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Growth Response of Croton (*Codiaeum variegatum pictum L.*) to Aloe Vera Gel and Indol-Butyric Acid in Different Propagation Media

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Authors' contributions

This work was carried out in collaboration between both authors. Author SEO designed the study, performed the statistical analysis, wrote the protocol, wrote the first draft of the manuscript and managed the analyses of the study. Author RNK managed the literature searches. Both authors read and approved the final manuscript.

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ABSTRACT

Croton is a species of plant in the genus, Codiaeum, which is a member of the family, Euphorbiaceae. They have a wide range of variations in leaf shape and coloration that have fascinated breeders, landscapers, horticulturists, and gardeners and a huge number of cultivars have been fixed for commercial production. Because of this crotons are in very regular demand and there is the need for fast propagation methods, with low cost and that assures the formation of vigorous, high-quality seedlings. The study, therefore, assessed the growth response of croton cuttings to different growth media and plant growth hormonesviz: Aloe vera gel and IBA. A 3x3 factorial Randomized Complete Block Design (RCBD) made up of three growth media (coco peat, sawdust, and topsoil) and two levels of growth-promoting hormones (Aloe vera gel and IBA) and a control was used. The study was carried out at the Multipurpose Crop Nursery at the College of Agriculture Education, Mampong Campus. Data was collected on sprouting response, the number of leaves, and the number of roots. The results indicated that the different growth media and hormones influenced sprouting response of croton at days to 50%, 70%, and 100% sprouting

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significantly ($p > 0.05$). Croton cuttings that were grown on topsoil and treated with Aloe vera gel recorded earlier days to sprout. The number of leaves and roots was higher among croton cuttings grown on topsoil and treated with Aloe vera gel. On the other hand, croton cuttings grown on sawdust recorded the least number of leaves at 28, 42, 56, and 70 DAP.). The results were similar for the number of roots. The study concluded that croton cuttings that were grown on a combination of topsoil and Aloe vera gel resulted in the earliest shoot response and a higher number of roots and leaves followed closely by those of IBA.

Keywords: Croton; growth; media; hormones; Aloe vera; IBA and cuttings.

ACRONYMS

DAP: Days after planting.

1. INTRODUCTION

Croton (*Codiaeum variegatum pictum L.)* is an ornamental shrub that originates in tropical forests [1]. It is native to India, Malaysia, and the Pacific Islands [2]. Croton is a species of plant in the genus, Codiaeum, which is a member of the family, Euphorbiaceae [3]. The plant grows in an assortment of shapes and colors including red, orange, purple, pink, yellow, green, and white. A wide range of variations in leaf shape and coloration had fascinated breeders, landscapers, horticulturists, and gardeners and a huge number of cultivars have been fixed for commercial production [4]. Crotons are primarily aesthetic in their value. Adding a croton plant brings a burst of color to an otherwise green landscape [5]. Because crotons are in very regular demand, there is the need for fast propagation methods, with low cost and that assures the formation of vigorous, high-quality seedlings. Vegetative propagation by cuttings allows the propagated plant to retain all the genetic characteristics of the parent plant and the production of large quantities of precocious and uniform seedlings [6].

Adventitious root formation of cuttings or saplings involves the activity of auxins, plant hormones transported to the base of the cutting that acts in the formation of meristematic centers or activates pre-existing meristems that induce root formation [6]. Aloe vera gel is known to contain natural growth regulators such as auxins and gibberellins as well as other plant nutrients [7,8]. These natural auxins and gibberellins stimulate and accelerate the formation of roots and improve the quality of roots [9]. Aloe vera is a cactus-like plant that grows in hot, dry climates [10]. Because of its use as folk medicine, it is asserted that Aloe vera has wound and burn healing properties, anti-inflammatory, and immune-modulatory effects [10]. It is mostly available, affordable, and could be considered as a potent alternative to synthetic plant growth hormones such as IBA. Theindol butyric acid (IBA) is a synthetic auxin used to promote rooting of ornamental plants on a commercial scale [6].

A medium is any material used for rooting or potting plants [11]. Examples include topsoil which is the uppermost layer of soil which contains a mixture of sand, silt, and clay and broken down organic matter known as humus, coco peat, sawdust, etc. Coco peat is an agricultural by-product obtained after the extraction of fiber from the coconut husk [12]. As a growing medium, coco peat can be used to produce several crop species with acceptable quality in the tropics [13,14]. Coco peat is considered a good growing media with acceptable pH components, electrical conductivity, and other chemical attributes.

