Original Research paper

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

ABSTRACT

Aims: To investigate the effects of coconut water treatment and polythene sheet dome on the establishment of *Ixoracoccinea*(*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 andDecember 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: Results showed that treatments with varying levels of coconut water in combination with the plain polythene dome had a significant influence on growth parameters. Increasing levels of coconut water resulted in a 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 percentage survival of plants however reduced significantly by 60 DAP [83.33%] when compared no polythene dome(control) [94.44%]

Conclusion:
The study concludes that*Ixoracoccinea (L.)* cuttings treated with 100 ml of coconut water in combination with a polythene dome will enhance the growth and development of *Ixoracoccinea (L.)*cuttings*,* however, the use of the polythene dome should be curtailed before 60DAP.

*Keywords: [*Coconut water,*Ixoracoccinea (L.),* 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 *Ixoracoccinea*(Linnaeus, 1753) generally involves the use of the 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 favorable [3]. One of such is the *Ixoracoccinea* plant.

Ixoracoccinea Linn is a common flowering shrub native to Asia belonging to the family Rubiaceaewhich is commonly known as Jungle of Geranium, Flame of the woods, or Jungle flame or vetchi in Ayurveda [4; 5].*Ixoracoccinea (L.)* is a hedging plant common in the subtropical regions of India and most tropical areas of the world [6;7].It is a common hedge plant in Ghana and it is used widely in most landscape designs.As a hardy shrub with beautiful bright flowers, colours range from yellow, red, pink, white, and peach. A combination of these varieties makes *Ixoracoccinea* an indispensable ornamental plant in many residential and commercial landscapes.Ixora is a moderate to root plant species and its rooting ability is moderate under natural conditions [8].It is traditionally used as hepatoprotective, Chemo protective, antimicrobial, anti-oxidant, anti-nociceptive, antimitotic, and anti-inflammatory substance [4].Root decoctions are used for treating nausea, hiccups, anorexia and are used to clarify the urine[4]: poultice fresh leaves and stems for sprains, eczema, boils and contusions and powdered roots are used for treating sores and chronic ulcers In Indochina [9].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 [10; 11]. 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 [12], time at which the cuttings were taken [13; 14] and the type of growth regulators used (IAA, IBA, cytokinin, and gibberellins) [15]. The hormone that stimulates the growth of adventitious roots is known as auxin, commercially available in the form of Indolebutyric acid (IBA) and Naphthalene Acetic acid (NAA).

Coconut water contains naturalplant growth hormones such as auxin, gibberellins, cytokinins and natural inhibitors and regulators that include ethylene, abscisic acid, phenols and flavonols [16; 17] Therefore, coconut water could be used to improve the rooting of Ixora cuttings and their establishmentsince it is 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 [18]. Before 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 [18]. Locally in Ghana, some nurserymen 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 and 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*Ixoracoccinea (L.)* stem cuttings under polythene dome.

2. MATERIAL AND METHODS / EXPERIMENTAL DETAILS / METHODOLOGY

2.1 Description of thestudy 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

Ixoracoccinea (L.) cuttings were sourced from the Hindu Monastery of Africa, Ashanti – Mampong Branch.

2.3 Growth Media

Topsoil was collected from the Multi-purpose Crop Nursery, sterilized, and sieved. Potting bags 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; (T_1)= No coconut water + No polythene dome, (T_2)=80ml coconut water + No polythene dome, (T_3)= 90ml coconut water + No polythene dome, (T_4)=100ml coconut water + No polythene dome, (T_5)= No coconut water + polythene dome, (T_6)=80ml coconut water + polythene dome,(T_7)= 90ml coconut water + polythene dome, (T_8)= 100ml coconut water + polythene dome which were all replicated three times. A total of ten cuttings was used per treatment.The varied levels of coconut water were applied once every weekthroughout the period of study.

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 of 500 gauge thickness (125 microns)was used in covering the bamboo frame and the ends were was firmed in at the edges with wet soil.

2.7 Data collection

Growth data including the number of leaves per plant, plant height, number of roots per plant and number of survived cuttings were collected at predetermined periods depending on the parameter being measured.

2.7.1 Number of leaves/plant

The 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 of survival

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 at seventy-five days after planting 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 the average estimated. This data was obtained at sixty days after planting.

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 Tukey's HSD at a 5% level of probability [19].

3. RESULTS AND DISCUSSION

3.1 Number of Leaves

There was a significant increase in the 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 the number of leaves per plant at 45 and 60 DAP. At 60 DAP, nosignificant effect was observed between 90 and 100 ml; 80 and 100 ml however varied significantly in terms of the number of leaves. The increase in the number of leaves through an increase in the levels of coconut water could be due to an increase in the concentration of auxins and nutrients that stimulate several life processes of the plant. This is in agreement with the results of [8], who observed that the number of leaves of *Ixoracoccinea (L.)* increased by 38%, 50%, and 70 % at 30, 45, and 60 DAP when treatment with 100 ml coconut water.

