

ROOTING DAO (*Dracontomelon dao*) SHOOT CUTTINGS WITH VARIOUS AUXIN AND CONCENTRATION

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ABSTRACT— This study conducted at Buhangin, Malite, Davao del Sur to come up with a technology on propagating with Dao shoot cuttings. The treatments were laid-out in a two factorial Complete Randomized Design (CRD) with three replications supplied with different kinds of Auxin (Factor A) and Various Auxin Concentrations (Factor B). The auxins were IBA, IAA and NAA. The concentrations were as follows: C1- 10 ppm; C2- 250 ppm; C3-500 ppm; C4-750 ppm and C5- 1000 ppm. Result of the study showed that there were highly significant differences on rooting percentage, the number of roots and the length of root of Dao shoot cuttings. Cutting treated with IBA obtained the highest rooting percentage, most number of roots and had the longest roots produced. Application of varying auxin at a concentration of at 1000 ppm significantly increased the rooting percentage, most number of roots and had the longest roots produced. There was a highly significantly difference on the interaction of the of Auxin at varying concentration. This implies that application of kind of auxin at varying significantly improved the rooting performance of Dao orthotropic shoot cuttings.

KEYWORDS: shoot cuttings, IBA, NAA, IAA

1. INTRODUCTION

Dao (*Dracontomelon Dao*) belongs to Anacardiaceae family. The geographic distribution is Cambodia, China, India, Malaysia, Myanmar, Papua New Guinea, Philippines, Solomon Islands, and Thailand. The Species usually occurs in primary or secondary evergreen or semi-deciduous forest as its natural habitat with an altitude of 0-500 (-1000) m in area with high rainfall. It also occurs less frequently in areas with a short dry season. It is found scattered from well drained to poorly drained clayey to stony soils, mainly alluvial flats and in swampy areas. Dao fruit is edible but considered inferior and mostly eaten by children, the kernel of the seed is also edible. The flowers and leaves are cooked and eaten as vegetable in Papua New Guinea and used as food flavoring in Moluccas. The bark is used against dysentery, leaves and flowers are also employed in traditional medicine. The wood used for veneers, furniture, plywood, interior trim and light frames [1]. The propagation method of Dao is usually by seeds. The seeds be extracted immediately after the fleshy fruits have been collected. The are 520-620 seeds/kg. In Malaysia, 85-95% of fresh seeds germinate after 28-67 days. However, the seed are recalcitrant and no germinate at all after 6 months under ambient conditions in Java. The over exploitation and destruction of the primary forest has resulted in threatening of plant species. The seed characteristic (recalcitrant) and rapid land used conversion had influenced the threatening of Dao [2]. On the other hand, there is a revival interest in the use of native trees such as Dao and other native trees species ensued after the long painful experience caused by failures in the planting of exotic trees [3]. One of the technologies generated for the production of good quality planting material is clonal propagation. It is synonymous with vegetative or asexual propagation wherein a plant is produced from plant parts such as shoot, stem cutting, bud and tubers. This process is now used to enhance tree productivity and save vanishing species such as Dao [4]. In addition, cloning also enhances the production of quality planting material of trees that exhibit erratic flowering and fruiting characteristics, produces seeds with short viability, and provides the

production of disease free and vigorous planting materials [5]. The orthotropic shoot cutting method has been widely practiced in foreign countries as their modern technique for genetic and phenotypic characteristics preservation and they successfully proved that rooting formation is enhanced using rooting hormones. However, in the Philippines this technology is still under verification. Henceforth, general objective of this study is to cope with a technology on propagating Dao by shoot cuttings. Specific objectives to: (1) evaluate performance of Dao orthotropic shoot cuttings as affected by kinds and concentrations of Auxin; (2) determine the appropriate kinds and concentration of auxin that generate early root development, number of roots developed of potted Dao orthotropic shoot cuttings; and (3) know the interaction effects of different kinds of auxin and concentration. Thus, the results of the study viewed only with respect to the prevailing environmental condition within the rooting chamber in particular.

2. Materials and methods

2.1 Location and Duration of the Study

Two (2) months or eight weeks' period of observation. This was conducted at the Macrosomatic Nursery of Southern Philippines Agri-Business and Aquatic School of Technology (SPAMAST), Buhangin, Malita, Davao del Sur. The experimental area 9 square meters and basically safe from animals and other invading pests as it is within the Macrosomatic Nursery of SPAMAST, Buhangin, Malita, Davao del Sur.

