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Effect of Different Shoot Cuttings and Soil Media in Rapid Multiplication of Pineapple (*Ananas comosus* L. Merr.) Cv Kew

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Abstract The aim of this research was to ascertain the influence of different shoot cutting and soil media on days required for leaf appearance, root initiation and root length and also to popularize the rapid multiplication technique in pineapple (*Ananas comosus* L. Merr.) cv Kew plant lets production. The experiment was conducted in the green house chamber. Shoot cuttings of suitable size from slips, suckers, crown, mother plant (before fruiting-BF) and mother plant (after fruiting-AF) were evaluated for pineapple plant lets production. As the propagation media, hill soil, riverbed sand and brick sand were compared for number of days taken for appearance of first leaf and root initiation from the day of planting and root length. A 3 × 5 factorial combination in a randomized complete block design with three replicates was planned. The results demonstrated that the mother plant (after fruiting) shoot cuttings significantly performed better than all the other shoot cuttings and gave the highest number of vigorous plant lets by using brick sand media.

Keywords Pineapple, Rapid multiplication, Shoot cuttings, Soil media.

Introduction

Pineapple (*Ananas comosus* L. Merr.) is a perennial herb belonging to the family Bromeliaceae, native to the American tropics. It is one of the most important commercial fruit crops of the tropical and sub-tropical regions of the world. Pineapples are grown all year round in the warmer climates and were originally consumed only as a fresh fruit. With the development of the processing industry, the fruit is highly valued because of its excellence in canning and other processing industries for the production of nutritious and valus added product like jam, jelly, candy, juices, syrups, crushed pineapple among others.

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In India, the major pineapple states are—West Bengal, Assam, Tripura, Karnataka, Bihar, Manipur, Meghalaya and Nagaland. The cultivated area in India is 109.9 ha ('000 Ha) with a net production and productivity of 1736.7 ('000 MT) and 15.8 MT/Ha respectively. It is one of the popular fruit crops of the North-Eastern region of India. There is ample prospect for expansion of its cultivation because of the ideal agro-climatic conditions prevailing in the region.

Out of many varieties proven for yield, quality and processing, the performance of Kew (syn Smooth Cayenne) was found to be superior in all respects compared to other varieties viz., Queen, Mauritius, Red Spanish. Pineapples have been traditionally propagated using three types of propagules ; Crowns, suckers and slips . However the cultivars in the cayenne group produce only one or two suckers per plant and seldom more than three slips. The average rate of production of sucker is about 0-2 per year. Thus, it takes about 30-35 years in order to produce enough planting materials for one hectare from a single mother plant. Moreover, the crown sections become unavailable for planting when the fruit and crown are sold together as a fresh fruit.

In the way of expansion of pineapple cultivation, mass propagation technique is needed to be developed. One of the technologies that can be used for this purpose is the *in vitro* technique. The use of this technique has two advantages. It can be used to produce large number and uniform pineapple propagules in a relatively short period of time [1] and can also be used to improve plant performances. However, this method is so sophisticated and requires skilled labor force. There is an alternative rapid propagation technique using stem cutting under *in vivo* conditions. This method has numerous advantages. Many new plants can be started in a limited space from a few stock plants. It is inexpensive, rapid and simple and does not require the special techniques necessary in micropropagation. Greater uniformity is obtained [2]. The parent plant is usually reproduced exactly, with no genetic change. It is easier to perform than *in vitro* tissue culture and after out-planting into the nursery, tissue culture plant lets need higher levels of subsequent care (i.e., photoperiod and temperature maintenance) than plants derived from stem cuttings [3].

The aim of the research was to ascertain the influence of different shoot cuttings and soil media on days required for leaf appearance and root initiation in production of pineapple plant lets and ultimately standardize a reliable protocol for rapid multiplication in order to meet the huge demands of pineapple plant lets.

Materials and Methods

The experiment was conducted in the green house chamber of the Department of Horticulture, College of Agriculture, Central Agricultural University, Imphal, during the year 2014—2015. There soil media viz., hill soil, riverbed sand and brick sand were used for planting different shoot cuttings viz., slips, suckers, crown and mother plant (before fruiting–BF and after fruiting –AF). The experiment was laid out in a factorial randomized block design (FRBD) with 3 number of replication and 15 numbers of treatments.

