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RESEARCH ARTICLE

Response of 'Bignay' [*Antidesma bunius* (Linn.) Spreng] to cutting origins, IBA and BioGroe treatments

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ABSTRACT

The response of 'Bignay' [*Antidesma bunius* (Linn.) Spreng] to the cutting origins and different levels of plant bio-regulators consist of Indole-3-butyric Acid (IBA) and Biogroe treatments were investigated by means of 3 x 9 factorial experiment in Completely Randomized Design (CRD) using an automated mist propagator. Two hundred sixteen (216) healthy seedlings containing 9 nodes each were used in the study. Results revealed that cutting origins significantly increased shoot length but have no influence on the root number, percent rooting and percent survival. The cuttings originated from the bottom portion of the stem recorded the longest mean in terms of shoot length (12.48 mm) including the highest percent survival and percent rooting (82.41%). Highest mean number of roots were observed on the top cuttings (1.93). Indole-3-butyric Acid (IBA) and Biogroe treatments on cuttings have no effects on the different parameters evaluated. The interaction effect between cutting origins and IBA/ Biogroe treatments significantly increased the percent rooting and percent survival except the shoot length and root number of Bignay cuttings. Overall, the findings inferred that *A. bunius* can be propagated by any cutting origin derived from the main stem of the donor plants tested. Cuttings can effectively be induced to produce roots and survive and can be economically mass propagated even without the application of different concentrations of IBA and BioGroe.

Introduction

Native trees are very important in the web of life. They are the foundation of our natural ecosystems (1). They provide food and shelter to wildlife much better than introduced tree species. Native trees also adapt naturally to their local surrounding, thus more resilient than introduced species (2). They also retain their natural capacity to form devastation caused by raging weather and from pests and diseases (1).

In recent decades, there was a sharp decline in the population of native trees because of destructive and extractive human activities. Deforestation, replacement by invasive alien species, mono-crop plantations that propagate only commercially popular varieties (3) and the rapid proliferation of exotic plant species (4) are some of the reasons why native trees have been disappearing at a very fast rate. Morever, local people also continuously replacing economically important tree species with "money trees" like Gmelina and Mahogany for profit. As a result, a significant number of native tree species were moved to "endangered" status because of the dwindling population and continuous threat.

The diminishing population and the threat of extinction of native trees justify the need to exert more effort to protect the fast desertion of native fruit and forest tree species in the country. The Ecosystems Research and Development Bureau (ERDB) in the country have already conducted researches in the macro propagation of native tree species to restore their status but concentrated on the Dipterocarp tree and well known native tree species but not on lesser known fruit and forest tree species. Hence, the researchers proposed the research project, "Development of Clonal Propagation Protocols for Native Forest and Fruit-Bearing Tree Species of Quirino and Nearby Provinces" funded by the The Department of Science and Technology- Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development ((DOST-PCAARRD). One of the fifteen identified fruit tree species included in the study is 'Bignay'.

Antidesma bunius (Linn.) Spreng ('Bignay') is an endemic tree species of Euphorbiaceae family. It is a dioecious tree, usually reaches a height of about 10 meters. The tree grows well in the primary or secondary montane rain forest reaching about 1800

meters altitude. They grow well in alluvial flats, clayey soils, peaty soils, volcanic soils, podzols and limestone type of soils (5). The edible fruit develops in clusters like grapes and its size reaches 8 mm long containing one seed per fruit. 'Bignay' fruit juice contains health-stimulating chemical compounds such as phenolic, anthocyanin, ascorbic acid and flavonoid that can be a natural source of antioxidants (6). Also, the entire plant is used as an antidysenteric, antioxidative, anticancer, antidiabetic and gives sudorific effects that increase its medicinal significance. Likewise, the leaves are sudorific and employed in treating snakebite in Asia (7).

