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Study on the effect of growth regulators and the concentration of coconut water on the growth and yield of garlic shallots (*Allium ascalonicum L.*)

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Abstract

An investigation on the influence of Atonic Growth Regulatory Substances and coconut water immersion on the growth and yield of shallots was conducted from March 3 to May 9 in 2023, in Tawangrejo Village, Ngrambe, Ngawi. The objective of this study is to analyze the impact of different doses of ZPT Atonik and coconut water on the growth and yield of shallots (Allium ascalonicum L). The experiment was designed using a Completely Randomized Block Design (RAKL), which included two factorials. The first factorial was the level of coconut water immersion concentration (K), consisting of four levels, namely K0 = 0%, K1 = 80%, K2 = 90%, and K3 = 100%. The second factor in this study is Atonik (A), which consists of four levels: A1 = 0 ml/l, A1 = 1.5 ml/l, A2 = 3.0 ml/l, and A3 = 4.5 ml/l. Each experiment in this study will be repeated three times and comprise four treatment levels, resulting in a total of 16 treatment combinations. We analyzed the data using Analysis of Variety followed by the Honest Significant Difference Test (BNJ) at the 5% level.

The study results revealed that the Atonik treatment and coconut water immersion did not have a significant effect on the observed parameters of the number of leaves (40.30), number of tubers (17.87), tuber diameter (2.45 cm), fresh weight (130.63 g), and dry weight (109.22 g), but had a significant effect on the observed parameter of plant height (41.33 cm).

Keywords: Garlic; Shallots; Coconut Water; Atonik; Growth

1. Introduction

Garlic shallots (Allium ascalonicum L) are a fundamental necessity for the Indonesian population. Shallots are used as a primary spice, traditional medicine, and a complement to cooking spices. In recent decades, there has been an annual increase in the cultivation of shallots for use as seeds and in consumption. Furthermore, shallots serve as a source of income and employment opportunities that contribute to the domestic community's growth. As reported by Firmansyah and Sumarmi (2013), the rise in industrial growth in Indonesia results in an increased need for shallots.

There is a high demand for shallots in the country, but Indonesia has not been able to meet it. Multiple factors can lower shallot production. These factors include pests, weather, and fertilizer deficiencies. For example, insufficient numbers or weights of bulbs produced contribute to unmet demand for shallots. Moreover, severe weather conditions that include high humidity and ample rain increase the susceptibility of shallots to fungal and bacterial infections. On the other hand, high temperatures attract caterpillars that can harm the plants (Refti, 2021).

One method to increase shallot production involves the application of plant growth-promoting hormones. Plant growth can generally be supported by three types of hormones, namely, gibberellins, auxins, and cytokinins. Each hormone

plays a distinct role. The application of ZPT can stimulate cell division in plant tissue. ZPT is a non-nutrient organic compound that, in specific concentrations, can support, prevent, or alter physiological processes in plants.

One of the most commonly used ZPT is Atonik is one of the most commonly used plant growth regulators. Enzyme activation in plants necessitates the use of atonic substances (Azwar, 2018). Hidayanto (2014) reported that nitroaromatic compounds present in Atonik promote root development and stimulate shoot growth. The dinitrophenol compounds in Atonik can enhance nutrient uptake and trigger shoot release. The selection of a specific ZPT determines the growth and development direction of the plant. Atonik contains the active ingredients sodium ortho-nitrophenol, sodium paranitrofel, sodium dinitrophenol, and sodium nitroguaiacol.

This study used both synthetic ZPT and coconut water concentrations. For shallot seeds to germinate successfully, natural ZPT is required to be soaked in coconut water. Coconut water contains cytokinins (5.8 mg/l), auxin (0.07 mg/l), small gibberellins, and other compounds that can stimulate germination and plant growth, according to Deni (2020).

2. Research methods

The research was carried out from March 3 to May 9, 2023 in Ngrambe District, Ngawi Regency, East Java Province. The land conditions are situated at an altitude of 600 meters above sea level, with a temperature ranging from 25-35OC. Andosol is the soil type in this area.

The experimental design utilized in this study was a Completely Randomized Block Design (RAKL) comprising two factorials. The first factorial was the concentration of coconut water immersion (K) with four levels, specifically K0 = 0%, K1 = 80%, K2 = 90%, K3 = 100%. The other stimulus is Atonik (A), comprising four levels, namely A0 = 0 ml/l, A1 = 1.5 ml/l, A2 = 3.0 ml/l, and A3 = 4.5 ml/l. The experiment will be repeated three times with four treatment levels, resulting in 16 treatment combinations for this study. The data analysis employed Analysis of Variety followed by Honest Significant Difference Test (BNJ) with a significance level of 5%.

The research procedure involved making beds with a 1 m length, 1 m width, and 30 cm height to ensure smooth water flow during the rainy season. The basic fertilizer applied was cow bokashi fertilizer at a rate of 15 tons/ha. The shallot seeds used in the study were sourced from Nganjuk, sorted for quality and superiority. We implemented a planting pattern with a 20 x 20 cm spacing resulting in 25 plant populations per plot, with 5 sample plants included. To improve seed quality, we immersed shallot seeds in coconut water with a predetermined concentration for 24 hours prior to planting. We applied Atonik to the plants when they were 15 and 36 days after planting. We used a sprayer to apply the Atonik with a concentration determined for each treatment. We performed follow-up fertilization during the vegetative period, 14 days after planting, and generative period, 36 days after planting. Pest and disease control is achieved through the use of fungicides and insecticides that work both systemically and on contact. Shallots are harvested at 67 HST, a stage marked by the falling and yellowing of leaves and the release of pungent aroma.

