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Improvement on the quality of chilli (*Capsicum annum L.*) seedlings through seed immersion in Supergib solution

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Abstract. This study aims to obtain the best supergib concentration and immersion ime that affect the growth of chili plant seeds. The study consisted of two stages, namely viability and vigor test of seeds which was carried out at the Laboratory of Plant Breeding and Seed Science, Department of Agronomy, Faculty of Agriculture, Hasanuddin University. The second stage is the chili plant nursery which is held at the Faculty of Agriculture, Hasanuddin University, Makassar. The study was conducted from December 2019 to February 2020. This study used a two-factor factorial randomized block design, with the concentration of supergib as the first factor consisted of 4 levels, namely 0 ppm, 10 ppm, 15 ppm and 20 ppm. The second factor was the length of soaking time which consisted of 3 levels, namely 6 hours, 9 hours, and 12 hours. The results show that the 10 ppm supergib concentration and 12 hours of soaking the seeds gave the best results at the growth rate of 19.35% and the supergib concentration of 15 ppm and the duration of soaking for 9 hours gave the best results on the primary root length of the sprouts (3.68 cm), plant height (11.77 cm) and the number of leaves (6.67). Soaking time for 6 hours resulted in the highest average germination capacity of 65%, and treatment for 9 hours of immersion resulted in the highest growth simultaneous value of 25.67%.

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1. Introduction

Chili (*Capsicum annum L.*) is one of the horticultural commodities which is quite important for the people of Indonesia because of its role as a complementary spice in cooking. Apart from being used as a complementary spice in cooking, chili plants are also widely used in the pharmaceutical sector such as making balms and in the foodstuff industry, for example making sauces. Chili contains nutrients including calories, protein, fat, carbohydrates, calcium, vitamins A, B1 and C [1].

The need for chili for big cities with a population of one million or more is around 800,000 tons / year or 66 tons / month. On holidays or religious days, the need for chilies usually increases by around 10% -20% of normal needs [2]. The need for this industry per day reaches 100 tons of large chilies [3].

Based on the Trade Assessment and Development Agency [4], the national production of large chilies in 2016 was 27,638 tonnes. In 2017, the total production was 32,289 tons. In 2018, it decreased by 26,944 tons for total production and in 2019 it increased to 29,090 tons. Meanwhile, the total consumption of chilies is estimated to increase every year, namely in 2016 of 2.90 kg / capita / year, in 2017 it was 2.95 kg / capita / year, in 2018 it was 3.00 kg / capita / year, and in 2019 it was amounting to 3.05 kg / capita / year. The imbalance between the need for chili plants and its production can be caused by less than optimal seeds, which causes reduced plant availability.

Plant conditions are carried out by plant propagation. The propagation of chili plants is done generative or using seeds. Cultivation of chili plants according to GAP (Good Agricultural Practicite) is



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to go through the nursery stage [5]. However, in the nursery process, chili plants often experience problems, especially in the process of seed germination.

Increasing the ability of seeds to germinate can be done by giving treatments to stimulate the seed germination. One of the efforts that can be made to overcome the problems that occur in the process of plant germination is to provide growth regulating hormones / substances. Growth regulators function to induce and assist plant process [6]. Hormone application to seeds is done by soaking the seeds using plain water or using water that is given treatment. One of the treatments that can be done in soaking the seeds is to provide growth hormone. Gibberellin is a growth regulator that can accelerate germination [7, 8].

Supergib is a plant growth hormone that contains 20% gibberellin which functions as a growth regulator and can be used to stimulate the germination process of seeds. The more recommended use of supergib is 1 supergib tablet weighing 5 grams dissolved in 50-100 liters of water. Mukti [9] in his research revealed that the concentration of gibberellin solution concentration of 20 ppm and soaking time for 6 hours was able to increase the proportion of maize seed germination by 37.78%. Ayuningtyas et al. [10] found that immersing the pine seeds for 9 hours can increase germination by 88%. Another previous study [11] found the best concentration and duration of soaking soursop seeds using gibberellin was at a concentration of 15 ppm for 12 hours which can increase the proportion of germination up to 100%. Soaking gibberellins against hard-skinned ones can be done to speed up the germination process and increase the growth regulators absorbed by the seeds so that they can accelerate germination.

Soaking the seeds aims to break the seed dormancy. Seeds with low water content can reduce the germination rate [12]. Broken dormancy in the soaked seeds occurs because of the imbibition process in the seeds. Imbibition is the process of absorption of water by hydrophilic substances that cause the substance to expand after absorbing water. The process of immersing the solution in the seeds causes the embryo and endosperm to expand. The development of the embryo and endosperm causes the rupture of the seed coat. After the seed coat breaks, the water will provide facilities for the entry and exit of oxygen from the seeds. The dry cell wall is almost not permeable to gas, but if there is an imbibition of the seeds, the gas will diffuse into the cell [13].

