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Rooting ability and early growth performance of Supa (*Sindora supa* Merr.) stem cuttings at varied indolebutyric acid concentrations

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Key words: Completely randomized design, Indolebutyric acid (IBA), Supa *(Sindora supa* Merr.), Stem cuttings

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Abstract

The study evaluated the rooting ability and early growth performance of Supa (*Sindora supa* Merr.) stem cuttings at varied indolebutyric acid (IBA) concentrations. The stem cuttings were planted in a polyethylene bag and were monitored inside the closed chamber for 45 days. The study used a completely randomized design (CRD) with five treatments (250ppm, 500ppm, 750ppm, and, 1000ppm) that were replicated four times. The result of the study shows that there were significant differences among treatment mean in percent shooting, percent rooting and number of adventitious roots, percent callusing, and number of leaves. Among the various IBA concentrations applied, 750ppm got the highest result in terms of percent shooting, percent rooting, length of shoots, length of adventitious roots, number of leaves, and the percent callusing. In contrast, the survival percentage of T5 (1000ppm) got the highest rate compared with other treatments. Therefore, 750ppm is highly recommended for the rooting ability of Supa (*Sindora supa* Merr.) stem cuttings.

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Introduction

Supa (*Sindora supa* Merr.), is a tree that is native to the Philippines and to belongs to the Fabaceae family. It is found in limestone ridges and low to medium-altitude forests in the provinces of Quezon, Nueva Ecija, Camarines, and Albay in Luzon, as well as Mindoro (Energy Development Corporation, 2019).

The wood is used in the region for high-end flooring, musical instruments, interior construction, veneer, and decorative paneling, while the wood oil is utilized as lamp oil to make varnishes, paints, transparency paper, and to cure skin problems (ERDB, 2018). Germination of Supa is generally delayed due to the woody hard-coated seeds (PROSEA Timbers, 2017).

The *S. supa* is considered a "vulnerable species" on the Red List of Threatened Species (IUCN, 2022) and (DENR, 2017). The *S. supa* can only be found in the Philippines (Stuart, 2019), In view of this, one way to speed up the rooting process of cuttings is to use plant growth regulators such as synthetic auxins, which speed up root development and result in more uniform and vigorous roots, also, speeding up the seedling formation process (Pizzatto *et al.*, 2011). Generally, plants respond to stimuli gradually until they reach an acceptable level of auxin, at which point, depending on the circumstance, the increase in concentration becomes inhibiting or even phytotoxic (Pop *et al.*, 2011). Thus, the purpose of this study was to evaluate the rooting ability and early growth performance of *S.supa* stem cuttings at various indolebutyric acid concentrations.

Materials and methods

The experiment was conducted in Bayombong, Nueva Vizcaya. The humidity is 69 percent, and the temperature is about 27°C. The rooting and early growth performance was observed for 45 days from May 2022 to June 2022. The completely randomized design (CRD) was utilized with five treatments and replicated four times. There were 8 stem cuttings planted in each experimental unit and for each treatment, there were 40 stem cuttings, a total of 160 cuttings in 20 experimental units.

Treatments used

The cuttings of *S. supa* were treated with varied IBA concentrations (T1-Control, T2-250ppm, T3-500ppm, T4-750ppm, and T5-1000ppm). The detailed descriptions of each treatment were stated in Table 1 below:

Table 1. Treatment and descriptions.

Treatments	Description
T1 Control	The stem cuttings were soaked in distilled water for 1 hour before planting it in the polyethylene bag and place inside a closed chamber.
T2 250ppm IBA concentration	The stem cuttings were soaked in 250ppm IBA concentration for 1 hour before planting in the polyethylene bag and placed inside a closed chamber.
T3 500ppm IBA concentration	The stem cuttings were soaked in 500ppm IBA concentration for 1 hour before planting in the polyethylene bag and placed inside a closed chamber.
T4 750ppm IBA concentration	The stem cuttings were soaked in 750ppm IBA concentration for 1 hour before planting in the polyethylene bag and placed inside a closed chamber.
T5 1000ppm IBA concentration	The stem cuttings were soaked in 1000ppm IBA concentration for 1 hour before planting in the polyethylene bag and placed inside a closed chamber.