The species of tree from which the sawdust is derived largely determines its quality and value for use in a growing media [15]. The high cellulose and lignin content along with insufficient nitrogen supplies creates depletion problems, which can severely restrict plant growth [16]. Physical properties obtained from sawdust are similar to those of Sphagnum moss [17]. The type of plant material and degree of decomposition largely determine its value for use in a growing medium [18]. Certain by the medium in which they are raised. Having in mind the potential of these growth promoters and media to induce the rapid establishment of croton cuttings, this study sought to determine the hormones, which are produced naturally and/or synthetically, aid in the growth and development of plants aside from the nutrients supplied growth response of croton (*Codiaeum variegatum pictum L.)* cuttings to different growth media and aloe vera gel and IBA treatments.

2. MATERIALS AND METHODS

2.1 Description of the Study Area

The study was carried out at the Multi-Purpose Crop Nursery of the University of Education, Winneba, College of Agriculture Education, Asante – Mampong Campus in the Ashanti Region of Ghanafrom February to May 2019. Mampong-Ashanti has a bi-modal rainfall pattern with annual rain fall between 1094.4mm and 1200mm. within the experimental period, the maximum temperature recorded was 30.6°C and the lowest was 22.3°C at the study area. The mean temperature of the Mampong area was about 30.0°C with high relative humidity (Meteorological Services Department - Asante Mampong, 2018).

2.2 Collection of Plant Materials

Fresh branches were collected from 3–4 years old healthy plants of *Codiaeum variegatum pictum L.* grown at the College Nursery. All the leaves were removed from the semi-hardwood branches after which they were cut into 20 cm long segments with 8 to 12 nodes.

2.3Surface Sterilization

All the selected cuttings were surface sterilized by soaking in freshly prepared 1% Calcium Hydroxide and Copper Sulphate solution for 10 minutes.

2.4 Hormone Concentration

A concentration of 5 liters (5000 ppm) of IBA was prepared according to the procedure described by Hartmann et al. [9]. Aloe vera gel of 2.5 liters was prepared. The surface-sterilized cuttings (cut ends only) were then dipped in a bucket containing the respective hormones solutions for 20 minutes to enhance the absorption of plant growth hormones.

2.5 Growth Media

Three different growth media (rooting media) viz. coco peat, sawdust, and topsoil were used for the study.

A total number of four hundred and five (405) nursery bags were filled with the growth media. Each growth medium had 135, (i.e., for topsoil, sawdust, and coco peat). After treating cuttings with hormones, the cuttings were planted directly into the respective growth media. A single cutting per cavity was inserted obliquely up to a depth of 3 cm.

2.6 Treatments and Experimental Design

There were nine(9) treatments; Coco peat × IBA (T_1), Coco peat × Aloe vera gel (T_2), Cocopeat x Control(T_3), Topsoil × IBA (T_4), Topsoil × Aloe vera gel (T_5), Topsoil (T_6)x Control, Sawdust× IBA (T_7), Sawdust × Aloe vera gel(T_8) and Sawdust x Control (T_9). The experimental design used was a 3x3 factorial arranged in Randomized Complete Block Design (RCBD) with each treatment replicated three times. The allocation of the treatments to the nursery bags in each block was by random selection.

2.7 Data Collected

2.7.1 Days to sprouting

This was the number of days the cuttings of croton (*Codiaeum variegatum pictum L.)* took to sprout. However, an observation was made on the sprouting behavior of the croton *and* was

Table 1. Determination of minerals and phytohormones (GA3, IAA, and ABA) in Aloe vera extract according to Shyamal et al. [8] and Rawe 1966 [24]

Mineral	Result mg/100 ml f. w	Phytohormone/ Nutrient	Result	Unit
Nitrogen	81	GA3	16	mg/100 gm f. w
Phosphorus	7	IAA	0.6	mg/100 gm f. w
Potassium	61	ABA	3.1	mg/100 gm f. w
Iron	0.3	Total carbohydrate	10	(%)
Zinc	0.02	Glucose	3	g/100 g
Manganese	0.03	Protein	1.0	mg/g
Calcium	40	Cholesterol	19	mg/g
Copper	0.004			
Magnesium	14			
Sodium	51			

Determination of minerals and phytohormones (GA3, IAA, and ABA) in Aloe vera extract according to Shyamal et al. [8] and Rawe 1966 [24]

recorded in percentages as; days to (50, 70, and 100) percent sprouting respectively, which were indicated by the continued prolific sprouting of the croton cuttings.

