

Original Research paper

GROWTH RESPONSE OF *IXORA COCCINEA* (L.) CUTTINGS TO COCONUT WATER TREATMENT UNDER A LOW POLYTHENE SHEET DOME.

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ABSTRACT

Aims: To investigate the effects of coconut water treatment and polythene sheet dome on the establishment of *Ixora coccinea* (L.) stem cuttings.

Study design: A 4 × 2 factorial Randomized Complete Block Design (RCBD) with three replicates was used.

Place and Duration of Study: The study was carried out at the Multipurpose Crop Nursery of the University of Education, Winneba, Mampong campus between September and December 2019.

Methodology: Two hundred and forty (240) cuttings of equal length of 12cm were excised and each cutting planted to a depth of 2cm with 10cm above the soil in each of the 240 potting bags, which were filled, with sterilized soil to a depth of 15cm from the bottom leaving 1.5cm from the top.

Results: The results ~~from this study~~ showed that treatments with varied levels of coconut water in combination with the plain polythene dome had significant influence on growth parameters. Increasing levels of coconut water resulted in subsequent increase in the number of leaves, plant height and roots as well as survival rate. The treatment with 100 ml coconut water in combination with polythene dome recorded the highest plant height, number of leaves per plant and number of roots per plant [12.22cm, 21.89 and 22.00] respectively at the end of the experiment. The survival rate of plants however reduced significantly at 60 DAP [83.33%] when compared no polythene dome (control) [94.44%]

Conclusion:

The study concludes that, *Ixora coccinea* (L.) cuttings treated with 100 ml of coconut under a polythene sheet dome will enhance the establishment of *Ixora coccinea* (L.) cuttings but the polythene dome should be removed once cuttings are fully sprouted.

Keywords: [Coconut water, *Ixora coccinea*, cuttings, polythene sheet, growth and survival rate]

1. INTRODUCTION

Cuttings are used as one of the Asexual means of propagating new plants. A cutting is a part plant separated from a parent plant or stock plant, which can grow under the favorable conditions for regeneration and will result in a new plant similar to the mother plant [1]. Vegetative propagation by stem cutting in *Ixora* generally involves the use of terminal and sub-terminal stem cuttings. These cuttings taken at various growth stages, may contain a considerable number of growing tips (terminal section or sub-terminal stem sections), and are referred to as tip cutting or stem cuttings respectively. Nursery cultivators and non-professional gardeners use vegetative propagation methods like stem cuttings [2]. Furthermore, several ornamental plants are known to have difficulty in initiating adventitious roots if conditions are not very favourable [3]. One of such is the *Ixora coccinea* plant.

Ixora (*Ixora coccinea* L.) is a hedging plant common in the subtropical regions of India and most tropical areas of the world [4; 5]. *Ixora* is a moderate to root plant species and its rooting ability is moderate under natural conditions [6]. Formation of adventitious root is an important step in vegetative propagation of most woody or horticultural species, and problems associated with root development of cuttings usually results in greater commercial losses [7; 8]. The success of rooting of woody stem cuttings, in the majority of ornamental plants and fruit trees depends primarily on the physiological stage of the mother plant [9], time at which the cuttings were taken [10; 11] and the type of growth regulators used (IAA, IBA, cytokinin and gibberellins) [12]. The hormone that stimulates the growth of adventitious roots is known as auxin, commercially available in the form of Indole butyric acid (IBA) and Naphthalene Acetic acid (NAA).

Coconut water contains natural plant growth hormones such as auxin, gibberellins, cytokinis and natural inhibitors and regulators that include ethylene, abscisic acid, phenols and flavonols [13; 14] Therefore, coconut water could be used to improve the rooting of *Ixora* cuttings and their establishment, being an accessible cheap source of nutrients and environmentally friendly.

Polyethylene plastic film was first used in the propagation of plants by cuttings at the Arnold Arboretum in February 1953 [15]. Prior to this, it had been used in making air-layers and also quite extensively used in the shipping of plant material from the Arboretum to distant parts of the world, but it had never been tried in the propagation of cuttings [15]. Locally in Ghana, some nursery men and gardeners employ the technique of starting *Ixora* cuttings under a low polythene sheet cover or dome and have claimed a higher success rate in some cases compared to not using the polythene sheet dome with or without a rooting hormone application. These claims have however not been substantiated with any empirical evidence or study and considering the opportunity it presents to the horticulture industry as a whole such knowledge is worth investigating and documenting. This current study therefore sought to investigate the effects of coconut water treatment on the establishment of *Ixora coccinea* stem cuttings under polythene dome.