More so, the polythene dome significantly increased the 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 the number of leaves at 30, 45, and 60 DAP. 100 ml of coconut water and polythene dome interactively (100* P_1) resulted in the significantly highest number of leaves followed by (90ml* $P_{1)}$ which however varied insignificantly from (100ml* P_1). It was observed during the study that there was 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 the concentration of the coconut water could have resulted in the 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 [20].

Table 1: Individual and interactive effects of coconut water and polythene sheet dome on 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 a column, means bearing different superscripts differ significantly (P ≤ 0.05).*

3.2 Plant Height

Generally, plant height increased with increasing levels of coconut water (Table 2). 100 ml treated cuttings recorded the highest mean values of 10.30cm, 11.06cm, and 11.88cm at 30, 45, and 60 DAP respectively which were also significantly higher than 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 nosignificant 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 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 [8] 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 [21] 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 favorable conditions for plant growth. This result agrees with that of [22] who reported that critical soil temperature increases the height and diameter of the tomato plant. [23] also recorded a significant increase in stalk length of sugarcane due to the use of colored polyethylene cover.

Table 2: Individual and interactive effects of coconut water and polythene sheet dome plant height (cm)

Treatment	**Days after planting (DAP)**		
Coconut water (ml)	**30**	**45**	**60**
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]
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 ≤ 0.05).*

3.3 Number of Roots

Coconut water treated cuttings gave a higher number of roots per plant when compared with the control. There were no significant differences observed in the number of roots for 80 and 90 ml coconut water application however 100ml coconut water showed a significantly higher number of roots (19.00) in comparison with both 80ml (16.11) and 90ml (16.72) coconut water applications. Also, Ixora cuttings covered with polythene dome (P_1) gave a significant *(P ≤ 0.05)* number of roots (17.47) over the control (P_0) (15.17).Interactively, 100ml*P_1 recorded the highest number of roots of 22.00 but this value was not significantly different from those of 80ml*P_1 and 90ml*P_1.0ml * P_0 recorded the least number of roots (12.67) which was significantly lower than the highest number of roots (22.00) recorded by 100ml*P_1.Coconut water contains auxins, various cytokinins, GAs, and ABA [24-28] all of which play critical roles in the growth and development of plants. As can be seen from Table 3, increasing levels of coconut water gave a corresponding higher number of roots. This was corroborated by [29], who asserted that adventitious root development was promoted in *Draceanapurplecompacta* L.by IAA in coconut water extracts.

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

	COCONUT WATER				
COVER	**0 ml**	**80ml**	**90ml**	**100ml**	**Mean**
P_o	12.67a	15.67bc	16.33c	16.00c	15.17a
P_1	14.22ab	16.55c	17.11c	22.00d	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 and columns means bearing different superscripts differ significantly (P ≤ 0.05).*

3.4 Percentage Survived Cuttings

Percentage survivedcuttingsat 60 DAP within coconut treated cuttings and between the controls was insignificant. The use of polythene dome at60 DAPshowed a significantly lower (76.39) percentage of survived cuttings compared with the control which recorded 88.89. Interactively, (80ml*P_0) and (100ml*P_0) recorded a higher (94.44)percentage of survived cuttings and was significantly different from (80ml*P_1) which had 66.67 at 60 DAP.There was however no significant difference between 100ml *P_1 and 100ml*P_0 at 60 DAP. The performance of the control could be attributed 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 at 60 DAP. Whiles, on the other hand, the covered cuttings experienced deprivation of carbon dioxide which hampered its continuous growth at that physiological stage resulting in reduced photosynthetic activity. At a more mature stage of the plant's development, they do need adequate amounts of Carbon dioxide to undergo photosynthetic processes for continued survival.

Table 4: Interaction Effect of Coconut water and Polythene dome on Number of Survived Cuttings

	COCONUT WATER				
COVER	**0 ml**	**80ml**	**90ml**	**100ml**	**Mean**
P_O	77.78ab	94.44a	88.89ab	94.44a	88.89a
P_1	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 ≤ 0.05).*

4. CONCLUSION

The results from the study showed a 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 significantly superior in enhancing the growth and development of *Ixoracoccinea (L.)*cuttings.

On the contrary, coconut water applications had no significant effect on percentage survivedcuttings andthe control recorded higher percentage survived cuttings when compared to cuttings under polythene dome by 60 days after planting. There was however, no significant difference in percentage survival between covered and uncovered cuttings treated with 100ml coconut water.

Ixoracoccinea (L.) cuttings treated with 100 ml of coconut water in combination with a polythene dome will enhance the growth and development of *Ixoracoccinea (L.)*cuttings, however, the polythene dome produced a significant detrimental effect on cutting survival by 60 DAP; an observation that could be further investigated to determine when best to remove the polythene dome.

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ABBREVIATIONS

DAP: Days after planting
P_0: No polythene cover
P_1: Polythene cover