Layout plan of the study

1 T5R1	2 T1R1	3 T4R1	4 T4R3	5 T1R2
6 T1R3	7 T3R3	8 T2R2	9 T2R3	10 T5R2
11 T2R4	12 T5R4	13 T4R4	14 T5R3	15 T1R4
16 T4R2	17 T3R2	18 T2R1	19 T3R4	20 T3R1

Fig. 1. Layout plan using completely randomized design (CRD).

Legend:

T1- Control (Distilled water)
T2- 250ppm IBA concentration
T3- 500ppm IBA concentration
T4- 750ppm IBA concentration
T5-1000ppm IBA concentration

Preparation of soil media

The soil media used includes sandy soil, garden soil, and loam soil with a ratio of 1:1:1/2. To ensure that the prepared soil medium was sterile, the soil was sun-dried for twelve hours.

Rooting hormone preparation

In a volumetric flask with a capacity of 1000 ml, two (2) grams of the IBA powder were dissolved in 5 ml of NaOH, and then these two components were completely mixed with the addition of one (1) liter of distilled water Quinan J. (2019). After careful preparation of *S. supa* stem cuttings, at least 1.0cm of the basal portion of each bundled cuttings were soaked for an hour in the various rooting concentrations, except for the control, which was soaked in distilled water.

Preparation of stem cuttings

Two node cuttings were taken from the apical shoot of *S. supa* of one and two-month-old seedlings early in the morning to minimize loss of moisture through transpiration. The homogenous cuttings of *S. supa* were placed in a bucket of tap water to prevent desiccation and dust accumulation. The leaves were trimmed vertically in half to minimize excessive transpiration and facilitate their insertion into the rooting medium. The cuttings were treated with a fungicide for approximately an hour in order to avoid the formation of bacteria and fungi.

Data Collection

The following parameters were measured; the number of shootings, length of shoots, number of adventitious roots, length of adventitious roots, number of calluses, number of leaves, and survival. The Shoots, roots, leaves, and callus were counted in individual cuttings. The length of the shoots was measured from base to tip of the shoot using a ruler in centimeters while the length of the roots was measured from the point of origin up to the tip of the roots. In the number of survivors, only those stem cuttings which have roots and shoots were considered survivors. The following formulas were used:

$$\text{Percent Shooting} = \frac{\text{Number of stem cuttings with shoots}}{\text{Total number of stem cuttings planted}} \times 100$$

$$\text{Percent Rooting} = \frac{\text{Number of stem cuttings with roots}}{\text{Total number of stem cuttings planted}} \times 100$$

$$\text{Percent Survival} = \frac{\text{Number of stem cuttings with roots and shoots}}{\text{Total number of stem cuttings planted}} \times 100$$

$$\text{Percent Callusing} = \frac{\text{Number of stem cuttings with callus}}{\text{Total number of stem cuttings planted}} \times 100$$

Data analysis

The STAR software was used to test the significant differences in rooting ability and early growth performance of *S. supa* under various IBA concentrations. Furthermore, the least significant difference (LSD) test was also used to further analyze the mean of statistically significant parameters.

Results and discussion

Percent survival

The result of the study reveals that T5 (1000ppm) got the highest survival of 40.63% followed by T2 (250ppm) which can be compared to the study conducted by An *et al.*, 2018 in guava that the IBA concentration of 250ppm treated cuttings had a survival rate of 40.58%.

This may be because the plant produced more shoots, roots, and leaves per cutting since it directed the majority of its assimilation to the leaf buds, which are also one of the sites where natural auxins are produced in addition to being crucial for photosynthesis and respiration (Wahab *et al.*, 2001).