'Bignay' seeds can be sown one month after ripening under the shade without pre-treatment (5). Its seeds germination rate ranges from 3% to 30% which will take 30 to 60 days after sowing. The low viability rate of 'bignay' seed makes the supply of quality seeds inadequate which posed a major problem for massive planting and restoration. The present status of bignay needs immediate action to conserve, multiply and prevent the species from being endangered.

In the absence of quality seeds, the use of other plant parts such as stem as planting propagule is a possible alternative. Vegetative propagation through stem cutting has been acknowledged as an effective technique of rapid propagation of exact replica, true-to-type of the needed tree species for commercial plantation with fast reproductive gains (8) and germplasm preservation of vital tree species (9). As affirmed in a study (10), due to the reduced time needed for cuttings of excellent quality trees to produce roots and survive, this method of propagation is a rapid and very essential nursery management technique that accelerates planting stock production.

With the rigorous management of forest areas and the proliferation of fast growing exotics, including the genetic improvement of forest tree species, it is vital to develop quick and cost effective methods of producing top quality planting stock. Vegetative propagation technique through stem cutting of forest trees is very promising for the reproduction of clones and for fast increase of planting stocks. Clones provide the advantages of genetic uniformity and the rapid multiplication of superior trees for seed orchards and plantations.

Successful vegetative propagation through stem cuttings was successfully undertaken through the application of plant bio-regulators. As a result, ERDB reported to have successfully propagated seven species of dipterocarp by cuttings through a non-mist propagation system using different plant bio-regulators with high rooting performances (11). Bio-regulators affect the fundamental processes of plant growth and development. Indole-3-butyric acid (IBA), Indole-3-acetic acid (IAA) and Naphthalene acetic acid (NAA) are plant bio-regulators belonging to the auxin group that play an important role in root initiation (12). The most relevant role of auxins in plant propagation is that they stimulate root initiation on stem and leaf cuttings and the development of branch roots (13). This function of auxin is essential for the propagation of cuttings in many plant species used in horticultural and in forestry industries. Usually, Indole-3-butyric acid (IBA) is found to be the most effective root promoting auxin (14) and least toxic for plant tissues (15). IBA has important functions in several phases of root development that include adventitious root formation (16). IBA also enhances rooting since it translocates poorly and is retained near the site of application (17).

BiGroe, on the other hand, is made up of solid-based microbial plant growth promoter comprising of Plant Growth-Promoting Bacteria (PGPB). PGPB are associated with bacteria that affect root growth. These bacteria synthesize plant hormones provide nutrients in insoluble form. PGPB also shield plant surface against pathogenic microbes that attack through direct competitive effects and creation of antimicrobial compounds. As pointed out in a study (18), plant hormone produced by soil microorganisms are tangled in plant growth promotion and development. This is due to the creation of plant growth regulators like gibberellins, auxins and cytokinins. BioGroe trials were successfully conducted to different crops with an increased yield of 8% to 88% and resulted to a higher income for the farmer. For ornamentals and other cut plants, the cuttings effectively survived at a ratio of 1:10 ratio of BioGroe to water suspension (19). There is no study conducted yet on trees using BioGroe as a root enhancer hence, the result of this test was first-hand information contributing to BioGroe technology.

Thus, the study determined the effect of cutting origins, IBA and BioGroe treatments on the growth and survival of *A. bunius*. It aimed to generate information of the macro-clonal propagation protocol for *A. bunius* that serves as a guide for proper propagation of the species to improve its germplasm, for *ex-situ* conservation, and for mass propagation for the establishment of a future plantation to adequately supply the raw materials needed by wine producers in the upland communities. Specifically, to find the best cutting origin that will significantly increase the survival and rooting of cuttings and to determine the most effective root promoting hormone and economical dosage best for the propagation through cuttings.