2.2 Experiment Treatments

Factor A (Kind of auxin)

KA1 – IBA

KA2 – IAA

KA3 – NAA

Factor B (Auxin concentration)

C1 – 10 ppm

C2 – 250 ppm

C3 – 500 ppm

C4 – 750 ppm

C5 – 1,000 ppm

2.3 Experimental Design and Layout

A 3 x 5 factorial experiment was arranged in Complete Randomized Design (CRD) with five (5) levels of rooting hormones of three (3) kinds Auxin in three (3) replications with ten (10) sample plants per replication. The total number of cutting used was four hundred fifty (450) cuttings.

2.4 Preparation of Rooting Chamber

A one-meter by nine-meter rooting chamber was constructed in SPAMAST, Buhangin Nursery. The top frame was covered with 0.50 mm acetate. A fungicide was sprayed inside the chamber to free the chamber from the occurrence of fungus [6].

2.5 Preparation of Rooting Media

A ratio of 1:1 (coir dust and fine river sand) media was used as rooting media. The soil was sterilized using boiled water to eliminate weeds and the causal organism that may affect the growth of Dao orthotropic shoot cuttings [6].

2.6 Rooting Hormone Preparation

The auxin (IBA, IAA and NAA) was procured in Davao City. The desired concentration of rooting hormone of auxin was prepared following the procedure of [7]. Preparing quick dip, right amount of auxin was mixed to 50% alcohol and 50% water. On the hand, precipitation with auxin solution problem was avoided by using distilled water. After formulation of the right concentrations, in accordance with the treatment, the formulated solutions (Table 1) were placed in each container and labeled.

Table 1. Formulated concentration from auxin per liter solution

Final concentration (ppm)	Auxin/liter solution (mg)
10	10
250	250
500	500
750	750
1,000	1,000

2.7 Steps in Rooting Cutting using Non-Mist System

2.7.1 Topping of the donor plant

The mature branches of the donor plant were pruned to encourage the production of healthy shoots for the plant materials. These shoots were allowed to developed for the duration of 2-3 months [6].

2.7.2 Collection of orthotropic shoots cutting

The orthotropic shoots (vertically oriental) were collected in Magsaysay, Davao del Sur using sharp pruning shears while the plagiotropic (laterally grown) shoot were discarded. The collected shoots were placed in a large plastic bag with small amount of water to maintain moisture in the cutting the likewise reduce water stress during collection [8].

2.7.3 Preparation of cutting

The two nodal cutting with two mature leaves were collected. The leaves were trimmed off to halves to slow down the rate of transpiration by reducing its surface area [8].

2.7.4 Sterilization of cutting

The two nodal cuttings were placed in a 200 ppm benlate (fungicide) solution for 15 minutes to prevent from fungal attack [8].

2.7.5 Treatment and Setting-up of Cuttings

A fresh scraped/wound (Pencil cut) was made at the basal end of the cutting to allow the contact between the rooting hormone and the portion in the stem was rooting initiates. Then, the scraped portion of the cutting was quick dipped immediately into the treatments of rooting hormone for 5 seconds. Immediately, the treated cuttings were stocked in the propagation bed.

2.7.6 Water Management

The moisture inside the chamber was maintained by regular watering though misting. The application was done using a backpack sprayer. Watering was done as needs arises. Regular monitoring was done every day to check the cuttings within the two months' period of experimentation.

2.7.7 Monitoring of Rooting

Weekly inspection of the rooting performance of the stocked Dao cutting was done. This was done though checking the base of the cuttings by sample uprooting. Thus, uprooted cuttings were restocked in soil media

after inspection.

2.8 Data Gathered

2.8.1 Rooting Percentage

Rooting cutting were counted and recorded after two (2) months from planting. The rooting percentage was calculated using the formula:

$$\text{Rooting Percentage (RP)} = \frac{\text{Number of rooted cuttings}}{\text{Number of cutting stocked}} \times 100$$

2.8.2 Average Number of Roots

The number of roots per rooted cutting were counted and recorded. The average number of roots was computed using the formula:

$$\text{Average number of roots} = \frac{\text{Number of roots per cutting}}{\text{Total number of rooted cuttings}}$$

2.8.3 Average Length of Roots

The length of roots was measured was and recorded. The average length of roots was computed using the formula:

$$\text{Average number of roots} = \frac{\text{Length of roots per cutting}}{\text{Total number of rooted cuttings}}$$

2.9 Statistical Analysis

Analysis of the data was done using the Analysis of Variance for factorial Complete Randomized Design (CRD). Significant results were analyzed further using Duncan's Multiple Range Test (DMRT).