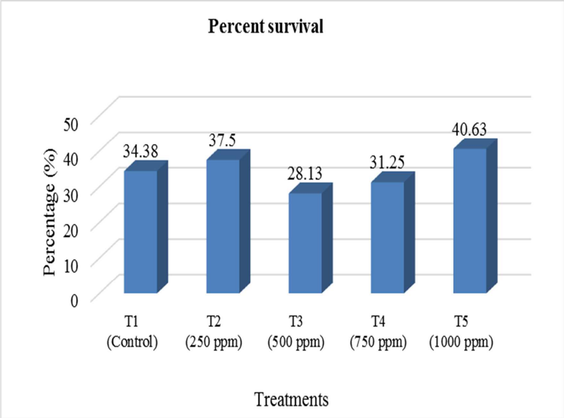

Fig. 2. Percent survival of *Sindora supa* Merr.

Percent shooting

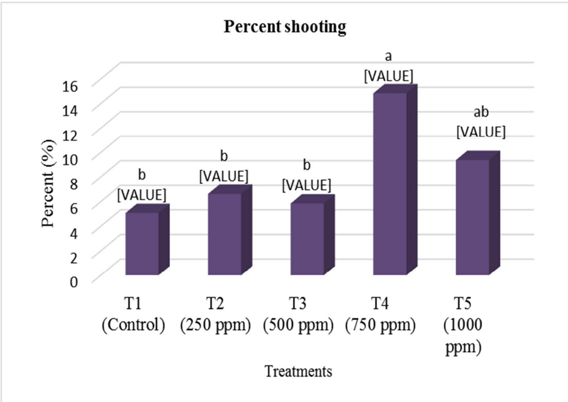

Fig. 3. Percent shooting of *Sindora supa* Merr.

In terms of shooting percentage, T4 (750ppm) showed the highest response with 14.84%, followed by T5 (1000ppm) at 9.38%, T2 (250ppm) at 6.64%, T3 (500ppm) at 5.86%, and T1 (control) with the lowest shooting percentage. In comparison to the control treatment, IBA concentrations led to a noticeably higher shooting percentage. As a result, auxins have been found to promote the growth of roots and shoots in several plant species (Wu *et al.*, 2007). There is a mean significant difference, as shown by the least significant difference (LSD) test, and the treatment with the highest mean significant difference is T4 (750ppm).

Percent rooting

The concentration of IBA has the largest proportion of rooted cuttings at 750 parts per million (T4) and 1000 parts per million (T5). The result indicates that rooting ability is increasing as the IBA concentration increases, hence, IBA concentration can promote root development. According to the findings on *Cedrus deodara* (Nandi *et al.*, 2002) and *Ginkgo biloba* (Pandey, 2011), the results indicated that IBA was more efficient for inducing root formation in stem cuttings. According to Rahman *et al.* (2002), auxin's effect on rooting may be explained by its role in promoting cell division in the vascular cambium, which results in the production of root primordial cells.

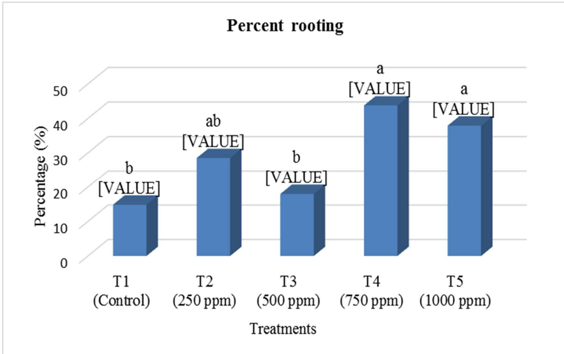

Fig. 4. Percent rooting of *Sindora supa* Merr.

