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The Effect of Using Natural Growth Regulators on the Seed Germination of Katokkon Pepper

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Abstract

Background: Katokkon (Capsicum annuum L.) is a local red pepper that is widely cultivated in the North Toraja Regency and several surrounding areas within the scope of South Sulawesi Province, Indonesia. This pepper has a spicy taste, is a unique fruit, is rich in nutrients, and serves as one of the commodities that can improve the people's economy. Katokkon pepper is adapted to grow well in upland areas so cultivation outside this habitat requires certain efforts to be optimal. Seed germination is an important step in plant cultivation. Coconut water and shallot extract were commonly used as sources of growth regulators substances to stimulate seed germination. Therefore, this study aims to determine the effect of natural growth regulators substances on the Katokkon pepper seed germination. **Methods:** of natural growth regulators substances on the Katokkon pepper seed germination. Methods: This study was conducted in a completely randomized design consisting of a control and six treatments with three replications. The Katokkon pepper seeds were soaked in 25%, 50%, and 75% of coconut water and shallot solution for 24 hours. **Results:** Treatment of coconut water and shallot extract was not significantly different from the control in the germination percentage and rate of Katokkon pepper. However, there was a significant difference between the 75% concentration of coconut water and the 25% shallot extract. **Conclusions:** The effect of natural growth regulators has not been seen significantly on the germination of Katokkon pepper. However, the greater the concentration used, the greater the percentage of germination obtained. The effect of 75% concentration of coconut water on the germination of Katokkon pepper was more significant than the 25% concentration of shallot extract.

Keywords: coconut water; katokkon pepper; natural growth regulators; shallot extract

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Introduction

Pepper or chili is one of the horticultural commodities that affect inflation and the national economy so the increase in its production becomes one of the indicators in the strategic plan of the Ministry of Agriculture for 2020 – 2024 (Ministry of Agriculture, 2019). It means that pepper has a significant economic value and is very influential in national development plans. Pepper contains various essential nutrients that contribute to human health both in food and medicine (Khan et al., 2014). Because it has become the daily consumption need of the Indonesian people, the quality and productivity of pepper are necessary to consider. Moreover, in the economic aspect, pepper has become one of the commodities that contribute to inflation both at the regional and national scales (Central Bureau of Statistics, 2019).

Red pepper is a plant species of the genus Capsicum, family Solanaceae originating from the Americas (Bosland & Vovata, 2012). Red pepper (*Capsicum annuum* L.) is found widely in most areas of Indonesia, but there are still many local varieties that have not been investigated, developed, and cultivated optimally. Katokkon pepper is one of the varieties of red pepper that is cultivated in the North Toraja Regency and several surrounding areas within the province of South Sulawesi. It has been registered in the Center for Plant Variety Protection and Agricultural Licensing with publication number 055/BR/PVL/02/2014 as a local pepper from North Toraja Regency, which is included in the red pepper species group (*Capsicum annuum* L.) (Center for Plant Variety Protection and Agricultural Licensing, 2014). Katokkon pepper has a spicy taste, a unique fruit shape resembling small paprika, and is rich in nutrients that are important for health such as vitamin C, carotenoids, and capsaicin (Tammu et al., 2021). An increase in chili or pepper production is one of the primary performance indicator components of the local agricultural department to increase people's income and reduce the inflation rate (North Toraja Department of Agriculture, 2019). The challenging problem factors in the field include the lower knowledge of farmers about agricultural crop cultivation technology, high production costs, and climatic conditions that affect the development of plant-disturbing organisms (North Toraja Department of Agriculture, 2018).

Katokkon pepper (*Capsicum annuum* L.) is cultivated by using its seeds. The seeds are round, flat, yellow in color, and have hard fairly skin. Inside the seed contains an embryo as a candidate for a new individual plant and food reserves or endosperm. The embryo generally consists of 3 main parts, namely the radicle, the cotyledon, and the cauliculus (Nugroho & Sumardi, 2015). The radicle is the part of the embryo that will grow into a root tip facing the navel of the seed. The cotyledon is the part of the embryo that will grow into the first leaf of a plant that functions as a place for storing food (looks like a seed chip), a tool for assimilation, and a sucker for food from the endosperm. The cauliculus is the embryo stem which consists of two parts, namely the stem's section above the cotyledon *(internodium epicotylum)* and the stem's section below the cotyledon *(internodium hypocotylum).* Usually, the cauliculus along with the prospective leaves is called the shoot (plumula).