3. Results and Discussions

3.1 Rooting Percentage

The rooting percentage of Dao orthotropic shoot cuttings showed a highly significant difference between the three kinds of auxin tested (Table 1a). Statistical analysis revealed that cutting treated with IBA marked highest rooting percentage than cutting treated with NAA and IAA. There was significant difference observed on the rooting percentage as affected by application of varying concentrations of auxin (Table 1b). Application of 1,000 ppm of NAA, and with 750 ppm and 500 ppm of IBA significantly obtained highest rooting percentage, respectively. However, interaction effect showed highly significant difference on the rooting percentage of Dao shoot cuttings (Table 1c). Duncan's Multiple Range Test (DMRT) indicated that 1,000 ppm of IBA was significantly different to the rest of the treatments except with 1,000 ppm NAA, and with 750 and 500 ppm IBA, respectively. This implies that application of various auxin and varying concentrations significantly affected the rooting percentage of Dao shoot cuttings. Similarly, [7] cited that IBA is the best auxin for general use because it is non-toxic to plant over a wide concentration range and is effective in promoting rooting of a large number of planting species. He stated further that the purpose of treating auxin is to increase percentage of cuttings than form roots. Moreover, [9] reported that treated with 1,000 ppm of IBA of *Shorea platyclados* and *Shorea acuminata* gave the highest rooting percentage.

Table 2a. The effect of various Auxin to rooting percent of Dao orthotropic shoot cuttings.

Treatment	Rooting Percentage (%)*
IBA	74.67 ^a
IAA	49.33 ^b
NAA	54.67 ^b

CV = 4.51%

*Means having common superscripts are non-significantly different at 5% level of significance using DMRT.

Table 2b. Effect of various concentration of Auxin to rooting percentage of Dao orthotropic shoot cutting.

Treatment	Rooting Percentage (%)*
C1 – 10 ppm	50.00 ^c
C2 – 250 ppm	50.00 ^c
C3 – 500 ppm	62.22 ^{ab}
C4 – 750 ppm	66.67 ^{ab}
C5 – 1000 ppm	68.89 ^a

CV = 11.65%

*Means having common superscripts are non-significantly different at 5% level of significance using DMRT.

Table 2c. Kinds of auxin x concentration of auxin on the percentage of Dao orthotropic shoot cuttings.

Auxin Concentration	Kind of Auxin *		
	IBA	IAA	NAA
C1 – 10 ppm	33.33 ^c	70.00 ^{bc}	46.67 ^{abc}
C2 – 250 ppm	56.67 ^{abc}	63.33 ^{bcd}	30.00 ^f
C3 – 500 ppm	86.67 ^{ab}	60.00 ^{cd}	40.00 ^{de}
C4 – 750 ppm	96.67 ^a	43.33 ^{de}	60.00 ^{cd}
C5 – 1000 ppm	100.00 ^a	10.00 ^f	96.67 ^a

CV = 23.16%

*Means having common superscripts are non-significantly different at 5% level of significance using DMRT.

3.2 Number of Roots

Highly significant results were observed on the of roots of orthotropic shoot cutting as affected by the kinds of auxin, their varying concentrations and interaction (Table 2a, 2b and 2c). Significantly the highest number of roots was observed under Dao shoot cuttings treat with IBA. The cuttings treated with NAA were not significantly different to cutting treated with IAA. There was a highly significant difference observed on the number of roots produced by shoot cutting treated with varying auxin concentrations. Shoot cuttings applied with 1,000 ppm predominated by the 250 and 10 ppm auxin. However, 1,000 ppm was not significantly different to shoot cuttings treated with 500 and 750 ppm. Results on interaction effect of the kinds of auxin and varying concentrations showed highly significant difference on the number of roots of Dao shoot cuttings Duncan's Multiple Range Test (DMRT) which was used to compare the significant means indicated that 1,000 and 750 ppm of IBA where significantly different from the rest of the treatments except 500 ppm of IBA. Results implied that the of Dao shoot cuttings were significantly increased with the application of 500, 750 and 1,000 ppm of IBA. According to [10] the surprisingly high concentration of auxin needed to cause the maximal number of roots to regenerate was a point of importance that has sometimes neglected. In addition, [11] reported that 1,000 – 10,000 ppm concentrations of IBA rooting hormone were effective in promoting rooting on the different dipterocarp species.

