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EFFECT OF SOAKING TIME AND CONCENTRATION OF GIBERELIN (GA_3) ON THE GROWTH OF GARLIC (*Allium sativum*) VAR. SANGGA SEMBALUN

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ABSTRACT

This study aims to determine the germination of garlic (*Allium sativum*) var. Sangga sembalun to the treatment of soaking time and GA_3 concentration. This research was conducted in the field of planting in Sukandebi Village, Naman Teran District, Karo Regency. This research was conducted from March to July 2022. The research design used was a factorial completely randomized design (CRD) with 2 factors and 4 replications. The first factor is the soaking time of GA_3 which is 12 hours and 24 hours. The second factor was the concentration of GA_3, namely 0 ppm, 3 ppm, 6 ppm, 9 ppm, and 12 ppm. The parameters observed consisted by time of seed germination, germination percentage, sprout height, and root length. The data obtained from this study were analyzed by analysis of variance (ANOVA) and to determine the best treatment, Duncan Multiple Range Test (DMRT) was conducted at the 5% significance level. The results of the study showed that the soaking time and GA_3 concentration on garlic var. Sangga sembalun significantly affected all parameters of observation which are time of seed germination, germination percentage, sprout height, and root length. The results showed that the soaking time of garlic var. Sangga sembalun for 24 hours was able to speed up the time of emergence of sprouts, germination percentage, sprout height, and root length. The concentration of 15 ppm GA_3 can accelerate the time to sprout and increase the percentage of germination, while the concentration of 9 ppm GA_3 increases the sprout height and root length.

Introduction

Garlic (*Allium sativum*) is one type of horticultural crop commodity whose market demand will continue to increase along with the increasing rate of population growth rates. The reason is because garlic is widely used in everyday life such as seasoning ingredients that almost all dishes use garlic as a flavoring ingredient. Unfortunately, the increasing needs of the community have not been matched by an increase in the amount of garlic production in this country. Sangga Sembalun garlic is one of the local garlic from Indonesia produced by the West Nusa Tenggara region (Hadiawati & Nazam, 2021). According to Titisari (2019) the color of the bulbs is whitish purple and has a strong scent compared to common garlic.

The use of garlic bulbs from harvest in propagation techniques also sometimes problem experiences such as garlic bulbs experiencing dormancy so that they are not

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ready to be replanted. Dormancy is a form of natural plant adaptation to an environment that is not suitable for plant growth and development. This dormancy condition can occur in plant organs, namely seeds, bulbs and shoots. Dormancy that occurs in seeds or bulbs can cause seeds to not germinate even in a good environment (Yuniarti, 2015). If the bulbs cannot germinate due to dormancy, then there is no growth and development of the plant. That is because germination is the beginning of plant development and growth.

Garlic bulbs that experience long dormancy result in a long planting time. Garlic in Indonesia has a dormancy period of about 5-6 months, so that the length of garlic dormancy time can limit the planting period so that it can affect the amount of production. Dormancy in garlic can be caused by low endogenous hormone activity and high inhibitor activity contained in the bulb itself (Mantoko and Kurnia, 2019). Therefore, special treatment is needed to break the dormancy which aims to reduce inhibitors or growth inhibitors.

There is a way to shorten the dormancy period of plants through the treatment of giving Plant Growth Regulators (PGR) (Puspitasari et al., 2020). Giving synthetic PGR to garlic bulbs aims to accelerate plant growth and development. The type of synthetic PGR that can be given is gibberellin. According to Mutakin (2008), gibberellins are compounds needed by plants to accelerate the germination process, stimulate stem and leaf growth, shoot development, and stimulate flowering (Sari, 2019). Gibberellin can speed up the germination process, because the seeds lose their dormancy period so that the seeds will be easier to germinate (Tetuko et al., 2015).