The high percentage of rooting in T4 (750ppm) is inconsistent with the study conducted by An *et al.*, 2018 that the application of IBA had an inhibiting impact on the root percentage in hardwood cuttings, and the greatest value possible was attained at 1000ppm. Overall, the ability to apply IBA in stem cutting can produce more roots than in control. The study supported by Aziz, 2020 that compared the effects of various concentrations of IBA on hardwood cuttings of black mulberry with those of control cuttings revealed that IBA concentrations were more efficient for rooting black mulberry hardwood cuttings than controlled cuttings.

Length of shoots

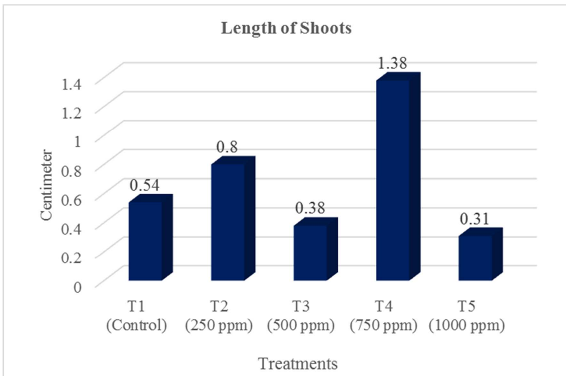

Fig. 5. Length of shoots of *Sindora supa* Merr.

T4 (750ppm) exhibits the longest shoot length among the treatments at 1.38cm, followed by T2 (250ppm) at 0.8cm, T1 (control) at 0.54cm, T3 (500ppm), and T5 (1000ppm) at 0.38cm and 0.31cm, respectively. The result can be compared to the findings of Benabise *et al.* (2021) stated that the different concentrations of IBA did not affect the length of shoots generated by cuttings, however, cuttings treated with 2000ppm of IBA (14.75mm) and 1000ppm IBA (12.52mm) were the shortest, with 500ppm IBA producing the longest shoots (8.81mm).

Length of adventitious root

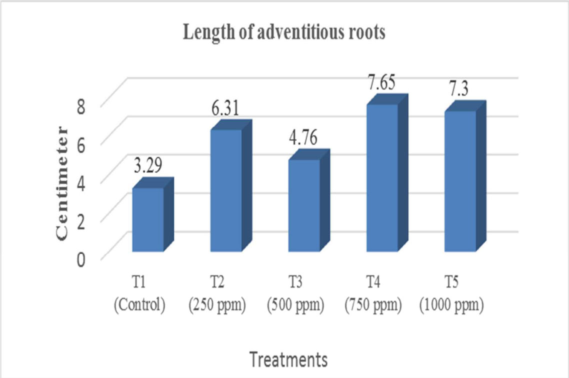

Fig. 6. Length of roots of *Sindora supa* Merr.

The length of roots was longest in T4 (750ppm) followed by T5 (1000ppm) compared to lower IBA concentrations. The finding was comparable to the study of An *et al.* (2018), which revealed that applying IBA considerably enhanced the average number of roots per cutting, but that IBA treatments had no appreciable impact on the average root length in hardwood cuttings. According to these findings, exogenous IBA can encourage the development of adventitious roots without changing their typical lengths.

Number of adventitious roots

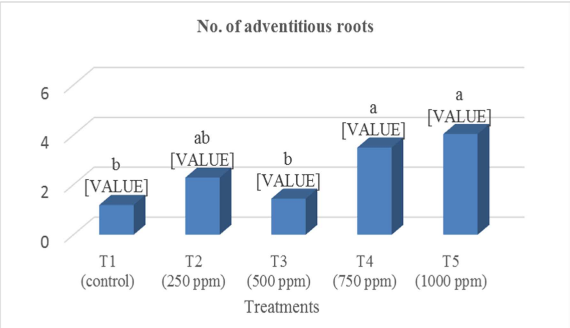

Fig. 7. A number of adventitious roots of *Sindora supa Merr.*

Based on the result of the study, there are more adventitious roots sprouted in T5 (1000ppm) with 4.04 and T4 (750ppm) with 3.5 roots compared to lower IBA concentrations (500ppm. 250ppm and control treatment). This might be due to the action of IBA, which would have resulted in the hydrolysis and transport of carbohydrates and nitrogenous substances at the cellular level near the base of cuttings, hence accelerating cell elongation and cell division under favorable climatic conditions (Rajamanickam *et al.*, 2021).

