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# Breaking Dormancy of Salak Seeds Using Various Concentration and Soaking Time of Gibberellins GA3

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**Abstract:** Dormancy is one of the obstacles in cultivating zalacca plants which have hard skin and seeds making them difficult to grow. Soaking using growth hormones is an alternative for growing seeds well. This research aims to determine the concentration of Gibberellin and determine the appropriate length of soaking time for Gibberellin (GA3) in germinating zalacca seeds. The research was carried out at the Seed Science and Technology Laboratory, Faculty of Agriculture, Tadulako University, Palu in January - February 2023 using a Completely Randomized Design with a factorial pattern. The first factor is the Gibberellin's concentration which consists of 40, 60, and 80 ppm. The second factor was the length of Gibberellin's soaking time which consists of 15, 55, and 95 minutes so that 9 treatment combinations were obtained which were repeated three times to obtain 27 experimental units. Each experiment used 20 seeds, therefore 540 zalacca seeds were needed, with 5 samples per experimental unit. The results show that gibberellin concentrations of 60 ppm and 80 ppm and soaking times of 55 and 95 minutes were treatments that provided good growth in germination capacity, germination time, plumule length, radicle length and dry weight of zalacca seed sprouts.

**Keywords:** Dormancy; Gibberellins; Salak; Soaking time

## Introduction

Salak is one of the horticultural crops that grows well in Indonesia. Salak is also widely favored by the Indonesian people because it has a distinctive taste, namely sweet, astringent, crunchy and also has a high enough nutritional content so that if consumed it is good for health, (Setyawaty et al., 2020; Smith et al., 2023). Salak plants are propagated generatively (using seeds), so they are easy to reproduce massively and also have strong roots and do not easily fall (Anam, C. et al., 2018; Haryoto & E. Priyatno, 2018). Salak plants also have the disadvantage that the seed coat is hard so it takes a long time to germinate (Dewi et al., 2023); (Harahap & E. Jumiati, 2023).

Physical dormancy or hard seed coat on salak seeds causes the water imbibition process to be inhibited so that germination is also inhibited (Nurasih, 2017); (Putri et al., 2021). Water plays a very important role in the germination process because water plays a role in activating embryonic cells in seeds (Asyi'ah et al., 2019; (Matanari et al., 2023).

Therefore, a way is needed to break the dormancy in salak seeds, so that salak seeds can grow quickly. One of them uses chemicals, namely Gibberellin (GA3). Gibberellin (GA3) can break dormancy in hard-skinned seeds by soaking salak seeds in gibberellin solution. Gibberellin is one of the growth regulators that can eliminate dormancy in the seed coat and accelerate the germination process, (Girsang & Harahap, 2021); (Panggabean et al., 2020).

Gibberellins also stimulate seed germination by activating hodrolytic enzymes that can break down food reserves so that these food reserves are easier to utilize by the embryo during germination and also encourage cell elongation so that the plumula can penetrate the seed coat, (Petric´ et al., 2013; (Zadeh et al., 2015).

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The results of research by Kartikasari et al, (2019) showed that germination, maximum growth potential, and the highest seedling height were found in the 60 ppm gibberellin concentration treatment. The highest germination, maximum growth potential, and seedling height were found in the 55-minute immersion treatment. The highest root length was found in the treatment of 60 ppm gibberellin concentration and 55 minutes soaking time.

Thus, it is deemed necessary to conduct research on breaking the dormancy of salak seeds using the concentration and soaking time of Gibberellin (GA3) which aims to determine the appropriate concentration of Gibberellin (GA3) in salak seed germination and to determine the appropriate soaking time of Gibberellin (GA3) in salak seed germination.

## Method

This research was conducted at the Seed Laboratory of the Faculty of Agriculture, Tadulako University, Palu. This research activity took place from January to February 2023.

The tools used in this research are germination tubs, scales, 1000 ml measuring cups, labels, rulers, ovens, stoves, pans, spatulas, sprayers, envelopes, cameras and writing instruments. The materials used were salak pondoh seeds, sand media, distilled water, and Gibberellin powder (GA3).