2. MATERIAL AND METHODS / EXPERIMENTAL DETAILS / METHODOLOGY

2.1 Description of the study area

The experiment was carried out at the Multi-purpose Crop Nursery of the University of Education, Winneba, College of Agriculture Education, Asante – Mampong Campus.

2.2 Planting materials

Ixora coccinea cuttings were sourced from Hindu Monastery of Africa, Ashanti – Mampong Branch.

2.3 Growth Media

Topsoil was collected from the Multi-purpose Crop Nursery, sterilized and sieved. Potting bag-s were filled with the topsoil to a depth of 15cm from the bottom of the bag leaving a space of 1.5cm from the top to avoid run-off during watering. Two hundred and forty (240) bags were used for the study

2.4 Planting

Two hundred and forty (240) cuttings of equal length of 12cm were prepared and each planted in a separate bag of soil to a depth of 2cm with 10cm above the soil.

2.5 Treatments and Experimental design

A 4 × 2 factorial Randomized Complete Block Design (RCBD) was employed. There were eight treatments; (T₁)= No coconut water + No polythene dome, (T₂)=80ml coconut water + No polythene dome, (T₃)= 90ml coconut water + No polythene dome, (T₄)=100ml coconut water + No polythene dome, (T₅)= No coconut water + polythene dome, (T₆)=80ml coconut water + polythene dome, (T₇)= 90ml coconut water + polythene dome, (T₈)= 100ml coconut water + polythene dome which were all replicated three times.

2.6 Polythene Dome

Polythene sheet dome was created by bending flexible bamboo branches into an arc and mounted at extreme ends and middle of an experimental block. A transparent polythene sheet was used in covering the bamboo frame and the ends were was firmed at the edges with wet soil.

2.7 Data collection

Growth data including number of leaves per plant, plant height, number of roots per plant and number of survived cuttings were collected at predetermined periods during the field experimentation.

2.7.1 Number of leaves/plant

Number of leaves was counted from three (3) plants in each replicate and the average estimated. This was done every two weeks from the first day of sprouting.

2.7.2 Plant height

Plant height was measured from three (3) plants in each replicate and the average estimated. This was done every two weeks from the first day of planting.

2.7.3 Percentage survival

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This was obtained by counting the number of plants that survived under each treatment and their percentage estimated from the total number of cuttings that sprouted. The counting was done at the end of the experimental period and the values computed.

2.7.4 Number of roots per plant

Six plants from each replicate were selected and their bags removed, leaving the soil around the root zone. The root zone with the soil was then immersed into water until all the soil was washed off, making the roots visible for counting. The number of roots for each plant was then counted and average estimated. This data was also obtained at the end of the experimental period.

2.8 Data Analysis

The collected data were subjected to analysis of variance (ANOVA) with the help of Genstat statistical package, windows version, 11th edition. Means which differed significantly were separated using the Tukey's HSD at 5% level of probability.

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3. RESULTS AND DISCUSSION

There was significant increase in number of leaves per plant at 30, 45 and 60 DAP with varied levels of coconut water when compared with the control (Table1). There was no significant variation between 80 and 90 ml of coconut water applied in terms of number of leaves per plant at 45 and 60 DAP. At 60 DAP, no significant effect was observed between 90 and 100 ml; 80 and 100 ml however varied significantly in terms of number of leaves. The increase in the number of leaves through increase in the levels of coconut water could be due to increase in the concentration of auxins and nutrients that stimulate several life processes of the plant. This is in agreement with the results of [6], who observed that number of leaves of *Ixora coccinea* increased by 38%, 50% and 70 % at 30, 45 and 60 DAP when treatment with 100 ml coconut water.

More so, polythene dome significantly increased number of leaves per plant as compared to the control throughout the experimental period. There were significant variations amongst the interactions of coconut water levels and polythene dome in terms of number of leaves at 30, 45 and 60 DAP. 100 ml of coconut water and polythene dome interactively (100* P₁) resulted in the significantly highest number of leaves followed by (90ml* P₁) which however varied insignificantly from (100ml* P₁). It was observed during the study that there was some warmth and high humidity inside the polythene dome each time the plants were visited. Temperature is a very important factor that influences the growth of plants due to its influence on enzymatic activities. The increase in concentration of the coconut water could have resulted in an accumulation of growth of hormones and nutrients which also accelerated the development of the leaves by the hormones inducing rapid meristematic growth. Thus, the polythene dome created an environment of optimal temperature and relative humidity, increased hormone and nutrient concentration with coconut water to induce rapid enzymatic activity for the plants to perform its functions, such as respiration and photosynthesis leading to the production of more leaves. Coconut water contains phytohormones such as auxins, gibberellins, cytokinins, ethylene, and abscisic acid, as well as the plant growth regulators polyamines and nitric oxide [16].