Soaking seeds can stimulate or speed up seed germination. Soaking the seeds in a gibberellin solution has been shown to increase the value of the seed growth rate. Seeds soaked in gibberellin solution with the right concentration and time found to affect the seed imbibition process [14]. The longer the seeds are soaked, the more optimum in increasing the speed of seed growth. According to research by Kurniawan [15], soaking the seeds in gibberellin solution for 18 hours showed that the seed growth rate was higher than other treatments which were lower.

Based on the description above, the recent research was carried out to study the effect of growth regulators in supergib and the duration of immersing the chili seeds on germination and growth of chili at early stage.

2. Methodology

2.1. Place and time

This research consisted of two stages, namely the first stage was the viability and vigor test of seeds carried out at the Laboratory of Plant Breeding and Seed Science, Department of Agricultural Cultivation, Faculty of Agriculture, Hasanuddin University. The second stage is the nursery which is held at the Faculty of Agriculture, Hasanuddin University, Makassar. This research was conducted from December 2019 to February 2020.

2.2. Tools and materials

The tools used in this study were analytical scales, 200 mL beaker glass, 12 mL spoit, glass, plastics, spoons, petri dishes, paper straw, tweezers, polybags 12 cm x 8 cm in size, ruler, label paper, stationery, and a camera. While materials used in this study were Supergib (20% Giberelin) chili seeds, compost, soil, aquades, and water.

2.3. Research methods

The study was conducted using a two-factor factorial randomized block design. The first factor is the concentration of supergib which consists of 4 levels, namely: K0 = 0 ppm, K1 = 10 ppm, K2 = 15 ppm, and K3 = 20 ppm. The second factor is the immersion time which consists of 3 levels, namely: L1 = 6 hours, L2 = 9 hours, and L3 = 12 hours. Thus, there were 12 treatment combinations that were repeated 15 times resulting in 36 experimental units. Data analysis was performed using analysis of variance with a significance level of 0.05%. The follow-up test was carried out using Tukey's test at confidence level of 5% if the F test results show a significant difference.

2.4. Preparation of supergib solutions

Preparation of a 10 ppm supergib solution was carried out by dissolving 0.010 grams of supergib using 1000 mL of distilled water. The 15 ppm supergib solution was made by dissolving 0.015 grams of supergib using 1000 mL of distilled water. The 20 ppm supergib solution was made by dissolving 0.020 grams of supergib using 1000 mL of distilled water.

2.5. Treatment application

The seeds were immersed in a supergib solution for 6 hours, 9 hours, and 12 hours with a concentration of 0 ppm, 10 ppm, 15 ppm and 20 ppm. The seeds are soaked in plastic cups that have been labeled with treatment. This study used the Test on Paper method using bamboo paper. The straw paper substrate was cut in a circle to adjust the diameter of the petri dish. The paper strips are placed in a petri dish and saturated using water. Then, the seeds are neatly arranged on the paper as much as 25 seeds using tweezers.

After the planting medium is ready, the seeds that have been treated are planted in polybags according to their respective treatments. The seeds are treated for up to 25 days. Nursery planting media is done using soil and compost in a ratio of 2: 1. Soil and compost are mixed and put in polybags measuring 12 cm x 8 cm.

3. Results and discussion

3.1. Effect of supergib solution on the germination of chili

Immersion of chili seeds in supergib solution had as significant effect on germination percentage and the uniformity of the seedlings to germinate. However responses were varied with the soaking period (table 1).

Table 1. Average of germination percentage (%) and uniformity (%) of Chili (*Capsicum annum* L.) seeds at different Supergib Concentration and Duration of Soaking.

Immersion time in Supergib Solution	Germination percentage (%)	Germination Uniformity (%)
6 hours	65.00 a	21.00 b
9 hours	60.33 ab	25.67 a
12 hours	59.67 b	24.67 a
Tukey's $\alpha_{0.05}$	5.22	0.35

Numbers followed by the same letter (a, b) are not significantly different based on Tukey's test at the confidence level of $\alpha_{0.05}$.

The treatment of duration of seed immersion had a significant effect on germination and subsequent growth. The results show that the highest average germination rate was obtained in the 6 hours soaking time of the seeds, namely 65% (table 1). Meanwhile, for the average growth synchronization, the best treatment that produced the highest value was the 9 hours soaking time of the seeds with the highest growth synchronization percentage of 25.67%.

The germinability of the seeds for 6 hours of immersion and simultaneous growth of the seeds for 9 hours of immersion had the highest rates to give the best results for the ability of seeds to germinate. This happens because the duration of soaking the seeds will activate cell function and make the absorption of growth regulators more effective. So that it can increase germination. The seeds are soaked for too long will cause the seeds to lack oxygen and inhibit cell activity.