This research was arranged using a completely randomized design (CRD) with a factorial pattern. The first factor consisted of three levels of Gibberellin concentration namely G1 = 40 ppm, G2 = 60 ppm and G3 = 80 ppm. The second factor consisted of three levels of immersion time, namely LI = 15 minutes, L2 = 55 minutes and L3 = 95 minutes. There were 9 treatment combinations where each treatment was repeated three times so that there were 27 experimental units and each experiment used 20 seeds, thus 540 salak seeds were needed and there were 5 samples of each treatment.

*Research implementation*

*Seed Preparation*

Salak seeds used from Tamarenja Village are salak pondoh from mother trees that are 5 years old and above and bear fruit every year and are resistant to pests and diseases. Ripe fruits were collected and selected, after which the pulp was separated from the seeds. Next, the seeds are washed and dried for one day.

*Preparation of Nursery Media*

The nursery media for salak seeds uses sand media. The sand used is first cleaned from dirt and sterilized or roasted for 30 minutes.

*Preparation of Gibberellin Solution*

Gibberellin solution is made by dissolving gibberellin powder, where the gibberellin powder is weighed with the dose of G1 40ppm (0.04 g), G2 60ppm (0.06 g), G3 80ppm (0.08 g). After that each gibberellin powder that has been weighed is dissolved respectively into sterile water (distilled water) as much as 1000 ml and stirred until the gibberellin powder dissolves into water.

*Giving Treatment*

The seeds that have been cleaned, then put into the gibberellin solution made according to the concentration of each solution, namely G1 40 ppm (0.04 g), G2 60 ppm (0.06 g), and G3 80 ppm (0.08 g). Then soaked for L1: 15 minutes, L2: 55 minutes and L3: 95 minutes.

*Seed Sowing*

The seeds that have been soaked with gibberellin solution and the length of soaking time according to the treatment then the seeds are arranged in the nursery by placing the seeds horizontally on the sand media.

*Nursery Maintenance*

Maintenance includes watering. Watering is done every day in the morning and evening to keep the nursery media moist. Germination was calculated at 6 weeks after planting (MST), by counting the seeds that germinated normally (Sutopo, 2010).

$$\text{Germination} = \frac{\text{number of normal sprouts}}{\text{number of seeds germinated}} \times 100\% \qquad (1)$$

*Germination Time*

The calculation of germination time starts from the first day until the 42nd day after the seeds are planted, by counting the normal germinated seeds on each day (Sutopo, 2010).

$$\text{Germination Time} = \frac{N_1T_1+N_2T_2+N_3T_3+\ldots\ldots+N_xT_x}{\text{Total germinated seeds}} \qquad (2)$$

Description:

WB = Germination time.

N = Number of seeds that germinate at a certain time unit.

T = The amount of time between the beginning of the test until the end of a certain interval of observation.

*Plumula Length*

Measurement of sprout plumula is done at the end of the observation of the dormancy breaking test by measuring the sprout plumula using a ruler from the base of the stem to the growing point.

*Radicle Length*

Observation of radicle length of the sprouts was done at the end of the dormancy observation test by unloading the sprouts in the germination tub. The radicle was cleaned from the remains and then air dried. Afterwards, measurements were taken using a ruler starting from the base of the stem to the tip of the longest radicle.

*Wet Weight of Sprouts*

The calculation of wet weight is done at the end of the observation of dormancy breaking by weighing the sprouts that have been cleaned from the remnants of sand.

*Dry Weight of Sprouts*

Calculation of dry weight was carried out at the end of the observation of breaking dormancy by putting the sprouts in an envelope, then in the oven for 2 x 24 hours at a temperature of 80 ℃ after the oven the sprouts were removed and then weighed to determine the dry weight.

*Data analysis*

Data from observations were analyzed using analysis of variance followed by the Honest Real Differences (BNJ) test at the 5% level.