The seed germination can be influenced by internal factors of seeds and external factors or the environmental condition where the seeds are planted. One way to stimulate seed germination and improve plant growth is to use growth regulators substances or phytohormones. Phytohormones are plant organic compounds that in low concentration affect physiological processes including growth, differentiation, plant development, and the way plants respond to the environment such as stomata opening and nutrient uptake (Lindung, 2014). Plant growth regulators substances are compounds, either natural or synthetic, that modify or control the growth and maturation of plants through physiological action (Ogunyale et al., 2014). Currently, many synthetic growth regulators are sold in the market for use by farmers. In fact, there are several natural ingredients that can be used as the source of growth regulators including shallot as a source of auxin, bamboo shoots as a source of gibberellins, banana weevil, and coconut water as a source of cytokinin (Lindung, 2014). Besides being cheaper, natural growth regulators sources are safe and environmentally friendly. Natural growth regulators sources are also widely applied to various types of plants, including red pepper.

The research reported that soaking red pepper seeds with 15% coconut water for 6 hours could increase the speed of seed growth, seedling height, wet weight, and dry weight of seedlings (Ernawati et al., 2017). Soaking pepper seeds for 10 minutes in coconut water (*Cocos nucifera* L.) with a concentration of 50% and shallot extract (*Alium cepa* L.) with a concentration of 30% was reported to give significant results in seed germination and growth of cayenne pepper plants seen from plant height, leaf width, number of leaves, leaf color and leaf length (Prianti et al., 2017). Therefore, this study aims to describe the effect of using coconut water (*Cocos nucifera* L.) and shallot (*Alium cepa* L.) as natural growth regulators on the seed germination of Katokkon pepper.

Methods

The materials used in this study were the Katokkon pepper seeds, coconut water, shallot, blender, sieve, aquadest or distilled water, composted soil, seeding containers (pots), and water sprayer, cotton, and tissue. The method used in this study was an experiment with a completely randomized design using control and six treatments with three replications (Un et al., 2018). Thus, in this study there were control (P0) and six treatment variations, as follows: coconut water concentration 25% (P1), coconut water concentration 50% (P2), coconut water concentration 75% (P3), shallot concentration 25% (P4), shallot concentration 50% (P5), and shallot concentration 75% (P6). The seeds of Katokkon pepper used were taken from healthy and ripe Katokkon fruit, marked by the color of the fruit body which is completely red. The seeds were washed and dried for about five to seven days. Stock solutions of natural growth regulators were prepared in the following steps:

Coconut water

Healthy young coconuts were split, and the water was taken. The coconut water was used to make three types of treatment solution concentrations with each volume of 200 ml. Coconut water solution with a concentration of 25% was made by mixing 50 ml of coconut water with 150 ml of distilled water. A 50% concentration of coconut water solution was prepared by mixing 100 ml of coconut water with 100 ml of distilled water. A solution of 75% coconut water was prepared by mixing 150 ml of coconut water with 50 ml of distilled water.

Shallot

Fresh and healthy shallot were peeled off the dry outer skin and then washed. Shallot was mashed using a blender and squeezed out the juice or extract then used as a stock solution with a concentration of 100%. The stock solution was used to make three types of treatment solution concentrations with each volume of 200 ml. The shallot solution with a concentration of 25% was prepared by mixing 50 ml of shallot juice with 200 ml of distilled water. Shallot extract solution with a concentration of 50% using 100 ml of shallot juice and 100 ml of distilled water. The red shallot extract solution with a concentration of 75% used 150 ml of shallot juice and 50 ml of distilled water.

The natural growth regulators solutions were put in the flacon bottles with three repetitions. The aquadest solution was used as a control with three repetitions. Each flacon bottle was filled with ten Katokkon pepper seeds, then soaked for 24 hours, washed with water, and drained. The seeds were sown in seedling containers (pots) that have been filled with organic growing media. During seeding, the growing medium was watered daily using enough water in a sprayer with an equal volume for each treatment. In this study, there were two variables that became the focus of observation, namely germination percentage, and germination rate. Calculation of germination percentage obtained from (Chuwang et al., 2019): (Number of sprouts/Number of seeds planted) x 100%. The germination rate was calculated by (Un et al., 2018): germination percentage divided by the time interval or etmal (7 days or a week). The data obtained in this study were analyzed using one-way ANOVA (α = 5%) and followed by the Duncan Multiple Range Test (DMRT) on the SPPS 22 Program.