Table 3a. The effect of various Auxin to the number of roots of Dao orthotropic.

Treatment	Rooting Percentage (%)*
IBA	6.52 ^a

IAA	4.87 ^b
NAA	5.13 ^b

CV = 4.18%

*Means having common superscripts are non-significantly different at 5% level of significance using DMRT.

Table 3b. The effect common of various concentration of Auxin to the number of roots of Dao orthotropic shoot cuttings.

Treatment	Rooting Percentage (%)*
C1 – 10 ppm	3.42 ^c
C2 – 250 ppm	4.88 ^b
C3 – 500 ppm	6.46 ^a
C4 – 750 ppm	6.33 ^a
C5 – 1000 ppm	6.45 ^a

CV = 5.99%

*Means having common superscripts are non-significantly different at 5% level of significance using DMRT.

Table 3c. Kinds of auxin x concentration on the number of roots of Dao orthotropic shoot cuttings.

Auxin Concentration	Kind of Auxin *		
	IBA	IAA	NAA
C1 – 10 ppm	3.61 ^g	4.31 ^g	2.33 ^h
C2 – 250 ppm	5.68 ^{cde}	4.41 ^{fg}	4.57 ^{efg}
C3 – 500 ppm	6.88 ^{ab}	5.80 ^{cd}	6.71 ^{bc}
C4 – 750 ppm	8.01 ^a	5.50 ^{def}	5.50 ^{def}
C5 – 1000 ppm	8.43 ^a	4.33 ^g	6.57 ^{bcd}

CV = 6.49%

*Means having common superscripts are non-significantly different at 5% level of significance using DMRT.

3.3 Length of Roots

The length of roots (mm) in respond to various auxin showed highly significant difference. The shoot cuttings treated with IBA obtained the highest mean value of 19.44 mm, where IAA and NAA obtained 15.66 mm and 15.0 mm, respectively (Table 3a). The was a highly significant on the length of roots of Dao orthotropic shoot cutting as treated with varying concentrations of auxin. The shoot cuttings treated with 1,000 ppm obtained the highest mean of 68.89 mm which was significantly different to cuttings treated with 500, 250 and 10 ppm, respectively. The interaction affects between different kinds of auxin and its varying concentrations showed highly significant differences on the length of roots. Duncan's Multiple Range Test (DMRT) indicated that 1,000 ppm of IBA was significantly different to the rest of the treatments. Results implies that application of IBA at 1,000 ppm concentration level significantly increased the root length of Dao shoot cuttings. The result conformed to the report of [12], [13]. In their research, they concluded that cuttings treated with cuttings treating with Seradex (powder IBA) produced more roots and hasted faster adventitious roots formation compared to other rooting hormones. However, [14] reported that though research had been conducted on the use of rooting hormones (IBA, NAA and IAA) to improve rootability or rooting performance, the is a little evidence that they increase rooting rates. They do, however, increase the number of roots and result in better development of root system. He stated further, that though IBA has been found to be more effective than other auxin, comparison is very difficult to make because, for instance, particular species may react differently to equivalent concentration of different auxin.

Table 4a. The effect of various Auxin to the length of root of Dao orthotropic soot shootings.

Treatment	Rooting Percentage (%)*
IBA	19.44 ^a

IAA	15.66 ^b
NAA	15.00 ^b

CV = 9.32%

*Means having common superscripts are non-significantly different at 5% level of significance using DMRT.

Table 4b. The of various of Auxin to the length of roots of Dao orthotropic shoot cuttings.

Treatment	Rooting Percentage (%)*
C1 – 10 ppm	11.44 ^d
C2 – 250 ppm	13.74 ^{cd}
C3 – 500 ppm	18.89 ^{ab}
C4 – 750 ppm	16.90 ^{bc}
C5 – 1000 ppm	22.52 ^a

CV = 13.04%

*Means having common superscripts are non-significantly different at 5% level of significance using DMRT.

Table 4c. Auxin x concentration on the length of roots of Dao orthotropic shoot cuttings.

Auxin Concentration	Kind of Auxin *		
	IBA	IAA	NAA
C1 – 10 ppm	11.50 ^{de}	12.38 ^{cd}	10.44 ^{de}
C2 – 250 ppm	17.52 ^{bc}	15.24 ^{cd}	8.47 ^{de}
C3 – 500 ppm	15.69 ^{cd}	22.75 ^b	18.22 ^{bc}
C4 – 750 ppm	22.50 ^b	13.25 ^{cd}	14.94 ^{cd}
C5 – 1000 ppm	29.97 ^a	14.67 ^{cd}	22.92 ^b

CV = 18.71%

*Means having common superscripts are non-significantly different at 5% level of significance using DMRT.