3. Results and discussion

According to Table 1, the control treatment exhibited a difference from the other treatments in terms of plant height. Atonik growth regulators can lead to an increase in plant height by stimulating cell elongation through the presence of auxin. Atonik plays several roles in plant growth such as functioning as a growth stimulant, a building block for organismal cells, and an organic catalyst that accelerates reactions while stimulating the formation and elongation of shoot cells.

Additionally, the number of shallot leaves parameter also displayed significant variations between each treatment, with A3 exhibiting the highest number of leaves (37.29 strands). Atonik belongs to a type of auxin that comprises compounds that have a positive effect on root formation. Moreover, when used in combination with cytokinins, it can regulate the growth of shoots, stems, and roots. The presence of leaves has a positive impact on root formation because they produce carbohydrates through photosynthesis, while shoots act as a source of auxin.

The tuber diameter parameter yielded significantly different results for each treatment with the highest yield found in A3 (2.30 cm). This demonstrates the significant impact of the appropriate Atonik concentration when the spraying interval remains continuous. Auxin regulates growth and other physiological functions throughout the plant body, including tissues outside of its production, and in small amounts, it acts as the active ingredient. Auxin affects the osmotic pressure of plants, resulting in an increase in cell size. Auxin softens cell walls, which leads to an increase in water absorption and cell elongation.

The final yield parameter was the dry weight of shallots, which exhibited a significant difference among treatments. Plant-absorbed atonic substances accelerate protoplasmic flow in cells and activate metabolism. Incidentally, dry weight increases when photosynthesis surpasses respiration. It is believed that administering Atonik increases cell wall permeability, thereby improving chlorophyll-forming nutrient absorption, which is crucial for enhancing photosynthesis. Increasing photosynthesis also results in increased dry tuber weight.

Table 1 The average results of the treatment of various concentrations ZPT Atonik

Treatment	Plant height	Number of Leaves	Tuber Diameter	Dry Weight of Tubers
A0	35,32 A	33,83 A	2,03 A	101,11 A
A1	36,68 B	35,01 A	2,07 A	102,68 A
A2	37,98 C	36,45 B	2,24 B	104,76 B
A3	37,68 BC	37,29 B	2,30 B	106,41 C

Note: Numbers followed by the same letter in the same column show no significant difference in the BNJ test at the 5% level.

Table 2 The average results of the treatment of various concentrations of coconut water

Treatment	Plant height	Number of Leaves	Tuber Diameter	Dry Weight of Tubers
K0	35,86 A	34,71 A	1,99 A	99,95 A
K1	36,39 A	35,20 A	2,08 A	103,94 B
K2	38,27 C	36,98 A	2,29 B	105,35 B
K3	37,14 B	35,69 A	2,28 B	105,72 B

Note: Numbers followed by the same letter in the same column show no significant difference in the BNJ test at the 5% level

The plant height parameter shows significant differences for each treatment, with the highest value observed in K2 (38.27 cm). Coconut water can be used as an organic material, providing an alternative to synthetic materials. The benefits of coconut water are similar to synthetic ingredients containing cytokinins or cytokinin hormone substitutes. In shallot plants with vegetative propagation, the growth is quick once shoots have emerged. The high ratio of leaves to roots promotes fast plant growth after onion bulbs sprout, resulting in efficient formation of new plant organs.

There was no significant difference in the results of each treatment based on the number of leaves parameter. The analysis of coconut water in this study revealed that the content of nitrogen (N) was below the quality standards for liquid organic fertilizers (namely 0.14% and 0.04%), which did not effectively promote the growth of shallots. External factors, such as the availability of nitrogen (N) nutrients, play a vital role. Nitrogen (N) plays a crucial role in plant vegetative growth and growth rate by increasing protein synthesis, which is essential in forming plant cells. Optimal levels of N can effectively encourage growth rate.

The next parameter is 'fresh,' indicating a significant difference for each treatment. The number and diameter of tubers increase due to the availability of food reserves. The significant tuber diameter indicates a large amount of carbohydrate food reserves that support the growth and development of seed tubers in the next season. These carbohydrates are utilized for growth, development, food storage, and cell development.

The dry weight of shallot bulbs was the last parameter, and the K3 treatment showed the highest value (105.72 g) with significant differences observed in each treatment. The length of immersion in young coconut water was found to be another factor responsible for obtaining the best plant height. There was an impact on the process of photosynthesis causing an increase in crop production. The concentration of coconut water has an impact on plant growth. Kristina

(2012) provides evidence that young coconut water contains three types of sugar, namely glucose (34-45% composition), sucrose (53-18% composition), and fructose (12-36% composition).

4. Conclusion

Based on the research results from the treatment of ZPT Atonik and coconut water, it can be concluded that :

- The application of Atonik at a concentration of 3 ml/l (designated as A2) resulted in the greatest increase in plant height. The highest values for the observed parameters of leaf number, tuber diameter, and tuber dry weight were obtained with a concentration of 4.5 ml/l Atonik (designated as A3).
- Coconut water treatment with a concentration of 90% (K2) resulted in greatest plant height, leaf number, and tuber diameter, whereas treatment with a concentration of 100% (K3) resulted in the highest dry weight of shallot bulbs.
- The application of ZPT Atonik and coconut water on shallots had no significant effect on the number of leaves (40.30 strands), diameter of tubers (2.45 cm), or dry weight (109.22 grams). The combined use of ZPT Atonik and coconut water had a significant effect on plant height (41.33 cm).

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to disclosed.

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