These 15 treatments were as follows : (a) Hill soil + slips cuttings–(S_1P_1), (b) Hill soil + suckers cuttings - (S_1P_2) , (c) Hill soil + crown cuttings- (S_1P_3), (d) Hill soil + mother plant (BF) cuttings - (S_1P_4), (e) Hill soil + mother plant (AF) cuttings- (S_1P_5), (f) Riverbed sand + slips cuttings (S_2P_1), (g) Riverbed sand + suckers cuttings (S_2P_2), (h) Riverbed sand + crown cuttings (S_2P_3), (i) Riverbed sand + mother plant (BF) cuttings - (S_2P_4), (j) Riverbed sand + mother plant (AF) cuttings - (S_2P_5), (k) Brick sand + slips cuttings - (S_3P_1), (l) Brick sand + suckers cuttings (S_3P_2), (m) Brick sand + crown cuttings - (S_3P_3), (n) Brick sand + mother plant (BF) cuttings -(S_3P_4), (o) Brick sand + mother plant (AF) cuttings - (S_3P_5).

Hill soil, as the name implied are soils developed under any forest cover. About 7.5 kg of hill soil was used to prepare 1 plot of 25 × 20 × 20 cm size. Riverbed sand which is generally composed of rounded particles and may or may not contain clay or other impurities was obtained from the banks and beds of river. The amount of riverbed sand used per

Table 1. Days taken for appearance of first leaf from the day of planting as affected by different shoot cuttings and soil media.

	P_1	P_2	P_3	P_4	P_5	Mean
S_1	38.56	38.78	40.56	37.22	37.89	38.60
S_2	36.56	35.67	38.78	34.78	35.00	36.16
S_3	34.78	35.11	38.22	34.22	30.00	34.47
Mean	36.63	36.52	39.19	35.41	34.30	36.41
		S		p		S × P
SE(d) ±		0.11		0.15		0.26
$CD_{(0.05)}$		0.23		0.29		0.51

Table 2. Days taken for root initiation from the day of planting as affected by different shoot cuttings and soil media.

	P_1	P_2	P_3	P_4	P_5	Mean
S_1	48.11	48.33	51.00	48.67	47.89	48.80
S_2	44.44	44.55	49.44	47.67	47.22	46.67
S_3	44.33	45.44	47.22	41.33	38.56	43.38
Mean	45.63	46.11	49.22	45.89	44.56	46.28
		S		P		S × P
SE(d) ±		0.09		0.12		0.21
$CD_{(0.05)}$		0.19		0.24		0.42

plot was 8.3 kg and brick sand are those which are used for making mortar for concrete work. Around 10.5 kg was required for preparing 1 plot.

Each treatment was composed of twenty cuttings. The cuttings were prepared after the leaves and roots are shreded and the stems were cut into 3–4 longitudinal slices of 2 cm thick. Again, it was cut transversely into triangular slices containing 2–3 nodes. Stem cuttings were planted with 1/4 of bottom part buried in the soil and the remaining top was covered with fine layer of soil with a spacing of 5 × 5 cm apart. Observations were performed on number of days taken for appearance of first leaf, days required for root initiation and root length. First observations were taken at 20 days after planting and subsequent observations at 20 days interval up to 140 day. The collected data on the different parameter of study were statistically analyzed to find out the significance of differences between the treatments. The means of all the treatments were calculated and the analyses of variances (ANOVA) for all the characters were performed by *F* variance test. The significances of differences between treatments means were compared by Least Significant Difference (LSD) test. In order to test the significance of mean differences between treatments, the following statistics were computed.

A. Standard error of mean differences (SEd)

$$SE(d) = \sqrt{\frac{2 \times EMS}{r}}$$

Where, EMS = Error mean sum of square, r = Number of replications.

B. Critical difference (CD)

$CD = SE(d) \times t_{.05}$ for error degrees of freedom.

Results and Discussion

Leaf appearance

It is evident from Table 1 that shoot cuttings from mother plant (AF) recorded the minimum days for appearance of first leaf and the shoot cuttings from crown took the maximum days. This may be due to

Table 3. Effect of different shoot cuttings and soil media on root length (cm) at 60 through 140 days after planting.

	Root length at 60 through 140 days after planting				
Treatments	60	80	100	120	140
S_1P_1	2.21	2.70	3.55	3.93	4.27
S_1P_2	2.24	2.70	3.14	3.60	4.22
S_1P_3	2.06	2.40	2.80	3.33	3.81
S_1P_4	2.67	3.04	3.29	3.77	4.30
S_1P_5	2.85	3.30	3.76	4.10	4.47
S_2P_1	2.97	3.73	4.30	4.73	5.29
S_2P_2	3.17	3.60	3.97	4.50	4.90
S_2P_3	2.47	2.87	3.34	3.88	4.49
S_2P_4	3.00	3.30	3.67	4.62	5.68
S_2P_5	2.87	3.27	3.96	4.71	5.63
S_3P_1	3.13	3.50	3.84	4.78	5.93
S_3P_2	3.37	3.70	4.27	4.87	5.58
S_3P_3	3.20	3.73	4.09	4.73	5.30
S_3P_4	3.80	4.57	5.16	5.97	6.43
S_3P_5	4.50	5.35	6.03	7.67	7.94
SE (d) ±	0.11	0.12	0.12	0.09	0.12
$CD_{(0.05)}$	0.22	0.24	0.23	0.18	0.24