Results

In Table 1, the germination of Katokkon pepper seeds treated with natural growth regulators reached a percentage of 60% to 100%. The coconut water treatment with a concentration of 75% (P3) produced the highest percentage of germination, but showed no significant differences with the control (Table 1). Both types of natural growth regulators, namely the coconut water and shallot extract, showed an increase in germination which was in line with the concentration used. In coconut water, the lowest germination rate of 67% was found in the P1 treatment which was the lowest

concentration (25%). The same effect was found in the shallot extract, the lowest germination rate of 60% was obtained in the P4 treatment which was a 25% concentration. However, the increase in germination was seen to be more significant in the coconut water than the shallot extract.

Table 1. The germination percentage and germination rate of Katokkon pepper seeds treated with natural growth regulators.

Treatment	Results	
	Germination percentage (%) ± SD	Germination rate (% *etmal*)
Control (P0)	90.00 ± 17.32^{ab}	6.83^{ab}
P1	66.67 ± 15.28^{ab}	4.71^{a}
P2	70.00 ± 26.46^{ab}	5.71^{ab}
P3	100.00 ± 0.00^{b}	8.41^{b}
P4	60.00 ± 36.06^{a}	4.92^{ab}
P5	66.67 ± 5.77^{ab}	3.68^{a}
P6	73.33 ± 11.5^{ab}	3.78^{a}

Note: The different letters following the numbers within a column indicate a significantly different at P <0.05

Based on Table 1, it can be seen that the coconut water treatment with a concentration of 75% (P3) also produced the highest value of germination rate, but showed no significant differences with the control. However, the coconut water treatment with a concentration of 75% (P3) showed significant differences with the concentration of 50% (P5) and 75% (P6) of shallot extract treatments. In Figure 1, it can be observed that the coconut water treatment with a concentration of 75% (P4) again showed the highest value of germination rate in all time intervals, namely 1st week, 2nd week, and 3rd week. Then, it followed by the control and the others treatments.

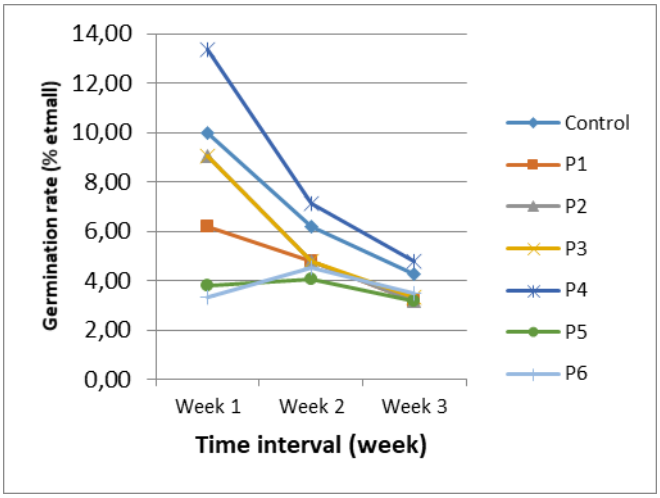

Figure 1. Germination rate of Katokkon pepper seeds treated by natural growth regulators. Note: Control (P0), P1 (coconut water concentration 25%), P2 (coconut water concentration 50%, P3 (coconut water concentration 75%), P4 (shallot concentration 25%), P5 (shallot concentration 50%), P6 (shallot concentration 75%).

Discussion

In this study, we found that there was no significant difference between the control and the treatment of both natural regulators, namely coconut water and shallot extract in the germination percentage and germination rate of Katokkon pepper seed. However, the higher the concentration of coconut water and shallot used, the more positive results were obtained regarding the germination percentage. In particular, in the treatment of coconut water, it was also found that the greater the concentration used, the higher the

germination rate achieved. This is due to the increasing content of nutrients and growth regulators contained in the given treatment. Young coconut water has been known to contain several phytohormones or growth regulators that play a very important role in the process of seed germination or plant growth including gibberellins, cytokinins, and auxins (Irwanto et al., 2019). Not only growth regulators, but coconut water also contains sugar, minerals, vitamins, and amino acids so that it further supports nutrient needs in triggering germination and plant growth, and can be used as a growth medium for other organisms such as bacteria (Prades et al., 2012; Barlina, 2004). The results of other studies also showed that in cayenne pepper plants, the use of 50% coconut water which was the highest concentration had a good effect on plant height, plant leaf width, leaf number, and leaf color (Prianti et al., 2017). Coconut water has a high capacity to improve seed vigor which resulted in high germination percentage and growth of pepper (Chuwang et al., 2019). Research also reported that medium with coconut water treatment of 150ml/l and 200ml/l resulted in the early germination and highest germination percentage on the Dendrobium orchid seed (Sumantra & Widnyana, 2011). Soaking with coconut water significantly affected the growth variables of the Christmas palm seedlings because it gave a better effect on the percentage of germination, the plant height, and the number of leaves (Trisnaningsih & Wahyuni, 2020).