This is in accordance with the statement of Asra [16] that soaking the seeds is done to speed up the germination process. The process of imbibition of water into the seeds to initiate germination takes a certain amount of time. It is hoped that the longer soaking the seeds will increase the growth regulators absorbed by the seeds so that they can accelerate germination and increase the percentage of germination power. In addition, Polhaupessy [11] stated that during the germination process, cell activity will continue. However, this cell activity still requires oxygen so that the seeds are soaked for too long it will result in a lack of oxygen being absorbed by the seeds which makes it difficult for the seeds to germinate. The availability of oxygen in the seeds will affect the strength of seed growth which will automatically affect the synchronization of seed growth.

3.2. Effect of supergib solution on the growth of chili seedlings

A significant interaction between concentration and soaking period was found in affecting the growth of chili seedlings. Soaking the seeds in the supergib solution at a concentration up of 10 ppm for 12 hours increased the germination rate of chili (table 2) compared to control. Similarly, increased in seedlings growth at the later stages also observed in the higher concentration and longer soaking duration indicated by the parameters of primary root length, seedling height and number of leaves.

Table 2. Effect of supergib concentration and duration of soaking on the average of germination rate (% / etmal), primary root length (cm), seedlings height (cm) and leaves number (leaves) of chili (*Capsicum annum L.*).

Supergib Concentration	Duration of soaking			Tukey's _{0.05}
	6 hours	9 hours	12 hours	
Germination Rate (% / etmal)				
0 ppm	11.03 c	9.39 c	13.30 bc	3.41
10 ppm	11.90 bc	12.55 bc	19.35 a	
15 ppm	13.75 bc	14.19 bc	13.25 bc	
20 ppm	11.82 bc	13.20 bc	14.46 b	
Seedlings primary root length 14 DAP (cm)				
0 ppm	1.91 c	2.02 c	2.74 b	0.52
10 ppm	3.08 b	2.20 c	2.67 bc	
15 ppm	3.47 ab	3.68 a	3.66 a	
20 ppm	3.59 ab	3.02 b	3.36 ab	
Seedling height 25 DAP (cm)				
0 ppm	9.22 c	8.50 c	10.21 bc	1.15
10 ppm	10.29 bc	9.50 bc	10.53 b	
15 ppm	9.41 bc	11.77 a	10.47 b	
20 ppm	8.90 c	9.00 c	10.26 bc	
Number of Leaves 25 DAP (leaves)				
0 ppm	5.67 bc	5.22 c	5.56 bc	0.55
10 ppm	5.33 c	5.33 c	6.11 b	
15 ppm	5.78 bc	6.67 a	6.00 b	
20 ppm	5.44 bc	5.67 bc	6.22 ab	

Numbers followed by the same letter (a, b) are not significantly different based on Tukey's test at the confidence level of $\alpha 0.05$.

The results showed that the growth rate parameter obtained the highest value, namely the treatment of the concentration of growth regulators of 10 ppm and the duration of immersion for 12 hours, namely 19.35% / etmal. The primary root length of sprouts, plant height and number of leaves, obtained the highest average value at the concentration of growth regulators of 15 ppm and immersion time of 9 hours, namely 3.68 cm at the length of the primary root, 11.77 cm for plant height and the number of leaves 6.77 (table 2).

The increase in seed growth rate occurred due to the soaking of the seeds using a supergib solution that contained gibberellins at a concentration and time that made it easier for the embryo to develop, thus affecting the speed of seed growth. Rusmin et al. [17] stated that one of the physiological effects of growth regulators with gibberellin content is to encourage the activity of hydrolytic enzymes in the process of seed germination. During the germination process, the developing embryo releases gibberellins into the aleurone layer. Then the enzyme enters the endosperm and hydrolyzes starch and protein as food for embryo development.

Data on the seedling growth proved that the increase in root length is directly proportional to plant height, and the number of leaves because gibberellin plays a large role in various plant physiological processes. Gibberellins not only break seed dormancy, but also stimulate germination and promote growth. Soaking the seeds and using a gibberellin solution have an effect on plant height and leaf number. Soaking the seeds in a solution will cause the seed coat to soften so that it is more permeable to water and oxygen. This will make it easier for the seeds to absorb the gibberellin solution.

Soaking seeds using gibberellin is known to be able to increase plant growth because one of its roles is to stimulate cell division which will be associated with the extension of plant canopy or stems, leaves and plant roots. This is in accordance with the statement of Yasmin et al. [18] that soaking seeds in gibberellin solution can increase seed germination, shoot growth, stem elongation, leaf growth, affect plant growth and root differentiation.

Gibberellins affect genetic traits and physiological processes in plants such as the mobilization of carbohydrates during germination. In vegetative growth, plant development depends on cell division. Gibberellin is able to stimulate cell division activity in stem and cambium meristems and stimulate cell enlargement so that it can accelerate the growth of stems and leaves in plants [16]. Gibberellin is not only useful for stem extension but also functions in the growth of all plant organs including leaves and roots [8, 19].

13 4. Conclusion

Based on the results of the experiments that have been carried out, it can be concluded that the best treatment for supergib concentration and soaking time for chili seeds was 15 ppm and 9 hours.

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