Materials and Methods

Collection and Maintenance of wildlings along Hedgerows

Two hundred and sixteen (216) wildlings of 'bignay' about 0.1 to 0.2 m were earth-balled from the mountainous ranges of Quirino province. These were initially placed in a mist chamber, acclimatized in nursery condition (i.e. Increasing the amount of outdoor exposure one hour each day to gradually acclimate the seedlings to increasing amounts of dappled sun and wind). The seedlings were finally grown in a 200 m^2 hedgerows established beside the clonal nursery of the university. These were maintained until they have reached approximately 6-10 nodes and are at least 0.9 m in height (Fig. 1).

Preparation of Cuttings

Two hundred and sixteen (216) healthy stem cuttings

Fig. 1. 'Bignay' seedlings acclimatized in nursery condition and maintained along hedgerows.

containing 9 nodes each were obtained from the seedlings grown along the hedgerows were used in the study. Cuttings were collected early in the morning and leaves were reduced to half their size to minimize transpiration. The cuttings were placed in a basin filled with water to wash off dust and to avoid drying. These were soaked in 5% Benlate solution, a fungicide for 30 min to eliminate fungal contamination. The cuttings were divided into three parts: top (1st-3rd nodes), middle (4th-6th nodes) and bottom (7^{th}-9^{th} nodes). These were bundled into 24 cuttings with the basal part at the same end trimmed and soaked in their specific dosage of rooting hormone treatments (Fig. 2).

Preparation of Rooting Chamber

The propagation chambers inside the clonal propagation facility are structures provided with elevated rooting beds (rooting chambers) equipped with a programmable mist system. The whole rooting bed had an area of 6 sq m and was divided into three chambers having dimensions of 1 m x 2 m each. Each

Fig. 2. 'Bignay' cuttings treated with different rooting hormone concentrations.

rooting chamber is sealed tightly with polyethylene plastic no. 8. The chambers were cleaned and washed by a fungicide (i.e. 200 ppm Benlate) solution to minimize possible fungi contamination. The rooting bed was filled with layers of sterilized gravel and sand. The gravel layer as the first layer has a thickness of 5 cm and the sand layer as the surface layer has a thickness of 20 cm. A net is placed between them to avoid the mixing of the gravel and sand. The planted cuttings were watered using the automatic mist system. This was programmed so that the cuttings were watered in an interval to keep the cuttings moist always.

Preparation of Rooting Media

Pure river sand collected from Bagabag, Nueva Vizcaya was used as a rooting media for the experiment. The rooting media was sterilized in an improvised autoclave through steam cooking for up to 80^0C to eliminate all possible microorganisms that could contaminate the cuttings. This was sprayed first with a fungicide solution to eliminate some available fungi in the media. The rooting medium was divided into compartments based on the experimental layout and labels were established for easier planting of the cuttings (Fig. 3).

Preparation of Rooting Hormone

The rooting hormone IBA was prepared in powder form. Using a digital weighing scale (Merc-2 gms capacity), 1 gm of powdered/solid form of IBA was diluted with enough distilled water and exposed to a water bath at 45 ^{o}C. After which, this was vortexed or titrated using the titrator machine. When properly diluted, the rooting hormone was volumed to 1000 ml

Fig. 3. Rooting media divided into compartment based on experimental layout.

by adding 1 l of distilled water using a volumetric flask producing a stock solution of 1000 ppm concentration (20). Varying concentration of 500 ppm, 1500 ppm and 2000 ppm was prepared from that stock solution of 1000 ppm by serial dilution. The same procedure was used in preparing the different levels of BioGroe treatments.

Parameters Measured

Assessment of treatment effects was done after 3 months. The following parameters were obtained:

- Mean number of adventitious roots, average shoot length, percent survival and percent rooting.
- The mean number of adventitious roots was calculated by counting the total number of roots emanated from the base of all cuttings per treatment divided by the total cuttings used per treatment.
- The average shoot length was determined by dividing the total length of shoots over the total number of sample cuttings with shoots. Shoot length was measured using a foot rule from the point of origin of the shoots up to the tip of the elongated shoots.