The results showed that the application of gibberellin can accelerate growth and shorten the dormancy period, including in shallots with a combination of concentration and soaking time of gibberellin in shallot bulbs had a significant effect on increasing sprouting power which has been done by Setiawan, et al (2021), where a concentration of 2-8 ppm soaked for 12-24 hours can produce good sprouting power compared to no treatment. In observing the growth of shallot seeds soaked at a concentration of 4 ppm for 24 hours can increase the height of good sprouts.

Materials and Methods

Materials

The materials used in this study were Sangga Sembalun garlic, humus soil, compost, distilled water, GA_3, and insecticides. This research was supported by tools including polybags, measuring cups, glass funnels, glass stirrers, drop pipettes, labels, analytical scales, rulers, cellphone camera, stationery, and sprayer.

Methods

The research was conducted in the field in Sukandebi Village, Naman Teran District, Karo Regency, North Sumatra from March to July 2022. The research design used was factorial CRD using two factors, namely soaking time and GA_3 concentration. The data collection method used observation or direct observation. Data were taken during the germination process, namely when sprouts appeared, germination percentage, sprout height and root length. This research was conducted with the following research procedures:

a) Preparation of Garlic Seeds

The seeds used in this study are garlic var. Sangga Sembalun taken from the previous harvest. The criteria for the selected bulbs have bulb skin that is not wrinkled, has a normal shape in general, has not appeared buds from the tip of the bulb clove and is not infected with pests or other diseases.

b) GA_3 Immersion Treatment

The treatment given was the immersion of bulbs into GA_3. First, made a GA_3 stock solution as much as 250 mg/L, then diluted by adding distilled water to reach concentrations of 0 ppm, 3 ppm, 6 ppm, 9 ppm, 12 ppm, and 15 ppm. Soaking was carried out by preparing 12 containers and then filling them with GA_3 solution according to the concentration. Twelve containers were separated into two groups to separate the soaking time for GA_3 between 12 and 24

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hours. Then put as many as 12 garlic seeds into each container.

c) Seeding

Preparation of seedling media, namely polybags filled with humus soil that has been mixed with manure in a ratio of 2: 1. Seedling media that are all ready are then given Gliotrico brand biofertilizer to accelerate the ripening of the manure so as to produce mature compost and increase soil fertility. The Sangga sembalun garlic seeds that had been given the GA_3 treatment were then sown directly into polybags. The seeds were inserted into the planting holes ± 5 cm deep by planting them 2/3 of the bulb height. A total of 3 seeds were planted in one polybag for each treatment.

d) Thinning of Seedlings

Thinning was done by leaving one seed that had grown into a sprout in a media polybag and leaving 48 sprouts as a representative of each treatment for growth observation samples.

e) Maintenance

Maintenance activities include weeding and watering twice a day in the morning and evening.

f) Observation

Observations were made by looking directly every day to observe the time of seed germination and the percentage of germination for 14 days and observations of sprout height and root length were made after 40 DAP. The observation parameters of the study included sprout emergence, sprout percentage, sprout height, and root length.

1. Time of seed germination (days)

The time of emergence of sprouts was observed every day from the 1st, 2nd, 3rd, ..., to the 14th day after planting (DAP).

2. Germination percentage (%)

This observation was made on the 14th day after planting, Sutopo (2004) determined the formula used to calculate the germination percentage as follows:

$$\text{Germination percentage} = \frac{\sum normal\ germination}{\sum seed\ germination} \times 100\%$$

3. Sprout Height

Sprout height was measured when the garlic plants were 40 days after planting. Sprout height was measured from the base of the stem to the top of the leaf. Height measurement is done with the help of a ruler.

4. Root length

The measurement time for root length is the same as the height of the sprout, that is, when the plant is 40 days after planting. Root length measurement is done by removing the plant from the planting medium and then measuring it using a ruler. Root length was measured starting from the base of the root to the tip of the lowest root.