## Result and Discussion

The results showed that the application of various concentrations of gibberellin can significantly break the dormancy of salak seeds, especially on the variables of germination, plumula length, radicle length and dry weight of sprouts. The results of research by Siregar et al (2021) suggest that chemical scarification treatment with KNO3, H2SO4, and GA3 on breaking dormancy and seed germination has a significant effect on germination, maximum growth potential, plant height, number of leaves at the age of 9, 10, and 11 weeks after planting. However, there was no significant effect at the age of 12 weeks, leaf length and leaf width. However, it did not give a significant effect at the age of 11 and 12 weeks after planting.

The results also showed that the higher the concentration given, the more effective in breaking the physical dormancy of salak seeds. Concentrations of 60 ppm and 80 ppm have been able to break the dormancy and increase the growth of salak seed sprouts well.

According to Copelan & McDonal (2014) gibberellin stimulates the synthesis of enzymes related to hydrolysis such as α- amylase. This α- amylase enzyme will break down carbohydrates to produce energy (ATP) for germination, (Suhendra et al., 2020). The use of gibberillin acid (GA3) as a result of breaking dormancy activates the metabolic process so that cell elongation runs faster with cell activation, koleoptil will be longer, (Akbar et al., 2017; Novita et al, 2023).

The results showed that the length of soaking salak seeds had a significant effect on the variables of germination, plumula length, and radicle length. The treatment of soaking time of 55 minutes and 95 minutes gave good germination growth. Soaking the seeds is done so that the cells in the seeds can actively grow. In line with research conducted by Setyaningsih 2018, that the treatment of soaking king palm seeds for 48 hours with a root length of 8.83 cm is more effective than soaking for 72 hours with a root length of 9.52 cm.

The longer the soaking, the faster the imbibition process in the seed. The imbibition process in seeds is useful for increasing the water content of seeds and activating enzymes (Herawati & Alfandi, 2013). Active enzymes can trigger the breakdown of food reserves, namely carbohydrate catabolism and fat metabolism.

According to Murrinie, E et al (2021), the imbibition process that occurs triggers an increase in the rate of respiration which activates the enzymes contained therein. Then endogenous gibberellins and exogenous gibberellins contained in the seeds will be translocated to the aleurone layer and produce the enzyme amylase which then enters the food reserves and encourages changes in food reserves in the form of starch into sugar to produce energy useful for cell activity and growth.

*Germination Power*

**Table 1.** Mean values of germination at several concentrations of gibberellin

| Giberelin | Mean | BNJ 5% |
|---|---|---|
| 40 ppm | 72.22 [a] | |
| 60 ppm | 81.11 [ab] | 9.89 |
| 80 ppm | 82.78 [b] | |

Notes: Numbers followed by the same letter in the same column show no difference.

The results of the BNJ test at the 5% level showed that the application of gibberellin with a concentration of 80 ppm (82.78%) produced a higher average germination rate but was not different from the concentration of 60 ppm (81.11%). While the soaking time of 95 minutes (83.89%) produced a higher average value of germination but not different from the soaking time of 55 minutes (81.67%).

Gibberellin with a certain concentration causes a chemical process in the seed that is characterised by germination. After the imbibition process, the release of gibberellin from the embryo will signal the seed to end its dormancy and germinate, (Campbell et al., 2003; Noprizal et al, 2023).

The research results of Agustiansyah et al (2020), suggest that the length of soaking in gibberellin can

increase the percentage of germination, maximum growth potential, growth speed, and time to germination.

*Germination Time*

**Table 2.** Average value of germination power at several gibberellin immersion times

| Immersion Time | Mean | BNJ 5% |
|---|---|---|
| 15 Menit | 70.56 a | |
| 55 Menit | 81.67 b | 9.89 |
| 95 Menit | 83.89 b | |

Notes: Numbers followed by the same letter in the same column show no difference.

Tables 1 and Table 2 showed that the provision of various concentrations of gibberellin and soaking time did not give a significant effect on the observed variable of germination time, but there was a tendency in the provision of gibberellin with a concentration of 60 ppm (22.27 days) resulting in faster germination time compared to concentrations of 40 ppm (24.74 days) and 80 ppm (24.00 days). While the immersion time of 95 minutes (22.85 days) resulted in faster germination time compared to the immersion time of 15 minutes (24.82 days) and 55 minutes (23.33 days).