Percent survival was computed by dividing the number of surviving cuttings that produced roots and shoots at the end of the experiment with the total number of stem cuttings planted and then multiplied by 100.

Percent rooting was determined by dividing the actual number of cuttings that rooted with the total number of cuttings planted and then multiplied by 100. Photos of survived cuttings that produced roots and shoots are shown (Fig. 4).

Experimental Design, Treatments and Statistical Analysis

The study utilized a 3 x 9 factorial experiment laid out in a factorial Complete Randomized Design (CRD) replicated three times. A two-way Analysis of Variance (ANOVA) was used to determine the significance of the data collected. A comparison of treatment means was done for parameters showing significant differences using the Duncan's Multiple Range Test (DMRT). A statistical package (Statistix 10) was used for the data analysis.

Fig. 4. 'Bignay' cuttings with roots and shoots.

There were two factors used in the study. Factor A composed of three cutting origins. C_1 were cuttings collected from the topmost part of the seedlings having the 1st three nodes with a pair of healthy leaves. C_2 were cuttings collected from the middle portion of the donor plant containing the 4th to 6th nodes with a pair of healthy leaves and C_3 were cuttings derived from the bottom part of the donor plat containing the 7th to 9th nodes.

Factor B was the hormonal treatments applied to the cuttings. There were 27 treatment combinations used per replication in the study (Table 1).

Results and Discussion

Percent Survival

The percent survival of the cuttings as affected by its origin showed no significant difference among each other (Table 2). The highest survival rate was observed in the bottom cuttings (82.41%) followed by the top cuttings (81.48%) and the lowest was recorded by the middle cuttings (72.22%), however, they do not vary statistically (Table 3). The high rate of survival was due to the juvenile state and presence of endogenous auxins in all cutting. As explained in a study (21), juvenile stem cuttings ensured higher photosynthetic activity due to an increase of stomatal conductance which leads to more supply of carbohydrates for root development and subsequent survival of the cuttings.

Among the levels of IBA and BioGroe treatments, the highest percent survival was exhibited by cuttings with 500 ppm IBA (86.11%) followed by cuttings treated with 500 ppm BioGroe (83.33%), and the least (70.83%) was yielded by the control (Table 4). However, the data showed that the application of IBA and BioGroe have no significant effect on the percent survival of the cuttings. This means that the cuttings can still survive even without the application of IBA or BioGroe.

The Analysis of Variance (ANOVA) on the percent survival of *A. bunius* cuttings as affected by various levels of IBA and BioGroe revealed no significant difference. This conforms with a research finding conducted in propagating *Dillenia suffruticosa* (Griff.) Martelli (22). However, the interaction effect of cutting origins and rooting hormone levels showed by the top cuttings (81.48%) and the least was noted in the middle cuttings (72.22%). This coincides with the findings of a study (23) where hardwood cuttings taken from the basal part of the stem recorded the highest rooting percentage (82.57 %).

Table 3 indicates that using any of the 3 set of cutting will yield a high rooting percentage. It is

Table 1. Treatment Combinations for the experiment

Top Cuttings (C1)		Middle Cuttings (C2)		Bottom Cuttings (C3)	
C1 T1	Control (distilled H2O)	C2 T1	Control (distilled H2O)	C3 T1	Control (distilled H2O)
C1 T2	500 ppm IBA	C2 T2	500 ppm IBA	C3 T2	500 ppm IBA
C1 T3	1000 ppm IBA	C2 T3	1000 ppm IBA	C3 T3	1000 ppm IBA
C1 T4	1500 ppm IBA	C2 T4	1500 ppm IBA	C3 T4	1500 ppm IBA
C1 T5	2000 ppm IBA	C2 T5	2000 ppm IBA	C3 T5	2000 ppm IBA
C1 T6	500 ppm BIOGROE	C2 T6	500 ppm BIOGROE	C3 T6	500 ppm BIOGROE
C1 T7	1000 ppm BIOGROE	C2 T7	1000 ppm BIOGROE	C3 T7	1000 ppm BIOGROE
C1 T8	1500 ppm BIOGROE	C2 T8	1500 ppm BIOGROE	C3 T8	1500 ppm BIOGROE
C1 T9	2000 ppm BIOGROE	C2 T9	2000 ppm BIOGROE	C3 T9	2000 ppm BIOGROE