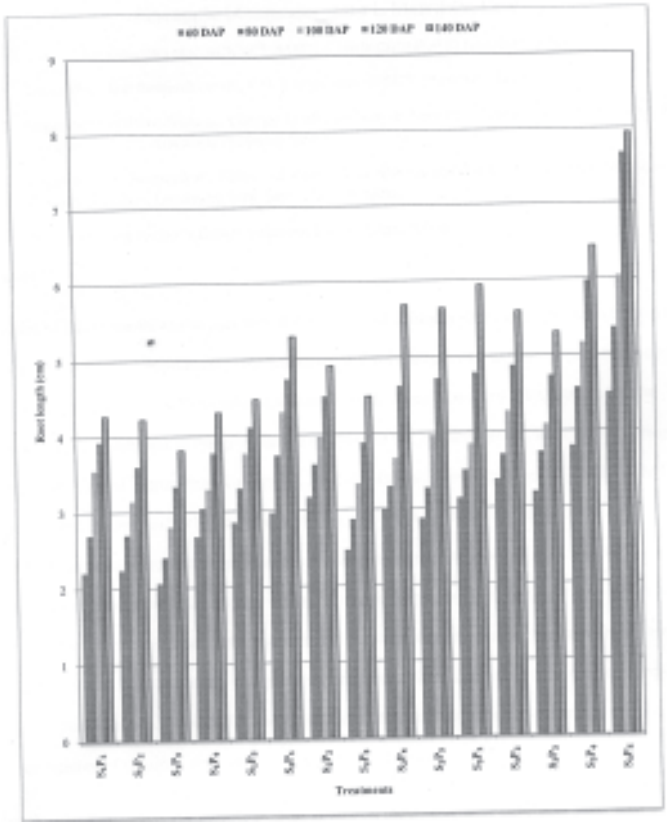

Fig. 1. Effect of different shoot cuttings and soil media on root length (cm).

the fact that mother plant (AF) stem has more nutritional reserves. Similar result has been obtained in Perola pineapple [4]. Poor leaf appearnce in crown cutting may be ascribed to inhibition of suckering due to the suppression of lateral bud growth as a result of hormone (auxin) secreted by the shoot apex, a phenomenon known as apical dominance. Among the soil media, brick sand took minimum days to produce leaf and hill soil recorded the maximum number of days. This finding is in accordance with the findings in *Gongronema latifolia* Benth [5]. Early appearance of leaf in brick sand media may be attributed to better aeration, water drainge and higher porosity in brick sand. Better sprouting of stem cuttings in brick sand has been reported in *Warburgi augandensis* [6]. Hill soil due to its compactness and less ability of water holding capacity could delay growth and development of the shoot cuttings.

Root initiation

The impact of different shoot cuttings and soil media on days to root initiation were statistically significant (Table 2). Shoots cutting of mother plant (AF) planted in brick sand rooted earlier than those planted in other growing media. Similar results have been obtained in *Mussaenda philipica* A. Rich [7]. This possibly may be due to increased root zone temperature and proper aeration in brick sand. It was observed that root zone temperature affects initiation of stem cuttings in plants. A study on rooting performance in *Vitellaria paradoxa* by Yeboah and Amoah [8] showed that high aeration in rooting media is responsible for promoting metabolic activities and enhancing root initiation. Cuttings rooted in sand medium also had well differentiated callus and higher percentage of callus formation. Rooting

medium can influence the type of callus produced, which in turn can affect emergence of newly-formed adventitious roots .

Root length

The longest root was recorded in mother plant (AF) planted in brick sand (Table 3 and Fig. 1). These are in confirmatory with the findings in *Plantanus orientalis* L. [9] and in *Mussaenda philippica* A. Rich [7]. A study in *Gongronema latifolia* Benth [5] obtained the longest tap roots and lateral roots in brick sand. Better root growth in brick sand is a result of better aeration potential and drainage capacity/porosity which enhance development and spreading of roots. Several authors have reported high drainage capacity and porosity in brick sand [7, 10]. The well aerated and loose texture of sand allows room for higher numbers of roots and vigorous root growth. The quality of roots in terms of number and length is very important for the successful establishment of the cuttings. On the other hand, least root length was observed in cuttings planted in hill soil which may be accredited to resistance to penetration which argued that it is dependent on water content, bulk density, structure and strength of the soil.

Conclusion

On the basis of results obtained from this study, it can be concluded that shoot cuttings of mother plant (AF) planted in brick sand media showed good response to growth and development of leaves and roots. Thus, these can be considered as the best technique for rapid multiplication of pineapple by shoot cuttings under *in vivo* conditions.

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