The research data obtained were analyzed using analysis of variance, then followed by the DMRT test at the 5% level if Fcalculation > Ftable (α=0.05)

Results and Discussion

Time of seed germination

Tabel 1. F value calculation of the soaking time and concentration GA_3 on the observation variable

Treatment	Variable observed	F-value	
		F-calculation	F-table
Soaking time GA_3	Time of seed germination (day)	5,629787*	4,11317
	Germination percentage (%)	6,52292*	4,1132
	Sprout height (cm)	42,9178**	4,11317
	Root length (cm)	47,2341**	4,11317
	Time of seed germination (day)	56,57106**	2,47717

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Concentration GA3	Germination percentage (%)	7,62006*	2,4772
	Sprout height (cm)	115,321**	2,47717
	Root length (cm)	422,678**	2,47717

Description: * = significant of α= 0,05; **= really significant of α= 0,05

The results of calculations using analysis of varians obtained that the value of Fcalculation > Ftable 5% means that the provision of two treatments soaking time GA_3 and five treatments concentration GA_3 is significantly different or significant. Giving soaking time and concentration GA_3 treatments have a real difference that affects the time of emergence of sprouts of Sangga sembalun garlic seeds (*Allium sativum*).

Tabel 2. DMRT Analysis

Treatment	Variable observed			
	Time of seed germination (day)	**Germination percentage (%)**	**Sprout height (cm)**	**Root length (cm)**
Soaking time				
12 hours	6,70833 a	69,45 a	25,5875 a	12,1208 a
24 hours	5,83333 b	83,3417 b	27,3667 b	13,1917 b
Concentration				
0 ppm	12 d	45,825 a	19,913 a	7,213 a
3 ppm	8 c	66,675 b	24,963 b	8,6 b
6 ppm	6,25 b	75,0125 bc	27,688 c	12,763 c
9 ppm	5,125 b	83,35 bcd	29,638 d	16,763 e
12 ppm	3,75 a	91,675 cd	28,525 c	15,4 d
15 ppm	2,5 a	95,8375 d	28,138 c	15,2 d

The results of the DMRT follow-up test at a significance level of 5% by giving two treatments of 12 hours and 24 hours of soaking time were able to increase the time of seed germination. The GA_3 soaking time given to Sangga Sembalun garlic seeds for 24 hours resulted in a faster average germination time of 5.83 DAP compared to 12 hours of soaking. Giving various concentrations of GA_3 can speed up the emergence time of Sangga sembalun garlic sprouts. GA_3 with a concentration of 15 ppm produces the fastest average sprout emergence time of 2.5 DAP. GA_3 is able to break the dormancy period of garlic bulbs var. Sangga sembalun, because GA_3 given from outside increases the performance of endogenous gibberellins from garlic bulbs so that the performance of inhibitory substances decreases and finally germination of seeds can take place (Mantoko et al., 2019). Soaking seeds in gibberellin solution aims to incorporate growth regulators into the cotyledons so that the germination process can occur. The beginning of the germination process is characterized by imbibition of water into the seed. Imbibition can occur because the water potential outside the seed is higher than the water potential inside the seed, so the water will move into the seed. (Romdyah et al, 2017).

Asra (2014) argues that the longer the soaking is done, the longer the seed imbibition process will be, so that more water and gibberellins enter the seed. Seeds that were soaked in gibberellin solution entered through the germpore where the operculum had been cracked.The presence of water and gibberellin makes the imbibition process so that the

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germination process increases. Gibberellin increases the activity of of synthesizing enzymes, especially α-amylase enzyme related to hydrolysis. The α-amylase enzyme is responsible for breaking down carbohydrates in the seed to produce energy during the germination process.

Germination Percentage

The results of the analysis of variance showed that soaking and GA_3 concentration were significantly different on the percentage of Sangga sembalun garlic germination. The average percentage of germination of Sangga sembalun garlic increased along with the longer the garlic seeds were soaked in GA_3 solution. The 24-hour soaking treatment gives the highest percentage value of germination which is 83.3417% compared to the 12-hour soaked only 69.45%. The average percentage of Sangga sembalun garlic germination also increased along with the higher concentration of GA_3 given. The average percentage of germination of 15 ppm GA_3 concentration increases the percentage of germination by 95.8375%, when compared to the control, the percentage of germination is very low, which only reaches 45.825%. This means that GA_3 is able to increase the percentage of Sangga sembalun garlic seed germination which is indicated by the high percentage value of germination at all concentrations compared to treatments that do not use GA_3.