Table 1: Number of leaves per plant

Treatment	Days after planting (DAP)		
Coconut water (ml)	30	45	60
0.0	2.11 ^a	7.16 ^a	13.78 ^a
80.0	4.33 ^b	10.33 ^b	18.16 ^b
90.0	5.00 ^c	11.67 ^b	18.83 ^{bc}
100.0	5.78 ^d	13.11 ^c	20.16 ^c
HSD (0.05)	0.334	1.418	1.406
Cover			
No polythene (P ₀)	3.22 ^a	9.06 ^a	16.75 ^a
Polythene (P ₁)	5.39 ^b	12.08 ^b	18.72 ^b
HSD (0.05)	0.507	1.002	0.994
Interaction			
0ml * P ₀	2.44 ^{ab}	7.11 ^a	13.89 ^a
0ml * P ₁	1.78 ^a	7.22 ^a	13.67 ^a
80ml * P ₀	3.11 ^b	8.67 ^{ac}	17.11 ^b

80ml *P ₁	5.55 ^c	12.00 ^b	19.22 ^{cd}
90ml *P ₀	3.11 ^b	9.33 ^{cd}	17.55 ^{bc}
90ml *P ₁	6.89 ^e	14.00 ^{be}	20.11 ^{de}
100ml *P ₀	4.22 ^d	11.11 ^d	18.44 ^{bd}
100ml *P ₁	7.33 ^e	15.11 ^e	21.89 ^e
HSD (0.05)	1.013	2.005	1.988

*Within column, means bearing different superscripts differ significantly ($P \leq 0.05$).

Plant height increased with increasing level of coconut water (Table 2) with 100 ml treated cuttings recording highest mean values of 10.30cm, 11.06cm and 11.88cm at 30, 45 and 60 DAP respectively which were also significantly different from the control. No significant variations existed amongst the applied levels of coconut water (80, 90 and 100 ml) in terms of plant height at 30 and 45 DAP. At 60 DAP however, 100 ml coconut water varied significantly from 80 and 90 ml in terms of plant height. Polythene dome significantly increased plant height at 30 and 60 DAP; but had no significant effect on plant height at 45 DAP (Table 2). Interactively, there were significant variations amongst some of the combined treatments in plant height (Table 2). The application of 100 ml coconut water together with polythene dome generally produced plant height of 10.48cm, 11.28cm and 12.22cm at 30, 45 and 60 DAP respectively and was significantly different from the rest of the combined treatments at 60 DAP.

The increase in plant height with the application of coconut water could be attributed to the influence of the auxins in the coconut water, which promotes in cell division and elongation. Cytokinins also increase the nitrogen content of leaves which is important in the formation of protein, nucleic acid, chlorophyll, enzyme, vitamins and plant hormones. The result is in agreement with [6] who reported 43%, 25% and 28% significant increases in the height of Ixora plants at 30, 45 and 60 DAP respectively due to the application of coconut water compared to the control. These results also corroborate with that of [17] who reported that cytokinins stimulate the growth of roots and shoots, which in turn, increased plant height.

The higher plant height recorded under polythene dome could be was a the polythene dome created an environment of optimal temperature, low evapotranspiration, availability of water and relative humidity, which are favourable conditions for plant growth. This result agrees with that of [18] who reported that critical soil temperature increases the height and diameter of tomato plant. [19] also recorded significant increase in stalk length of sugarcane due to the use of coloured polyethylene cover.