Table 2. Summary of the Analysis of Variance on percent survival, percent rooting, number of adventitious roots and length of shoots of Bignay (*Antidesma bunius*)

Source of Variation	Percent (%) survival	Percent (%) rooting	Number of adventitious roots	Length of shoots (mm)
FACTOR A	3.07ns	3.07ns	0.47ns	5.05**
FACTOR B	0.65ns	0.65ns	1.88ns	2.03ns
FACTOR A x B	2.00*	2.00*	1.51ns	1.54ns
CV (%)	21.22	21.22	28.59	29.21

* significant at 5% level ; ** significant at 1 % level; ns = not significant

Table 3. Summary of the parameters evaluated as affected by the different cutting origins of Bignay (*Antidesma bunius*)

Cutting Origins	Percent (%) survival	Percent (%) rooting	Mean Number of adventitious roots	Mean Length of shoots (mm)
Top Cuttings	81.48	81.48	1.93	8.71^{b}
Middle Cuttings	72.22	72.22	1.74	10.96^{ab}
Bottom Cuttings	82.41	82.41	1.85	12.48^{a}
F Computed	3.07^{ns}	3.07^{ns}	0.47^{ns}	5.50^{**}
CV (%)	21.22	21.22	28.59	29.21

** significant at 1 % level; ns = not significant

Table 4. Summary of the parameters evaluated as affected by the different rooting hormone treatments of Bignay (*Antidesma bunius*)

Different levels of rooting hormone treatment	% Survival	% Rooting	Mean number of adventitious roots	Mean length of shoots (mm)
T1 – Distilled H_2O	70.83	70.83	1.44	10.42
T2 - 500 ppm IBA	86.11	86.11	1.89	8.81
T3 -1000 ppm IBA	75.00	75.00	2.00	12.52
T4 - 1500 ppm IBA	80.56	80.56	1.89	11.02
T5 - 2000 ppm IBA	76.39	76.39	2.56	14.75
T6 - 500 ppm Biogroe	83.33	83.33	1.89	11.44
T7 -1000 ppm Biogroe	79.17	79.17	1.56	9.66
T8 - 1500 ppm Biogroe	77.78	77.78	1.67	9.35
T9 - 2000 ppm Biogroe	79.17	79.17	1.67	8.49
F computed	0.65^{ns}	0.65^{ns}	1.88^{ns}	2.03^{ns}
CV (%)	21.22	21.22	28.59	29.21

ns = not significant

a significant difference at a 5% level of confidence. This means that the percent survival was different for every treatment combination. DMRT results showed that top cuttings applied with 500 ppm IBA was significantly different from untreated top cuttings, top cuttings treated with 1000 ppm IBA, untreated middle cuttings, middle cuttings with 500 ppm IBA treatment, top cuttings applied with 500 ppm BioGroe and middle cuttings with 2000 ppm BioGroe (Table 5).

Percent Rooting

Percent rooting of cuttings was not influenced by cutting origins in Bignay. As shown in the Analysis of Variance (ANOVA), it was observed that there is no significant difference among the percent rooting of each cutting origin (Table 2). This implies that the percent rooting of 'bignay' is not dependent on the origin cuttings. The highest rooting percentage (82.41%) was obtained by the bottom cuttings followed possible that the age of the ortet where the 3 stem cutting origins were derived contributed to the high rooting of the cuttings. This could be connected to the report that juvenile seedlings as a source of cuttings produce lower rooting inhibitors as compared to older plants (24). This report coincides with the findings that, propagating juvenile leafy stem cuttings of *Litsea monopetala* (Roxb. ex Baker) Pers. can be a helpful method to increase the rooting percentage (25).