The research results of Oktavianti & Adelina (2021) suggest that increasing the concentration of geberelin to 60 ppm has been able to increase germination, germination time, plumula length, and radicle length.

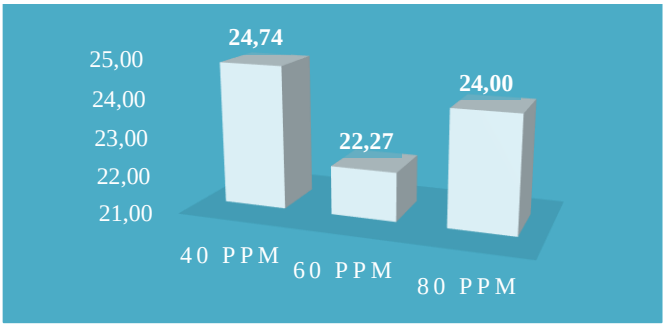


**Figure 1.** Average value of germination time at several gibberellin concentrations.

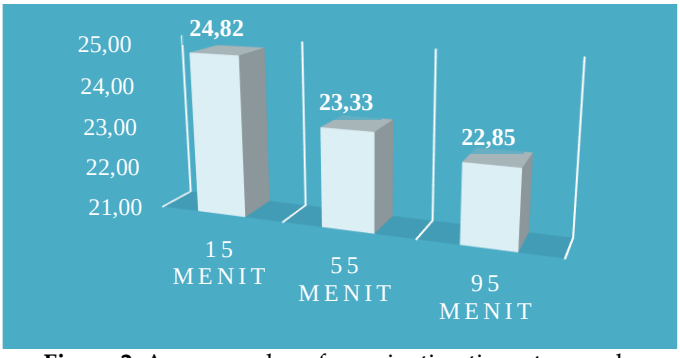


**Figure 2.** Average value of germination time at several gibberellin immersion times.

*Plumula Length*

**Table 3.** Mean values of plumula length at several gibberellin concentrations

| Giberelin | Mean | BNJ 5% |
|---|---|---|
| 40 ppm | 3.71 a | |
| 60 ppm | 4.58 ab | 0.61 |
| 80 ppm | 4.78 b | |

Notes: Numbers followed by the same letter in the same column show no difference.

**Table 4.** Mean values of plumula length at several gibberellin immersion times.

| Immersion Time | Mean | BNJ 5% |
|---|---|---|
| 15 Menit | 3.98 a | |
| 55 Menit | 4.42 b | 0.61 |
| 95 Menit | 4.67 b | |

Notes: Numbers followed by the same letter in the same column show no difference.

BNJ test results showed that the use of gibberellin with a concentration of 80 ppm (4.78 cm) produced a longer average plumula length but not different from the concentration of 60 ppm (4.58 cm). While the gibberellin immersion time of 95 minutes (4.67 cm) produced a longer average plumula length but not different from the immersion time of 55 minutes (4.42 cm).

It is suspected that the gibberellin concentration of 60 ppm is a good concentration in affecting the germination of salak seeds. Proven by the research of Oktavianti & Adelina (2021), by giving a gibberellin concentration of 60 ppm can encourage the growth of salak seed germination at a plumula length of 5.52 cm and a radicle length of 5.15 cm.

*Radicle length*

**Table 5.** Mean values of radicle length at several gibberellin concentrations

| Giberelin | Mean | BNJ 5% |
|---|---|---|
| 40 ppm | 5.51 a | |
| 60 ppm | 6.64 b | 0.62 |
| 80 ppm | 6.86 b | |

Notes: Numbers followed by the same letter in the same column show no difference.

**Table 6.** Mean values of radicle length at several gibberellin immersion times

| Immersion Time | Mean | BNJ 5% |
|---|---|---|
| 15 Menit | 5.77 a | |
| 55 Menit | 6.52 b | 0.62 |
| 95 Menit | 6.72 b | |

Notes: Numbers followed by the same letter in the same column show no difference.