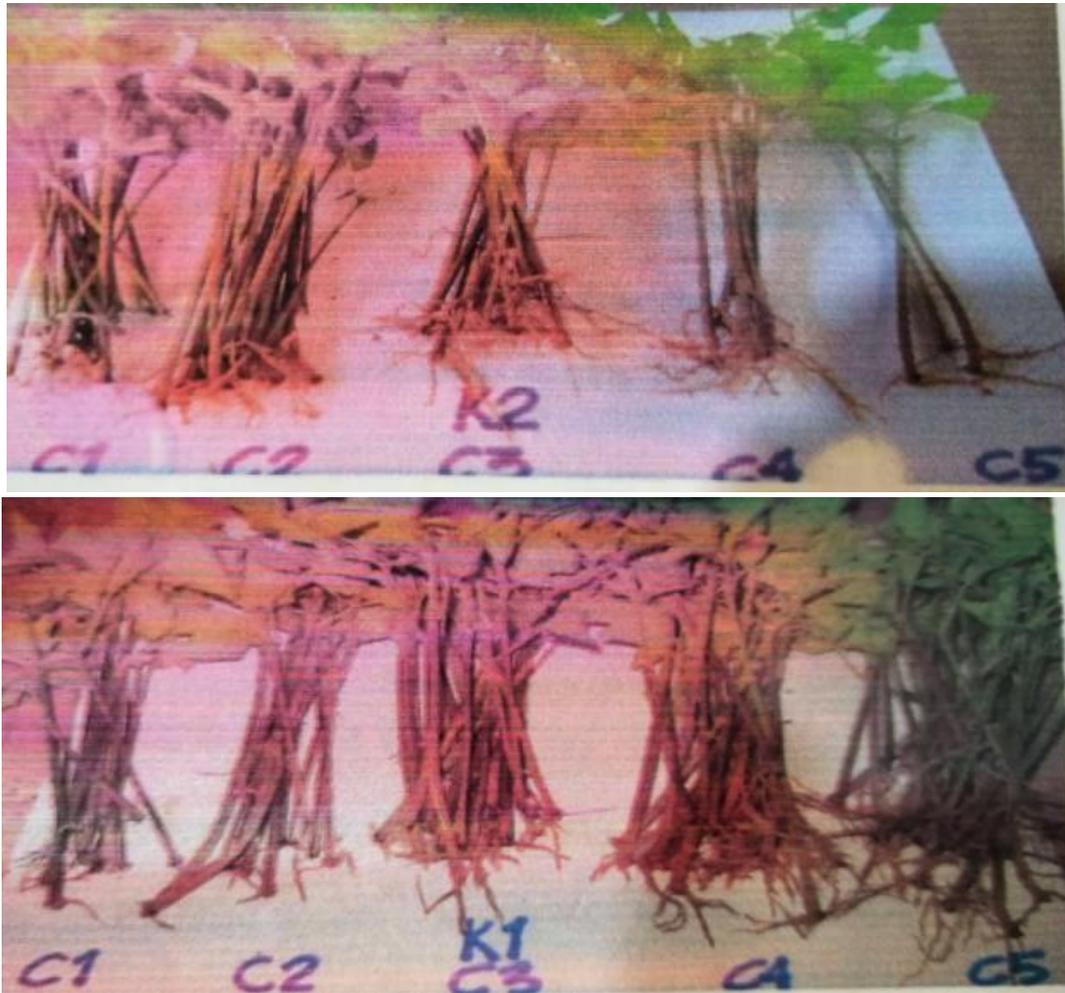


Figure 2. Photographs of rooted Dao (*Dracontomelon dao*).

4. Conclusions

Indole Buteric Acid (IBA) remarkably increased the rooting percentage and, the number and length of roots of Dao orthotropic shoot cuttings. Auxin concentration of 1,000 ppm consistently increased the rooting percentage and the number and length of roots of Dao orthotropic shoot cuttings.

5. Recommendation

Application of IBA at 1,000 ppm concentration level is highly recommended for rooting of Dao orthotropic shoot cuttings to obtain highest rooting percentage more number of roots and longest length of roots.

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