International Journal of Research in Engineering, Science and Management
Volume 7, Issue 11, November 2024
https://www.ijresm.com | ISSN (Online): 2581-5792

Application of NAA (*Naphthalene Acetic Acid*) Growth Regulator and Planting Media Modifications on Bulbil Growth of Porang (*Amorphophallus muelleri* Blume.) Madiun Variety

Tutik Nurhidayati[1*], Tyas Wahyuning Aprilia[2], Kristanti Indah Purwani[3], Nengah Dwianita Kuswytasari[4]
[1,2,3,4]*Department of Biology, Faculty of Science and Data Analytics, Institut Teknologi Sepuluh Nopember, Surabaya, Indonesia*

***Abstract*: Propagation of porang plants is still constrained by the long growth period. One of the propagations of porang plants can use bulbils. The propagation technique is carried out using the application of Growth Regulatory Substances (PGR) and engineering of planting media. The purpose of this study was to determine the growth of bulbils of porang plants (*Amorphophallus muelleri Blume*.) Madiun 1 variety with the application of NAA (*Naphthalene Acetic Acid*) and modification planting media. The aim of this research is to determine the growth of bulbils of porang plants Madiun 1 variety with the application of NAA and modification of planting media. The method of porang plant propagation is carried out in vivo. The planting medium consists of a mixture of top soil, rice husk charcoal, and compost. Furthermore, the planting medium is given an application of NAA 100 ppm, 200 ppm and control (0 ppm). This study used a Completely Randomized Design (CRD) with a factorial pattern consisting of 2 factors. The first factor is PGR consisting of 3 levels (0 ppm, 100 ppm, 200 ppm) and the second factor is planting media engineering consisting of 4 levels, namely top soil, rice husk charcoal, and compost with 4 ratios (1:1:1, 2:1:1, 1:2:1, 1:1:2). Data were analyzed using parametric analysis in the form of Two Way ANOVA at a confidence level of 95%. The results showed that the treatment of modification of top soil, rice husk charcoal, and compost (1:1:1) planting media with the application of ZPT (0 ppm) had the highest average value, namely plant height 41.1 cm, stem diameter 4.91 mm, leaf area 439.2 cm2, dry weight 1.94 g, dry weight of the crown 1.53 g, dry weight of roots 0.41 g, root length 8.4 cm, and number of roots 29.**

***Keywords*: *Amorphophallus muelleri*, Madiun Variety 1, NAA, PGRs, Planting Media Modification.**

1. Introduction

Porang is a tuber plant that has economic value and promising prospects to be developed in Indonesia. This is because porang has a high glucomannan content [1] which has the potential to be developed as a raw material for industries such as the food, pharmaceutical, textile, paper, cosmetics, and oil industries [2]. Based on Indonesian porang export data from January to July 28, 2020, it reached 14,568 tons with a value of IDR 801.24 billion. The export value at that time only covered around 10% of world market demand [3]. Therefore, effective porang cultivation techniques are needed to meet market demand.

Porang cultivation can be done vegetatively and generatively. In vegetative propagation using plant parts in the form of stem tubers, leaf tubers (bulbil) and leaves. Propagation with bulbils takes at least 1 year [2]. In addition, propagation with bulbils if planted directly in the seedling medium, cannot grow immediately and experiences quite a long dormancy (5-6 months). Therefore, plant growth regulators (PGRs) are needed to stimulate the growth of porang bulbils [4].

One of the PGRs that is often used is Auxin. One type of auxin used to stimulate the growth of porang bulbils is Naphthalene Acetic Acid (NAA). The application of NAA to plants can stimulate cell elongation and division and stimulate plant root initiation [5]. According to [6], the administration of NAA can affect root length and number of roots [6].

In addition, the planting medium also affects the growth of porang plants. Therefore, it is necessary to modify the planting medium from organic materials such as top soil, rice husk charcoal and organic compost. This is because the three organic media are able to maintain the humidity of the area around the roots, provide sufficient air, and are able to maintain the availability of nutrients and support the improvement of soil structure so that aeration and drainage are better [7]. This is in line with research by [8] and [9], which reported that topsoil planting media with compost provided a response of increased plant height, stem diameter, dry weight of the crown and dry weight of the roots.