Percent Callusing

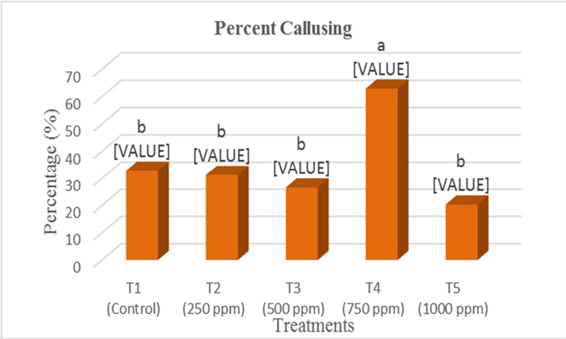

Fig 8. Percent callusing of *Sindora supa* Merr.

The result of this study showed the effect of IBA concentrations on *Sindora supa* Merr. were effective on callus formation in all treatments. This is supported by research by Kordzadeh *et al.*, 2021, which found that auxin and H_2O_2 treatments had a positive impact on the callus development and rooting of cuttings of *Prunus amygdalus X Prunus persica*. As a result, the internal auxin level is essential in callus formation and cutting roots in diverse plants.

Number of leaves

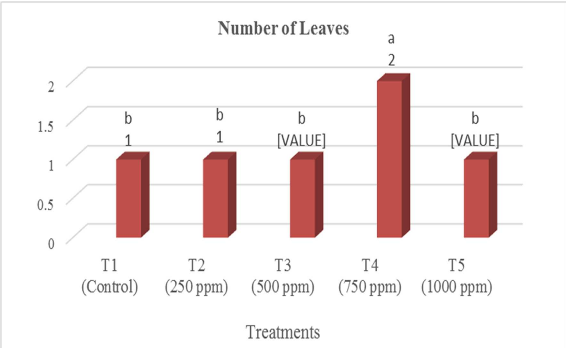

Fig 9. Number of leaves of *Sindora supa* Merr.

While all of the other treatments had the same number of leaves, the number of leaves considerably varies in the T4 (750ppm). There were a greater number of leaves in T4 (750ppm) because of the increased number of roots and shoots in T4 (750ppm). The use of IBA may have contributed in some respect to the increase in the number of leaves per cutting (EurekaMag. 2002). The result shows that T4 (750ppm) differs among treatments.

Table 2. Summary of Analysis of Variance for Supa (*Sindora supa Merr.*).

Parameters	*p*-value at 5%	Interpretation
Percent Survival	0.77	Not Significant
Percent shooting	0.02*	Significant
Percent rooting	0.00*	Significant
Length of shoots	0.09	Not Significant
Length of adventitious roots	0.10	Not Significant
Number of adventitious roots	0.00*	Significant
Percent callusing	0.00*	Significant
Number of leaves	0.00*	Significant

* Significant at 5%

The analysis of variance indicated that percent rooting, number of adventitious roots, percent callusing and number of leaves in *S. supa* differed substantially across treatments since the p-value was less than the 0.05 level of significance while percent survival, length of shoots, and length of adventitious roots didn't detect any significant differences among treatment means since the p-value was greater than 5% level of significance.

Conclusion and recommendation

The investigation findings lead the researchers to conclude that various concentrations of IBA had a substantial impact on the rooting ability and early growth of *S. supa* stem cuttings. In the current investigation, IBA concentrations of 750ppm exhibited the highest result in terms of percent shooting, percent rooting, length of shoots, length of adventitious roots, number of leaves, and percent callusing. Therefore, it is highly recommended that 750ppm be used as rooting hormones for *S. supa*.

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