Supardy (2016) concluded that the length of soaking and the concentration of gibberellin (GA_3) had an effect in increasing germination. Research by Herawati & Alfandi (2013) showed that 24 hours of soaking treatment can give a significant effect on germination. GA_3 given externally is able to change the internal gibberellin level contained in the seed, this level will be the trigger for the germination process. GA_3 is able to help accelerate the breaking of dormancy of garlic seeds var. Sangga sembalun and increase the division and elongation of embryo cells after the breakdown of food reserves in the seeds, so that the seeds will germinate more quickly (Tetuko et al., 2015).

Sprout height

The results of the analysis of variance showed that the soaking time and GA_3 concentration were both significantly different to the height of the sprouts at 40 DAP. The treatment of soaking time on the height of Sangga sembalun garlic sprouts 40 DAP shows that it is able to increase the height of the sprouts. The treatment of soaking time for 24 hours produced the highest sprout height of 27.3667 cm compared to soaking for 12 hours.

The highest average sprout height occurred in the 9 ppm GA_3 treatment which amounted to 29.638 cm, while the lowest average sprout height in the treatment that was not given GA_3 or control which amounted to 19.913 cm. The effective GA_3 concentration is 9 ppm GA_3 concentration. This is because the 9 ppm concentration of GA_3 is the concentration that produces the best value for the height of garlic sprouts. The higher the concentration, the lower the growth of onion sprouts.

GA_3 soaking can also increase sprout height as the most specific response of most plants given GA_3 from outside. The increase in sprout height is due to an increase in the activity of apical cell division so that cell size will increase (Maharani et al., 2018). This is corroborated by (Pertiwi et al., 2016) which states that the length of soaking will stimulate cell division and elongation of seed cells, resulting in responses to plant physiology such as stem length.

Gibberellin given exogenously makes an interaction between the endogenous hormones of the seed so as to produce a growth response in the form of sprouts that become long. Gibberellin affects the activation of food reserves by producing energy and nutrients followed by protein formation. This energy is then used to form new cells followed by the process of cell differentiation until a plumula is formed as a leaf candidate (Supardy et al., 2016). Sprouts increase in height due to increased activity of apical cell division so that cell size will increase (Maharani et al., 2018).

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Root length

The treatment of soaking time and concentration of GA_3 solution given to garlic seeds differed significantly on root length observed after 40 DAP. Soaking time in GA_3 for 24 hours was able to lengthen the roots which was 13.197 cm. The use of soaking time for 24 hours was 8.12 cm longer than the treatment of soaking for 12 hours. The use of soaking time for 24 hours was 8.12 cm longer than the soaking treatment for 12 hours.

GA_3 concentration of 9 ppm produced the longest root length of 16, 763 cm. When viewed with the control or treatment without using GA_3 solution which has a shorter root length of 7.213 cm. Previous research conducted by Herawati (2013) concluded that the length of soaking soybean seeds that she did for 24 hours was able to provide the highest epicotyl length. This is supported by the statement of Pujiasmanto (2020) that gibberellin as a PGR has the ability to affect seed growth, affect stem elongation and root growth. Exogenous administration of gibberellin makes an interaction between endogenous hormones from the seed so as to produce a growth response in the form of roots that become long. Root elongation is caused by the process of cell division and elongation in the meristematic area, including at the tip of the root. Root growth is very important for sprouts, because the longer and more the number of roots, the better for the growth of the sprouts (Nirmala, 2019).

Conclusion

The treatment of soaking time and concentration GA_3 were significantly different for all observation parameters. Soaking time of 24 hours was able to increase the time of seed germination, germination percentage, sprout height, and root length. GA_3 concentration of 15 ppm was able to increase time of seed germination and germination percentage, while the concentration of 9 ppm sprout height, and root length.

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