2. Materials and Methods

A. Preparation of Seeds, Planting Media and PGRs

The seeds used are bulbils with relatively uniform weight. Furthermore, NAA PGRs is prepared with concentrations of 100 ppm and 200 ppm. The planting media used are top soil, rice husk charcoal, and compost with 4 ratios (1:1:1, 2:1:1,

*Corresponding author: tutikn961@gmail.com

1:2:1, 1:1:2). The treatment of the planting media used is as follows:

C0P1: Without PGRs application with top soil: rice husk: compost planting media (1:1:1)

C0P2: Without PGRs application with top soil: rice husk: compost planting media (2:1:1)

C0P3: Without PGRs application with top soil: rice husk: compost planting media (1:2:1)

C0P4: Without PGRs application with top soil: rice husk: compost planting media (1:1:2)

C1P1: Addition of 100ppm PGRs with top soil: rice husk: compost planting media (1:1:1)

C1P2: Addition of 100ppm PGRs with top soil: rice husk: compost planting media (2:1:1)

C1P3: Addition of 100ppm PGRs with top soil: rice husk: compost planting media (1:2:1)

C1P4: Addition of 100ppm PGRs with top soil: rice husk: compost planting media (1:1:2)

C2P1: Addition of 200ppm PGRs with top soil: rice husk: compost planting media (1:1:1)

C2P2: Addition of 200ppm PGRs with top soil: rice husk: compost planting media (2:1:1)

C2P3: Addition of 200ppm PGRs with top soil: rice husk: compost planting media 1:2:1)

C2P4: Addition of 200ppm PGRs with top soil: rice husk: compost planting media (1:1:2)

B. Seed Planting

The bulbil porang seeds are soaked in PGRs NAA for 24 hours. Then the seeds are put into fungicide to inhibit fungal growth. Next, the bulbil seeds are planted in planting media that has been prepared according to the treatment. Plants are harvested at 120 DAP (Day after planting).

C. Observations

Observations Made on Porang Plants Include:

1) plant height (cm), by measuring the base of the stem to the tip of the stem using a ruler;
2) Stem diameter (mm), measured using a vernier caliper by measuring the middle of the stem;
3) Leaf area (cm2), leaf area is determined using the gravimetric method, namely by drawing the leaves and estimating their area on a piece of paper by measuring the ratio of the weight of the leaf replica to the total weight of the paper with the following formula [10]:

$$LD = \frac{Wr}{Wt} \text{ x } LK$$

Description:
LD = Leaf Area
Wr = Replica weight
Wt = Total paper weight
LK = Paper Area

4) Dry plant weight (g) is the sum of the dry weight of the crown and the dry weight of the roots by drying the plant sample using an oven at a temperature of 80°C until the weight is constant.
5) Root Length (cm), root length measurements are carried out on the longest root using a ruler.
6) Number of Roots, the number of roots is calculated from the number of roots that grow on the porang bulbil.

D. Data Analysis

The study used a Completely Randomized Design (CRD) with a factorial pattern consisting of 2 factors. The first factor was PGRs NAA consisting of 3 levels (without ZPT, 100 ppm, 200 ppm) and the second factor was the modification of the planting media consisting of top soil: rice husk charcoal: compost with 4 ratios (1:1:1, 2:1:1, 1:2:1, 1:1:2). Each treatment was repeated 5 times. The data were analyzed using statistical analysis, namely the Two Way ANOVA (Analysis of Variance) test at a 95% confidence level and further testing was carried out using the Duncan test.

3. Results and Discussion

Plant growth can be observed from plant height, stem diameter, leaf area, plant dry weight, root length and number of roots. The growth results of porang plants with the application of PGRs NAA and modification planting media are shown in Figure 1.

Based on the results of two-way ANOVA, it is known that the application factor of PGRs NAA has a significant effect on plant height, stem diameter, root length, number of roots and dry weight of plants with a value of $p = 0.000$ ($p < 0.05$). Based on Figure 1, it is known that there is a tendency for plant growth to decrease with the application of PGRs NAA with increasing concentrations. This causes a decrease in the rate of cell division in the meristem tissue. Meristem tissue is a tissue whose cells actively divide to increase the number of cells, so that it can affect plant height, stem diameter and number of roots. The decreasing number of roots results in the ability of the roots to absorb nutrients also decreasing. This has an impact on reducing the reach of the roots in absorbing nutrients. Low nutrient absorption causes the rate of photosynthesis to decrease, so that photosynthate also decreases. The decrease in the amount of assimilates from photosynthesis causes a decrease in cell division activity, resulting in a decrease in plant dry weight [11]. In addition, the application of PGRs NAA with high concentrations can inhibit cell elongation which causes plant height growth to be inhibited. Based on research by [12], it was stated that auxin with a concentration of 200 ppm did not have a significant effect on the growth of *Manihot esculenta* plants, this was because auxin concentrations that were too high could inhibit plant growth. Auxin is a PGRs that plays a role in the process of cell elongation, division, and differentiation and initiates root formation [13]. Auxin stimulation affects different tissues, the strongest stimulation is found in the apical meristem cells of the stem. At high levels, auxin is more inhibitory to growth. In addition, the application of exogenous auxin at high levels will increase hormone levels in plant tissues. Increased accumulation of hormones in tissues can inhibit plant growth

and inhibit the performance of other hormones so that plants have difficulty growing and can even die [14]. This condition is shown in Figure 1, plants with high concentrations of PGRs NAA application treatment have shorter sizes compared to treatments without PGRs NAA application.