2.7.2 Number of leaves per cutting

This was the number of leaves from the sprouts on the cuttings of croton (*Codiaeum variegatum pictum L.)*. The number of leaves on the sprouted crotons was counted.

2.7.3 Number of roots per cutting

This was the number of roots on the cuttings and was counted once every two weeks.

2.8 Data Analysis

The mean values of data collected on various parameters were subjected to analysis of variance (ANOVA) using GenStat software program version 19 (2017). The means were separated using the Least Significant Difference (LSD) at 5% probability level.

3. RESULTS AND DISCUSSION

In this result, we obtained interaction between growth media and growth hormone on sprouting, number of leaves and roots.

3.1 Sprouting Response

Growth media and growth hormone interaction effects on sprouting response of croton cuttings at days to 50%, 70%, and 100% sprouting (Table1) shows interaction of topsoil and Aloe vera gel recorded significantly (P=0.05) shortest days to 50%, 70%, and 100% sprouting. Its means of 33.67, 40.00, and 46.00 days were significantly (P=0.05) shorter to Sawdust and IBA Interaction which recorded the longest days to 50%, 70%, and 100% sprouting. The general observation was that all growth hormone interactions with Topsoil recorded the shortest days to 50%, 70%, and 100% sprouting compared to growth hormone interaction with cocopeat and sawdust.

Topsoil has a high moisture and nutrient retention with fine particle sizes as compared to coco peat and sawdust. Hence, in combination with aloe vera gel, it acts as a catalyst for the new roots through inducing rapid cell division and elongation in the presence of auxins and nutrients. According to Subramanian et al. [19], aloe vera gel extracts are proven to possess compounds with antimicrobial properties which could be used as an antimicrobial agent. This property could have also played a role to protect the cuttings from microbes that may have been introduced during the preparation process, thereby maintaining the general health of the cuttings which encouraged increased sprouting. The result of the current study is also corroborated by Khattab [17] and Leonardi et al. [5] who in their separate studies reported that growing Aspen (*Populus tremuloides L.*) in topsoil using aloe vera gel to treat the cuttings resulted in an increased sprouting rate.

3.2 Number of Leaves

Growth media and growth hormone interaction effects on the number of new leaves are observed in Table 3. The results show significant (P=0.05) differences between treatment means. Significantly (P=0.05) highest number of leaves on croton cuttings were recorded for topsoil and aloe vera gel interaction compared to other growth media interactions with IBA and control at 28, 42, 56, and 70 DAP. The results also show that number of leaves recorded for growth hormone interactions with Topsoil was highest followed by growth hormone interactions with Cocopeat. The least (P=0.05) leaf numbers recorded were from growth hormone interactions with Sawdust.

Topsoil and aloe vera gel interaction producing the highest number of leaves could be as a result of the topsoils capacity to hold and slowly release the nutrients and auxins available in the Aloe vera gel for adequate vegetative growth. According to Govinden-Soulange et al. [20], the number of leaves produced per cutting is determined by the type of cutting used, plant growth regulators utilized, temperature, and dry matter content of the cuttings as well as the medium and health status of the plant. Since all cuttings used in this investigation were uniform, the highest mean number of leaves of croton cuttings rooted in topsoil could be attributed to other medium characteristics like porosity, water holding capacity, and nutrient content. Topsoil was also found to be superior in the propagation of *Rosa hibrida* (L.) and *Bougainvillea glabra* (L.) when compared to the other media components [20].

3.3 Number of Roots

The interactive effect of growth media and growth hormones on the number of roots counted at 14, 21, 28, and 35DAP in Table 4.

