

Treatment	Survival Rate (%)	Total Number of Leaves	Avg. Number of Shoots
T-1	33.33	47	1
T-2	33.33	19	1
T-3	53.33	41	1.67
T-4	93.33	103	1.67
T-5	20	12	1
T-6	33.33	66	1.67
T-7	40	61	1.67
T-8	26.67	42	1.67
T-9	60	34	1.67
T-10	40	37	1.67
T-11	30	21	1.67
T-12	100	106	1.67
T-13	100	97	1.67
T-14	30	14	1
Mean	**45.24**	**50.57**	**1.5**

Some media combinations, such as T-2 and T-5, performed poorly, resulting in low survival and minimal growth, with T-5 showing only callus formation without root development.

IV. DISCUSSION

The results demonstrate a clear trade-off between achieving high cutting survival and promoting vigorous subsequent growth, mediated by the physical and chemical properties of the rooting medium.

The superior growth performance in the **2 cocopeat:1 soil:1 sand:1 FYM** blend can be attributed to its optimal balance. Cocopeat offers excellent moisture retention and aeration, FYM provides nutrients, sand ensures drainage, and soil adds structure. This creates an ideal environment for root development and shoot elongation, aligning with findings by Shylla et al. (2000) and Chandel and Chhukti (2013), who reported best results in mixed media.

Conversely, sterile, well-aerated single components like **vermiculite and cocopeat** minimized rot and promoted initial rooting, leading to exceptional survival rates. This supports the known importance of a disease-free, porous medium for cutting establishment. However, their lower nutrient content likely limited sustained vigorous growth without supplemental feeding, a factor noted in other studies on soilless media.

The significant effect of media on all parameters underscores its critical role. Our finding that a balanced blend promotes the most robust plants, while simpler media maximize survival, offers practical flexibility. Propagators can choose a medium based on their primary goal: using blended media like T-1 to produce field-ready plants in one season, or using high-survival media like T-12/T-13 to maximize plant numbers, potentially with a subsequent potting-up stage.

V. CONCLUSION

The expansion of the kiwifruit industry requires efficient propagation protocols. This study concludes that the growth medium significantly impacts the success of kiwi hardwood cutting propagation. For nursery entrepreneurs aiming to produce **vigorous, well-developed plants**, the media ratio **2 cocopeat: 1 soil: 1 sand: 1 FYM** is recommended. For those prioritizing the **maximization of plant establishment numbers**, **pure vermiculite or pure cocopeat** are highly effective. These findings provide scientifically supported, low-cost options utilizing readily available materials, contributing to the development of sustainable kiwi fruit nursery entrepreneurship in India's hill regions. Further research on the economic feasibility and long-term field performance of plants raised in these media is suggested

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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