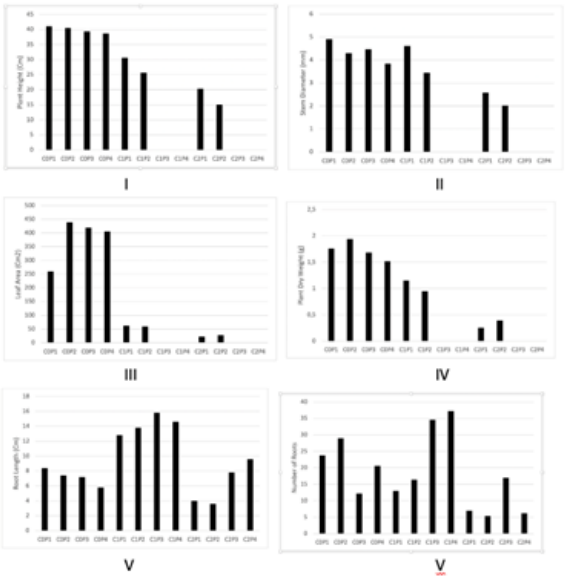

Fig. 1. Growth of Porang Plants 120 Days after Planting (DAP) in Various Treatments: (I) Stem Diameter; (II) Plant Height; (III) Root Lenght; (IV) Leaf Area; (V) Number of Roots and (VI) Plant Dry Weight: C0P1: Without PGRs application with top soil: rice husk: compost (1:1:1) planting media; C0P2: Without PGRs application with top soil: rice husk: compost (2:1:1) planting media; C0P3: Without PGRs application with top soil: rice husk: compost (1:2:1) planting media; C0P4: Without PGRs application with top soil: rice husk: compost (1:1:2) planting media; C1P1: Addition of 100ppm PGRs with top soil: rice husk: compost (1:1:1) planting media; C1P2: Addition of 100ppm PGRs with top soil: rice husk: compost (2:1:1) planting media; C1P3: Addition of 100ppm PGRs with top soil: rice husk: compost (1:2:1) planting media; C1P4: Addition of 100ppm PGRs with top soil: rice husk: compost (1:1:2) planting media; C2P1: Addition of 200ppm PGRs with planting media of top soil: rice husk: compost (1:1:1); C2P2: Addition of 200ppm PGRs with planting media of top soil: rice husk: compost (2:1:1); C2P3: Addition of 200ppm PGRs with planting media of top soil: rice husk: compost (1:2:1); C2P4: Addition of 100ppm PGRs with planting media of top soil: rice husk: compost (1:1:2)

Fig. 2. Growth of Porang Plants in Various Treatments: A: C0P1; B: C0P2; C: C0P3; D: C0P4; E: C1P1; F: C1P2; G: C2P1; H: C2P2 at Age 120 DAP: C0P1: Without PGRs application with planting media of top soil: rice husk: compost (1:1:1); C0P2: Without PGRs NAA application with planting media of top soil: rice husk: compost (2:1:1); C0P3: Without PGRs NAA application with planting media of top soil: rice husk: compost (1:2:1); C0P4: Without PGRs NAA application with planting media of top soil: rice husk: compost (1:1:2); C1P1: Addition of 100ppm PGRs NAA with planting media of top soil: rice husk: compost (1:1:1); C1P2: Addition of 100ppm PGRs NAA with planting media of top soil: rice husk: compost (2:1:1); C2P1: Addition of 200ppm PGRs NAA with planting media of top soil: rice husk: compost (1:1:1); C2P2: Addition of 200ppm PGRs NAA with planting media of top soil: rice husk: compost (2:1:1)

4. Conclusion

The growth of porang plants including plant height, stem diameter, root length, number of roots and plant weight were significantly influenced by the application of PGRs NAA. Treatment without PGRs NAA application had the highest average: plant height with the highest value of 41.1 cm (C0P1); stem diameter with the highest value of 4.91 mm (C0P1); plant dry weight with the highest value of 1.94 gr (C0P2). While the treatment with the application of PGRs NAA 100 ppm had the highest value in root length with the highest value of 15.8 cm (C1P3), and the number of roots with the highest value of 37 (C1P4).

Leaf area growth was significantly influenced by the interaction of PGRs NAA application and planting media modification with the highest value of 439.2 cm2 (C0P2).