BNJ test results showed that the use of gibberellin with a concentration of 80 ppm produced a longer average radicle length (6.86 cm) but not different from the concentration of 60 ppm (6.64 cm). While the

germination time of 95 minutes (6.72 cm) produced a longer average radicle length, but was not different from the germination time of 55 minutes (6.52 cm).

The results of the study Kartikasari et al (2019) suggest that increasing the concentration of geberelin to 60 ppm can increase germination, growth potential, plant height and root length.

According to Romdyah et al (2017), in general, seeds experience three phases of water absorption, namely, the fast phase, the slow absorption phase, and the active absorption phase. A good seed metabolic process causes good germination. Good availability causes oxygen to enter the seed and break down food reserves which are used as a source of energy for sprout growth, (Andayani et al., 2022; Murrinie, E et al., 2021).

*Sprout Dry Weight*

**Table 5.** Mean values of dry weight of sprouts at several concentrations of gibberellin

| Giberelin | Mean | BNJ 5% |
|---|---|---|
| 40 ppm | 1.94 [a] | |
| 60 ppm | 2.10 [ab] | 0.26 |
| 80 ppm | 2.30 [b] | |

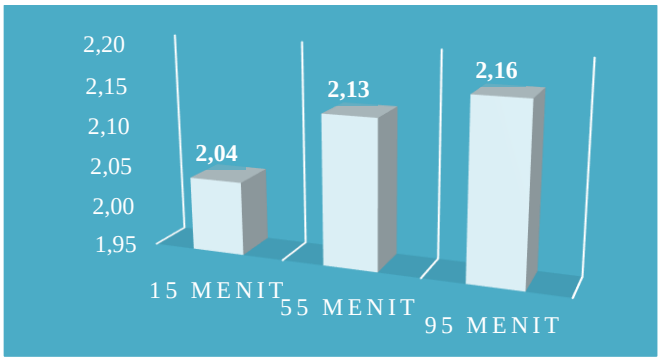


**Figure 3.** Average value of dry weight of sprouts at several gibberellin soaking times.

The results showed that the use of gibberellin with a concentration of 80 ppm produced an average value but not different from the concentration of 60 ppm, and gibberellin immersion for 95 minutes can produce the heaviest dry weight of sprouts compared to other treatments.

The high dry weight of sprouts is an indicator of the ability of seeds to explore their energy and environment (light, water and temperature). It is known that the 80 ppm gibberellin concentration produced the highest sprout dry weight of 2.30 g while the 60 ppm gibberellin concentration produced the dry weight of the sprouts of 2.10 g. This shows that the seeds have a good growth rate. This shows that the seeds have good germination growth and have high vigour.

The results of research by Sari et al (2014) suggested that gibberellin treatment had a significant effect on crown dry weight parameters. This is because the use of gibberellin can increase plant length. The increase in plant length is because gibberellin can increase cell division activity under the shoot meristem. Stem elongation occurs through two processes: cell division and cell enlargement. Cells enlarge and reach the maximum size, followed by cell division. Gibberellin addition to increasing plant height, also increases leaf area and dry weight or wet weight of plants.

## Conclusion

The treatment of gibberellin concentration of 60 ppm and 80 ppm gave good growth in the observation variables of germination, germination time, plumula length, radicle length and dry weight of sprouts. While the length of Immersion time of 55 minutes and 95 minutes gives a good growth effect on the observation variables of germination, germination time, plumula length, radicle length and dry weight of sprouts.

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**Author Contributions**
Conceptualization: Ad., Jk., Mt and Fd; methodology: Ad., Jk., dan Fd; validation: Mt., and Fd; formal analysis: Ad., Mt dan Fd.; investigation, Mt and Fd.; resources: Ad., Jk., dan Fd.; data curation, Jk and Mt.; writing—original draft preparation, Ad., Fd and H.Y.J.; writing—review and editing: M.S.N., Mk dan Fd; visualization, M.S.N., M.R and H.Y.J.; supervision, M.S.N and G.O; project administration: M.R and H.Y.J.

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**Conflicts of Interest**
The authors declare no conflict of interest.

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