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Levels of concentration on the growth performance of red nato (*Palaquium luzoniense* Fern. Vill.) cuttings using alpha naphthalene acetic acid (ANAA) root hormone

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Abstract

This study was conducted to investigate the effects of various levels of concentration on the growth performance of Red Nato (*Palaquium luzoniense*), utilizing a Randomized Complete Block Design (RCBD). The study used 120 Red Nato cuttings with varying concentrations of ANAA hormone (0, 1000 ppm, 2000 ppm, and 3000 ppm). Each treatment comprising of ten cuttings was replicated three times. Over a two-month monitoring period, growth parameters, such as number of roots, length of roots and number of leaves were assessed. Results revealed that Treatment 0 (control) exhibited the highest root number and length with Pr (> F) values of 0.2733 and 0.7845, respectively, while Treatment 1 (1000 ppm) showed the highest leaf count Pr (> F) value of 0.8809. The study concluded that there is no significant difference among the treatment levels. Hence, it was suggested to prolong the observation period of the study to three (3) to six (6) months. Moreover, it was suggested to use a concentration of 1000 ppm of Alpha Naphthalene Acetic Acid in order to achieve better results in terms of the number of leaves.

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Introduction

The Red Nato, scientifically known as *Palaquium luzoniense*, is a towering evergreen species with a trunk diameter of about one meter and a majestic crown reaching heights up to 45 meters. Its vibrant red heartwood, which deepens in color with age, is highly prized for its durability and aesthetic appeal. Native to Southeast Asian rainforests like Malaysia, Thailand, Indonesia, and the Philippines, these trees thrive in areas with abundant precipitation and humidity. Their elliptical or oblong leaves, arranged alternately on branches, transition from a vivid green in their youth to a richer hue as they mature, presenting a stunning sight in their natural habitat. However, the conservation status of Red Nato is currently classified as vulnerable (GBIF Secretariat, 2023; World Conservation Monitoring Centre, 1998).

Vegetative propagation, also known as asexual reproduction, is a method widely employed in plant cultivation, enabling growers to produce genetically identical plants without the use of seeds. While advantageous for ensuring uniformity and consistency in crops, this method necessitates careful selection of propagation material to avoid the spread of diseases and mutations. Various techniques, including stem cuttings, layering, division, and grafting, facilitate vegetative propagation, offering efficient means to propagate plants with complex or lengthy reproductive cycles. Despite its benefits, the application of synthetic auxins like Alpha Naphthalene Acetic Acid (ANAA) to promote plant growth requires ongoing research to optimize plant productivity while mitigating risks such as phytotoxicity, thereby ensuring the development of high-quality crops (Topaçoğlu *et al.*, 2016; Brown, 2021).

The assessment for *Palaquium luzoniense* indicated that its population size was declining due to habitat loss and fragmentation caused by deforestation and unsustainable harvesting practices, which has led to a decrease in its natural populations in its native range (Oldfield *et al.*, 1998). This study sought to carry out cutting-based production using various levels of Alpha Naphthalene Acetic Acid (ANAA) root hormone concentration. This study aimed to determine the ANAA levels of concentration which used to help in the plant's rapid growth, development, and productivity. Moreover, the main objective of this study was to determine the effects of various levels of concentration of ANAA root hormone on the growth performance of Red Nato (*Palaquium luzoniense* Fern. -Vill.*)*.

Materials and methods

Description of the study area

This research was carried out at the Clonal Facility of the Department of Environment and Natural Resources (DENR), previously recognized as the Ecosystems Research Development Bureau- Forest and Timber Resources and Research (ERDB-FTRRC), situated in Upper Pulacan, Labangan, Zamboanga Del Sur. The facility spans one hectare and is specifically designated for cloning native and indigenous species. Positioned within a tropical climate, the site experiences a minimum temperature of 18°C (64°F) and receives significant annual rainfall, situated at an elevation ranging from 203 to 207 meters above sea level. The research project extended over two months, commencing on November 28, 2023, and concluding on January 28, 2024.

Research design and sampling

The experiment followed a Randomized Complete Block Design (RCBD), comprising four treatments, including the Control, which was replicated three times. Alpha Naphthalene Acetic Acid (ANAA) was utilized as the growth hormone, with concentrations limited to four levels: 0 ppm, 1000 ppm, 2000 ppm, and 3000 ppm. Rooting performance was evaluated based on the number and length of roots, as well as the number of leaves. This study was specifically making use of simple random sampling. It is a process wherein the researcher chose the cuttings randomly by making draw lots. Hence, each cuttings have an equal probability or chance to be selected. This way, the researcher can eliminate any possible biases that may arise in the experiment. In this study, a total of one hundred twenty (120) Red Nato cuttings

were selected out of 150 cuttings. Each treatment was comprised of ten (10) cuttings and has three (3) replications.