Acknowledgement

This research was supported by “The Research Magister of the Ministry of Education, Culture, Research and Technology, Indonesia.” Project Project No. 1784/PKS/ITS/2024, Sub Project ID No. 038/E5/PG.02.00.PL/2024. We all thank all members of Plant Biosains and Technology Laboratory for their valuable help in supporting to experiment.

References

[1] Q. A‘yun, N. Harijati and R. Mastuti. The Selection Technique of Bulbil Porang (*Amorphophallus muelleri* Blume.) Based on Growth Response. *Journal of Enviromental Engineering & Sustainable Technology.* Vol. 6 (1): 30-35, 2019.

[2] M.S.D. Ibrahim. Perbanyakan Iles-Iles (Amorphophallus spp). Secara Konvensional dan Kultur in Vitro Serta Strategi Pengembangannya. Jurnal Perspektif. Vol. 18 (1): 67-78. http://dx.doi.org/10.21082/psp.v18n1.2019.67-78 (2019).

[3] I. Yasin, S. Kusnarta, Bustan & Fahrudin Menggali Potensi Porang Sebagai Tanaman Budidaya di Lahan Hutan Kemasyarakatan di Pulau Lombok. *Prosiding SAINTEK*. Vol 3, 2021.

[4] Sumarwoto and Maryana. Pertumbuhan bulbil iles-iles (Amorphophallus muelleri Blume.) berbagai ukuran pada beberapa jenis media tanam. *Jurnal Ilmu Kehutanan*, Vol.2. No.1: 91-98, 2011.

[5] N.E. Wardani, W.A. Subaidah and H. Muliasari. Ekstraksi dan Penetapan Kadar Glukomanan dari Umbi Porang (Amorphophallus muelleri Blume.) Menggunakan Metode DNS. Jurnal Sains dan Kesehatan. Vol. 3 (3): 383-391, 2021.

[6] E. Syahputra, M. Rahmawati and S. Imran. Pengaruh Komposisi Media Tanam Dan Konsentrasi Pupuk Daun Terhadap Pertumbuhan Dan Hasil Tanaman Selada (*Lactuca sativa* L.). Jurnal Floratek. 9(1):39-45, 2014.

[7] S.E. Sofyan, R. Melya and Duryat. Pemanfaatan Limbah Teh, Sekam Padi, dan Arang Sekam sebagai Media Tumbuh Bibit Trembesi (*Samanea saman*). Jurnal Sylva Lestari Vol. 2, No. 2: 61-70, 2014.

[8] Z. Mardhiyetti, N. Syarif, I. Jamarun and Suliansyah. Pengaruh BAP (*Benzil Adenin Purin*) Dan NAA (Naphthalen Acetic Acid) Terhadap Eksplan Tanaman Turi (*Sesbania grandiflora*) Dalam Media Multiplikasi In Vitro. pastura Vol. 5 No. 1:35–38, 2015.

[9] A. Irawan and Y. Kafiar. Pemanfaatan Cocopeat Dan Arang Sekam Padi Sebagai Media Tanam Bibit Cempaka Wasian (Elmerrilia ovalis). *Pros Sem Nas Masy Biodv Indon*. Vol. 1, No. 4, 2015.

[10] A.W. Irwan and F.Y. Wicaksono. Perbandingan Pengukuran Luas Daun Kedelai dengan Metode Gravimetri, Regresi dan Scanner. *Jurnal Kultivasi*. 16(3): 425-429, 2017.

[11] T. Haryuni, K.D. Soemarah and T. Nuryati. Pengaruh Dosis Rhizoctonia Binukleat (Bnr) Dan Pupuk Posfor Terhadap Pertumbuhan Benih Vanili (*Vanilla planifolia* Andrew). The 2nd University Research Coloquium, 2015.

[12] Suhardjito. Pengaruh Zat Pengatur Tumbuh Terhadap Pertumbuhan Bibit Pada Tanaman Singkong (*Manihot esculenta*) Dengan Metode Single

Bud. *Jurnal Ilmu Pertanian, Kehutanan dan Agroteknologi* Vol. 18(1), 2017.

[13] R.A. Alifianto, R. Azrianingsih and B. Rahardi. Peta Persebaran Porang (*Amorphophallus muelleri* Blume.) Berdasarkan Topografi Wilayah di Malang. *Jurnal Biotropika*, Vol. 1, No. 2, 2013.

[14] D. Susanto, E.Yuliani, D. M. Ratnasari, R.K. Gresiyanti, F.D. Anissa Setyawati and Adelia. Perbandingan Efektivitas Ekstrak Bawang Merah dan Auksin Sintetik Terhadap Pertumbuhan Akar Jagung (*Zea mays* L.). *Prosiding SEMNAS BIO*. Universitas Negeri Padang, 2021.