Table 2. Interaction between growth media and growth hormone on sprouting response

Growth Media and Hormone Treatments	Days to 50% Sprouting	Days to 70% Sprouting	Days to 100% Sprouting
Coco peat*Aloe vera Gel	36.00[b]	42.00[c]	47.00[c]
Coco peat*IBA	36.33[b]	43.33[a]	48.00[b]
Coco peat*control	36.18[b]	42.67[b]	47.51[b]
Sawdust*Aloe vera Gel	37.67[a]	42.67[b]	49.67[a]
Sawdust*IBA	37.73[a]	43.00[a]	50.00[a]
Sawdust*control	37.49[a]	42.83[b]	49.83[a]
Topsoil*Aloe vera Gel	33.67[d]	40.00[e]	46.00[e]
Topsoil*IBA	35.00[c]	41.00[d]	47.00[c]
Topsoil * control	34.32[d]	40.49[e]	46.50[d]
L.S.D. (0.05)	0.839	0.593	0.419

Within columns, means bearing different superscripts differ significantly (P=0.05)

Table 3. Interaction between growth media and growth hormone on number of leaves

Growth Media and Hormone Treatments	Number of leaves			
	28DAP	42DAP	56DAP	70DAP
Coco peat*Aloe vera Gel	1.33[ab]	2.33[ab]	3.00[ab]	4.83[ab]
Coco peat*IBA	0.83[ab]	2.50$_{ab}$	3.33[ab]	4.83[ab]
Coco peat*control	0.77[ab]	1.41[ab]	2.13[b]	3.81[b]
Sawdust*Aloe vera Gel	0.33[b]	1.17[b]	3.00[ab]	3.67[b]
Sawdust*IBA	0.33[b]	1.00[b]	2.83[b]	4.17[b]
Sawdust*control	0.34[b]	1.09[b]	1.91[b]	2.90[b]
Topsoil*Aloe vera Gel	1.83[a]	3.50[a]	4.83[a]	5.83[a]
Topsoil*IBA	1.17[ab]	3.00[a]	3.83[ab]	5.17[ab]
Topsoil* control	1.12[ab]	2.00[ab]	3.34[ab]	4.50[ab]
L.S.D.(0.05)	1.309	1.569	1.899	1.497

Within columns, means bearing different superscripts differ significantly (P=0.05); DAP= Days after planting

Table 4. Interaction between growth media and growth hormone on the number of roots

Growth Media and Hormone Treatments	Number of roots			
	14DAP	21DAP	28DAP	35DAP
Coco peat*Aloe vera Gel	0.33	1.67	2.83[ab]	5.50[ab]
Coco peat*IBA	1.00	2.33	3.33[ab]	5.67[ab]
Coco peat*Control	0.61	1.53	2.14[b]	3.94[b]
Sawdust*Aloe vera Gel	0.17	1.00	2.33[b]	4.17[b]
Sawdust*IBA	0.50	1.17	2.00[b]	3.50[b]
Sawdust*Control	0.43	1.05	1.67[b]	3.06[b]
Topsoil*Aloe vera Gel	0.83	2.50	4.67[a]	6.83[a]
Topsoil*IBA	0.50	1.33	3.00[ab]	6.17[ab]
Topsoil*Control	0.62	1.60	2.52[b]	4.45[ab]
L.S.D.(0.05)	0.726	1.96	2.11	2.48

Within columns, means bearing different superscripts differ significantly (P=0.05); DAP= Days after planting

The results show that growth media and growth hormone interactions had no significant (P=0.05) effect on the number of roots at 14 and 21DAP. It was however observed that there were significant (P=0.05) differences in the number of roots counted at 28DAP and 35DAP. Significantly (P=0.05) highest number of roots at 28 and 35DAP were 4.67 and 6.83 respectively which was recorded by topsoil and aloe vera gel interaction while the least were means of 1.67 and 3.06 at 28 and 35DAP respectively recorded by sawdust and control interaction.

The nutrient-rich nature of aloe vera gel (Table 1) coupled with the good physicochemical properties of topsoil could have resulted in the observation of significantly higher root numbers for their interaction effect. The response of

selected ornamentals to a rooting hormone in different propagating media reported that the highest number of the root was recorded in topsoil treatments, higher than the other combinations of IBA and sawdust [21]. IBA treatments significantly increased the rooting percentage compared with the control in Hibiscus*rosa-sinensis* [22]. These reports correlate to the results of the present study. It is important to note however that the effectiveness of exogenous applications of auxins in enhancing rooting on stem cuttings is reliant on sufficient absorption by plant tissue [23].

4. CONCLUSION

Aloe vera gel and top soil interaction have proven significantly potent in enhancing the growth of croton cuttings when compared with IBA and the control.

Interactive effects of Topsoil and Aloe vera gel recorded the shortest days to sprouting, a higher number of leaves and roots which was significantly higher than growth media interaction with IBA (5000 ppm).

The combined effects of sawdust and untreated cuttings recorded the longest days to sprouting and the least number leaves and roots.

DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by the personal efforts of the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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