Preparation of rooting bed

Fine sand and coco coir dust were employed as rooting substrates with a ratio of 1:1, offering essential physical and chemical properties conducive to root development. With its excellent aeration, drainage, and water retention capabilities, fine sand is favored for fostering root growth. Meanwhile, coco coir dust, sourced from coconut husks, serves as a sustainable alternative to dwindling peat moss resources, boasting high water retention, aeration, and pH buffering capacities.

Collection of serial cuttings

Juvenile stems were collected from an established hedge garden at the Clonal Facility of the Department of Environment and Natural Resources (DENR) located in Upper Pulacan, Labangan, Zamboanga Del Sur. These juvenile stems were then propagated into new plants through serial cutting methods. In this process, each stem cutting was taken with at least 3 pairs of leaves to ensure that the cutting had enough energy reserves to develop into a new plant successfully. The collected stem cuttings were then placed inside a styro box containing a small amount of water to keep them moist.

Preparation of serial cuttings

The stem cuttings were immediately processed into three-nodal cuttings, which mean that each cutting contained three leaf nodes separated by two internodes or stem segments between them. Sterilization of Red Nato stem cuttings using Neotec Fungicide Solution, an essential step in the propagation process as it helps prevent the spread of pathogens and diseases that could affect the health and survival of the new plants. Alpha Naphthalene Acetic Acid (ANAA) root hormone was prepared by dilution in a fixed 1-liter tap water at three different concentrations: 1000 ppm (1 ml), 2000 ppm (2 ml), and 3000 ppm (3 ml). The cuttings were then bundled and dipped into a container with different concentrations of ANAA (0, 1000, 2000, 3000 ppm) for one (1) hour. The process of planting the prepared stem cuttings into a specialized environment called a rooting chamber at the DENR Clonal Facility located at Upper Labangan, Pulacan, Zamboanga Del Sur, which is designed to promote root formation and growth in the cuttings. The rooting chamber provides optimal conditions for rooting, such as high humidity, controlled temperature, and proper air circulation.

Data collection and analysis

The Statistical Tool for Agricultural Research (STAR) was utilized to analyze the collected data in this study. ANOVA (Analysis of Variance) was applied to assess whether significant differences existed between the main plot and subplot across the various treatments.

Results and discussion

Number of roots

As it was shown in the Fig. 1, it was presented the number of roots per treatment of Red Nato cuttings after two (2) months. In all three blocks or the replications in the propagation of Red Nato cuttings, To which is the Control had produced the highest yield in terms of the number of roots. It indicated that in all three replicates or sets of experiments, the control treatment (which did not receive any ANAA) produced the highest number of roots. It has an average number of roots of 1.23. It was then followed by the Treatment 1 which was subjected to 1000 ppm which has an average number of roots of 1.07. The treatment that was subjected to 2000 and 3000 ppm has the lowest yield of the number of roots suggests that treatments received higher concentrations of ANAA (2000 and 3000 ppm) had produced the lowest number of roots compared to other treatments. The analysis of variance (ANOVA) revealed the average number of roots produced by each treatment after two months of propagation. It indicated that there is no any significant difference in the number of roots produced by the different ANAA concentrations, as evidenced by the Pr (> F) value (0.2733) being higher than 0.05 significant level, which is commonly used as the threshold for statistical significance in scientific research studies.

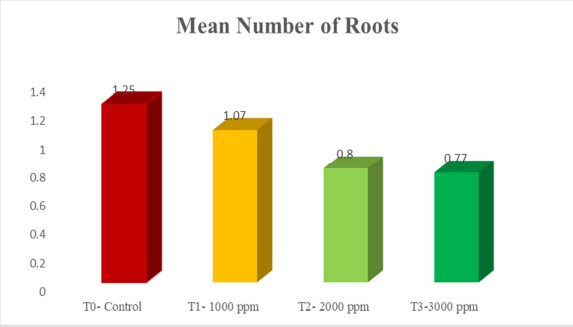

Fig. 1. Mean interaction on the effects of different levels of ANAA root hormone in terms of number of roots of *P. luzoniense* serial cuttings