Table 2: Plant height (cm)

Treatment	Days after planting (DAP)		
	30	45	60
Coconut water (ml)			
0.0	10.07 ^a	10.43 ^a	11.01 ^a
80.0	10.22 ^{ab}	10.66 ^{ab}	11.26 ^{ab}
90.0	10.22 ^{ab}	10.96 ^b	11.50 ^b
100.0	10.30 ^b	11.06 ^b	11.88 ^c
HSD (0.05)	0.162	0.314	0.250
Cover			
No polythene (P ₀)	10.13 ^a	10.77 ^a	11.29 ^a
Polythene (P ₁)	10.27 ^b	10.79 ^a	11.53 ^b
HSD (0.05)	0.115	0.222	0.177
Interaction			
0ml *P ₀	10.06 ^a	10.60 ^{ab}	11.18 ^{ab}

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0ml *P ₁	10.08 ^{abc}	10.27 ^a	10.84 ^b
80ml *P ₀	10.13 ^{abc}	10.53 ^{ab}	11.11 ^{ab}
80ml *P ₁	10.31 ^{bcd}	10.79 ^{bc}	11.40 ^{ac}
90ml *P ₀	10.22 ^c	11.09 ^c	11.35 ^{ac}
90ml *P ₁	10.22 ^c	10.82 ^c	11.64 ^c
100ml *P ₀	10.12 ^c	10.85 ^{cd}	11.54 ^c
100ml *P ₁	10.48 ^d	11.28 ^d	12.22 ^d
HSD (0.05)	0.230	0.444	0.354

*Within column means bearing different superscripts differ significantly ($P \leq 0.05$).

Coconut water treated cuttings gave a highly significant effect on number of roots per plant when compared with the control. 80 and 90 ml coconut water varied insignificantly but both differed significantly from 100 ml in terms of root count. Ixora cuttings covered with polythene sheet gave a significant ($P \leq 0.05$) number of roots over the control. Interactively, (80ml*P₁), (90ml*P₁) and (100*P₁) resulted in 16.55, 17.11 and 22.00 significant increases respectively in terms of root count. There were however significant variations amongst the combined treatments in terms of root count.

Percentage survival rate within coconut treated cuttings and between the controls was insignificant. The use of polythene dome significantly reduced survival rate of established cuttings as compared with the control. Interactively, (80ml*P₀) and (100ml*P₀) recorded high rate of survival and was significantly different from (80ml*P₁). The performance of the control was due to its exposure to the ambient temperature of the immediate environment, sunlight and relative humidity which was much more conducive for the plants at that physiological stage. Whiles on the other hand the covered cuttings experienced a deprivation of carbon dioxide which hampered its continuous growth at that physiological stage due to reduced photosynthetic activity. At the matured stage of the plants, they do need high amounts of Carbon dioxide to undergo photosynthetic processes, which the control had access to at the detriment of those covered with the polythene dome

Table 3: Interaction Effect of Coconut water and Polythene dome on Number of Roots per Plant

COVER	COCONUT WATER				Mean
	0 ml	80ml	90ml	100ml	
Polythene	12.67a	15.67bc	16.33c	16.00c	15.17a
No polythene	14.22ab	16.55c	17.11c	22.00c	17.47b
Mean	13.45a	16.11b	16.72b	19.00c	
HSD(0.05) : Cover: 1.025, Coconut Water:1.450, Coconut Water*Cover:2.051					

*Within rows, means bearing different superscripts differ significantly ($P \leq 0.05$).

Table 4: Interaction Effect of Coconut water and Polythene dome on Percentage Survival of Plant

COVER	COCONUT WATER				Mean
	0 ml	80ml	90ml	100ml	
Polythene	77.78ab	94.44a	88.89ab	94.44a	88.89a
No polythene	83.33ab	66.67b	72.22ab	83.33ab	76.39b
Mean	80.56a	80.56a	80.55a	88.89a	
HSD(0.05) : Cover: 12.486, Coconut Water:17.658, Coconut Water*Cover:24.972					

*Within rows, means bearing different superscripts differ significantly ($P \leq 0.05$).

4. CONCLUSION

The results from the study showed positive response of *Ixora* cutting establishment to the application of coconut water and the use of polythene dome. The application of 100 ml coconut water together with polythene dome interactively proved superior in enhancing the growth of *Ixora clones*.

Increasing the level of coconut water subsequently resulted in an increase in the number of sprouted cuttings, growth as well as survival rate.

On the contrary, coconut water had no significant effect on survival rate of established cuttings whilst the use of polythene dome significantly reduced survival rate.

Ixora coccinea cuttings treated with 100 ml of coconut water in combination with a polythene dome will enhance the establishment of *Ixora coccinea* cuttings but the polythene dome should be removed once cuttings are fully sprouted.

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ABBREVIATIONS

DAP: Days after planting

P₀: No polythene cover

P₁: Polythene cover

UNDER PEER REVIEW