The different concentrations of IBA and BioGroe applied to cuttings revealed that there is no effect on the percent rooting of bignay cuttings (Table 4). The highest rooting percentage was exhibited by cuttings treated with 500 pm IBA (86.11%) followed by cuttings applied with 500 ppm BioGroe while the lowest was in cuttings treated with control (70.83%). This implies that bignay is an easy to root species. Easy to root plants respond better to the exogenous

Table 5. Comparison of means for the interaction effect of cutting origin and rooting hormone levels on percent survival and percent rooting of 'Bignay' (*Antidesma bunius*)

Interaction of Factor A X B	Percent Survival (%)	Percent Rooting (%)
C1T1	54.17^{d}	54.17^{d}
C1 T2	100.00^{a}	100.00^{a}
C1 T3	58.33^{cd}	58.33^{cd}
C1T4	87.50^{abc}	87.50^{abc}
C1T5	95.83^{ab}	95.83^{ab}
C1T6	83.33^{abcd}	83.33^{abcd}
C1T7	70.83 ^{bcd}	70.83^{abcd}
C1T8	91.67 ^{ab}	91.67 ^{ab}
C1T9	91.67 ^{ab}	91.67 ^{ab}
C2T1	66.67^{bcd}	66.67^{bcd}
C2T2	66.67 ^{bcd}	66.67^{bcd}
C2T3	79.17^{abcd}	79.17^{abcd}
C2T4	79.17^{abcd}	79.17^{abcd}
C2T5	66.67^{bcd}	66.67^{bcd}
C2T6	87.50^{abc}	87.50^{abc}
C2T7	75.00 ^{abcd}	75.00^{abcd}
C2T8	58.33^{cd}	58.33^{cd}
C2T9	70.83^{abcd}	70.83^{abcd}
C3T1	91.67 ^{ab}	91.67 ^{ab}
C3T2	91.67 ^{ab}	91.67 ^{ab}
C3T3	87.50^{abc}	87.50 ^{abc}
C3T4	75.00^{abcd}	75.00^{abcd}
C3T5	66.67^{bcd}	66.67^{bcd}
C3T6	79.17^{abcd}	79.17^{abcd}
C3T7	91.67 ^{ab}	91.67 ^{ab}
C3T8	83.33^{abcd}	83.33^{abcd}
C3T9	75.00^{abcd}	75.00^{abcd}
F Computed	2.00*	2.00*
CV (%)	21.22	21.22

*significant at 5% level

treatment of rooting hormone (26). Table 4 showed that there was no significant difference in any of the treatments of IBA and BioGroe applied to Bignay cuttings. This conforms with the findings where IBA, NAA and their combination treatments were not significant in rooting azalea cuttings (27).

The interaction effect of cutting origin and various concentrations of hormones was observed to have a significant difference among each other (Table 5). This result coincides with the findings in rooting the stem cuttings of African Blackwood (*Dalbergia melanoxylon* Guill. & Perr.) (28). It was revealed that the highest percent rooting was observed on the top cuttings applied with 500 ppm IBA (100%). Comparison of means using DMRT showed that this was statistically the same with the middle cuttings applied with 500 ppm BioGroe (87.50%). Economically, the result showed that the best combination of treatment to use in rooting bignay stem cuttings would be middle cuttings applied with 500 ppm BioGroe since it is cheaper than IBA.