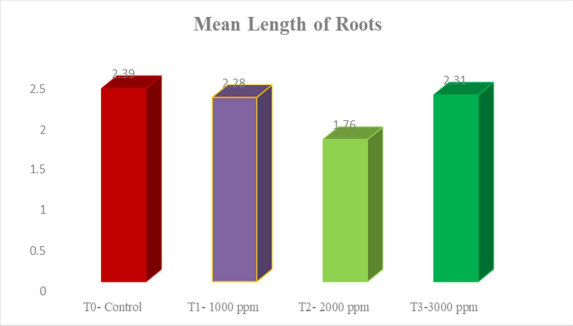

Fig. 2. Mean length of rooted cuttings of *P. luzoniense* in response to alpha naphthalene acetic acid

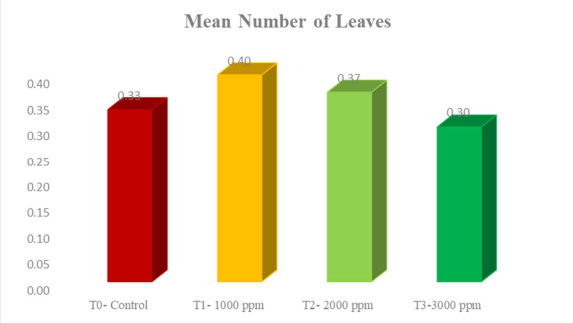

Fig. 3. Mean interaction on the effects of different levels of ANAA root hormone in terms of number of leaves of *P. luzoniense* serial cuttings

Length of roots

Fig. 2 shows the length of roots per treatment of Red Nato cuttings after two (2) months. The untreated treatment had produced the highest yield in terms of the average length of roots. It was observed that the Treatment 0 which is the Control had produced the highest mean number of 2.39 cm, followed by the Treatment 3 (3000 ppm) which obtained a mean of 2.31 cm indicating that the treatment that received the highest concentration of ANAA (3000 ppm) produced the second-longest roots on average. While Treatment 1 (1000 ppm) and Treatment 2 (2000 ppm) had lower mean averages which are 2.28 cm and 1.76 cm, respectively. Suggesting that the treatments that received lower concentrations of ANAA (1000 and 2000 ppm) produced shorter roots on average compared to the control treatment and the treatment with the highest concentration of ANAA (3000 ppm). It indicated that there is no any significant difference in the length of roots produced by the different ANAA concentrations, as evidenced by the Pr (> F) value (0.7845), which is higher than 0.05 level of significance.

Number of leaves

As it was shown in Fig. 3, all three (3) blocks or the replications in the propagation of Red Nato cuttings, Treatment 1 which was subjected to 1000 ppm had produced the highest yield in terms of the number of leaves. It has an average number of roots of 0.40. It was followed by the Treatment 2 which was subjected to 2000 ppm had produced an average number of roots of 0.36. This was followed by Treatment 0 (Control), which has an average number of 0.33. However, Treatment 3 which was subjected to (3000 ppm) had produced the lowest yield of the number of leaves with an average of 0.30. The result showed the average number of leaves after two (2) months. It was observed that there was no significant difference between the sample, columns, and interactions since the Pr (> F) value (0.8809), which was higher than 0.05 significant level.

Conclusion

Based on the findings of this study, the following conclusions were drawn:

1. There were no significant effects on the growth performance of *P. luzoniense* in terms of number of roots, length of roots and number of leaves, this can be attested by the result of the analysis of variance where the Pr (> F) values were 0.2733, 0.7845, 0.8809 respectively, which were higher than the 5% level of significance.

2. The analysis of variance showed that there was a difference between the treatments. However, the difference was not significant. T2 was subjected to 2000 ppm and produced better result in terms of number of leaves.
3. Untreated cuttings (control) have yielded the most in terms of number of roots and length of roots. However, in terms of number of leaves, cuttings that were subjected to 1000 ppm had produced the highest yield.

Recommendation(s)

The following recommendations are hereby suggested:

1. To have a better result, increase the observation period of the study to three (3) to six (6) months.
2. Consider investigating other factors, such as nutrient levels, watering, schedules, or propagation methods, which may have a significant impact on Red Nato cuttings' growth and development.
3. Use a concentration of 1000 ppm of Alpha Naphthalene Acetic Acid in order to achieve better results in terms of the number of leaves.
4. Further studies to confirm these findings and to explore potential opportunities for improving Red Nato cuttings growth performance by considering other methods or treatments.

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