The use of coconut water to stimulate seed germination can be applied differently to each type of plant and combined with other ingredients. The research reported that the coconut water combined with $AgNO^{-3}$ resulted in significantly higher production of elongated rooted shoots of *Capsicum annuu*m L. (Mythili et al., 2017). The Arabica coffee beans treated in the form of a mixture of a solution of 100% coconut water and 20% H_2SO_4 produced the largest average germination rate of 86.66%, which was significantly different from the control and other treatments (Hedty et al., 2014). In orchids, 92% germination success was reported in seeds cultured with MS media containing 20% coconut water and 2gr/L peptone (Utami & Hariyanto, 2016).

Soaking Katokkon pepper seeds using shallot extract with a concentration variation of 25% to 75% resulted in a 60% to 73% germination percentage. Similar to the effect of coconut water, the higher the concentration of shallot extract used the greater germination percentage of Katokkon pepper seeds obtained. But, the same result and effect was not found in terms of germination rate or seed growth speed. Soybean seed soaking with shallot extract concentrations of 40% to 100% can increase the value of germination, vigor index, maximum growth potential, seed growth speed, plant height, and the number of leaves (Lestari et al., 2020). The sandalwood seed germination achieved 70%, as the highest percentage, after soaking in shallot or shallot extract which functions as a phytohormone that is useful in the process of plant growth and development (Djawa et al., 2020). The application of 40% shallot extract combined with 40% bamboo shoot extract increased the root dry weight of the binahong plant (Manurung et al., 2020). The shallot extract also was effective to increase the germination rate, the fresh weight and the dry weight of melon plant (Yunindanova et al., 2018).

In our study, the effect of natural growth regulators of coconut water and shallot extract on the germination of Katokkon pepper seeds has not been seen significantly. But, many studies have been reported the significant effect of coconut water and shallot extract in the seed germination. In sandalwood, treatment with shallot extract and coconut water also increased the percentage of seed growth by 70% and 60%, respectively, which was different from the controls (Djawa et al., 2020). Coconut water and shallot extract are sources of natural growth regulators that have been widely used in plant cultivation efforts. Coconut water contains natural ingredients such as auxin hormones, cytokinins, and gibberellins which play a very important role in providing a stimulus for the growth and germination of a plant (Hedty et al., 2014). The minerals, cytokinins, auxins, phosphorus, and gibberellins in coconut water are useful for accelerating the process of cell division, development of plant embryos, and stimulates the growth of shoots and roots (Ernawati et al., 2017). Moreover, shallot also are a source

of the hormone auxins, which has functions in the process of cell development, root growth, phototropism, geotropism, parthenocarpy, apical dominance, callus formation, and respiration (Kurniati et al., 2017). Auxins are compounds that influence cell enlargement, bud formation, and root initiation so it is commonly applied to stimulate root growth and used along with cytokinins for mass propagation in culturing tissue plants (Ogunyale et al., 2014). Not only auxin and cytokinins, but the gibberellins also promote seed germination. It affects the enzyme production that mobilizes food production used for the growth of new cells by modulating chromosomal transcription (Ogunyale et al., 2014). The physiological processes in the plant can be influenced by growth regulators substances in low concentrations and it is commonly used for soaking the seeds to stimulate the germination process (Darojat, 2014).

The effect of natural growth regulators on seed germination may be influenced by the type and age of the material used. This may be one of the factors that influence our results. In this study, the material used was the young coconut. The young coconut water contains higher natural growth regulators than old ones, which includes gibberellins (0.460 ppm GA3, 0.22 ppm GA5, 0.053 ppm GA7), cytokinins (0.441 ppm kinetin, 0.247 ppm zeatin), and auxin (0.237 ppm IAA) (Zuhro et al., 2017). Young coconut water has higher natural growth regulators because that substance tends to be produced in young tissues that are still actively dividing (Kristina & Syahid, 2012).

Conclusions

The treatment of natural growth regulators, namely coconut water and shallot extract, showed no significant effect on the percentage and rate of seed germination of Katokkon pepper. The higher the concentration of natural growth regulators used, the higher germination percentage obtained. The coconut water treatment with a concentration of 75% (P3) showed significant differences with the shallot extract treatment with concentration of 25% (P4) in the germination percentage. It also showed significant differences with the concentration of 50% (P5) and 75% (P6) of shallot extract treatments in the germination rate.

Declaration statement

The authors reported no potential conflict of interest.

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