Number of Adventitious Roots

The effect of cutting origin on the number of adventitious roots produced in the cuttings is not significant (Table 2). As shown in Table 3, the highest number of adventitious roots was recorded by top cuttings (1.93) while the least was observed in middle cuttings (1.74). This indicates that the numerical difference between the cutting origin means is not enough to create a significant difference among each other, hence they are treated statistically equal. This implies that the origin of cuttings does not influence the number of adventitious produced by the respective cuttings. The result was opposite to the findings of (29) where softwood cuttings significantly increase the number and length of adventitious roots of Tindalo cuttings.

Table 4 revealed that the greatest number of adventitious roots produced was exhibited by cuttings treated with 2000 ppm IBA (2.56) followed by cuttings applied with 1000 ppm IBA (2.00) and the least was noted in control (1.44). This contradicts with a research finding (30) where root production of *Holarrhena pubescens* Wall. ex G. Don is a little more receptive to lower levels of IBA concentrations. Analysis of Variance revealed no significant difference among the different rooting hormone treatments (Table 2). It implies that the mean number of adventitious roots was statistically the same even when applied with different levels of IBA and BioGroe. This means that with or without the application of hormones such as IBA and BioGroe, the number of adventitious roots produced by the cuttings will still be the same. Bignay stem cuttings can produce roots even without the application of the rooting hormone. This conforms with the findings on rooting of *Drimys brasiliensis* Miers, *Ficus elastica* Roxb. ex Hornem and *Albizia zygia* (DC.) J. F. Macbr. respectively (31, 32, 33). Their findings showed that the rooting hormone treatment tested by them did not influence the number of roots per cutting, percentage of rooted cuttings, percentage of cuttings with callus and length of the longest roots per cuttings.

Length of Shoots

The longest shoot (12.48 mm) was obtained by the bottom cuttings while the lowest (8.71 mm) was obtained by top cuttings (Table 3). Analysis of variance revealed that there is a significant difference among cutting origin means. This means that the length of shoots differs from each other. Further analysis using LSD in comparing the means of cutting origin showed that the longest shoot (12.48 mm) was obtained by the bottom cuttings that were statistically the same with middle cuttings (10.96 mm). Meanwhile, the shortest shoot obtained on top cuttings with a mean length of 8.71 mm was found to be statistically different from bottom cuttings (12.48 mm).

Furthermore, in terms of the effect of the various concentrations of IBA and BioGroe to the length of shoots produced by the cuttings, data showed that there is no significant difference among the treatment means. The same findings were recorded on the stem cuttings of *A. bunius* as with that of the length of adventitious shoots of *Swietenia macrophylla* King, of which they were not significantly affected by the IBA treatments (34) but they differ on the significant effect of different doses of indole-3-butyric acid (IBA) on the shoot length and other vegetative growth performance of hardwood cuttings of Flordaguard peach (35*)*.

The longest shoot was noted in cuttings applied with 2000 ppm IBA (14.75 mm) followed by cuttings applied with 1000 ppm IBA (12.52 mm) while the shortest was achieved by cuttings applied with 500 ppm IBA (8.81 mm). This implies that even if the

mean length was numerically different from each other, they are still statistically the same as revealed by the Analysis of Variance.

Likewise, the interaction of Factor A and Factor B as revealed by the Analysis of Variance shows no significant difference between each other. This implies that the different treatment combinations, when used in 'bignay', have a comparable result.

Conclusion

The study revealed that 'Bignay' stem cuttings are effectively rooted and survived using the three cutting origins. Further, rooting of *A. bunius* ('Bignay') cuttings does not necessarily need the application of growth hormones such as IBA and Biogroe since the cuttings produced roots and survived easily without the aid of these treatments. For the mass production of Bignay cloned seedlings, it is best to use any cutting origins severed from the test plants without exogenous auxin application. Findings of this study may be used as macro-clonal propagation protocol for 'bignay' to economically propagate and adequately supply the planting materials needed by wine producers in the upland communities in Quirino province.

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Authors' contributions

EV Benabise, JJ Quinan, JG Carig had contributed equally in this work.

Conflict of interests

Authors do not have any conflict of interest to declare.

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