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TEAK SEEDS (*Tectona grandis* L.f.) GERMINATION BASED ON DIFFERENT CONCENTRATION AND SOAKING TIME LENGTH USING SULFURIC ACID (H_2SO_4)

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ABSTRACT

Teak (Tectona grandis L.f.) is a plant that produces raw materials for the wood industry, which is very popular due to its high quality and selling value. One problem in cultivating this plant is seed germination due to dormancy. One technique that can be used to break seed dormancy is through chemical treatment. This study aims to determine the concentration of sulfuric acid (H_2SO_4) and the appropriate soaking time to solve the teak seeds dormancy. This research was conducted for two months in the Permanent Nursery of the Department of Forestry, State Agricultural Polytechnic of Kupang, from 15 November 2022 until 15 January 2023. This study used a Completely Randomized Design (CRD) with two factors. The first factor was the concentration of sulfuric acid (control: K0, 75% H_2SO_4: K1, 80% H_2SO_4: K2, and 85% H_2SO_4: K3). The second factor was the soaking time (T1: 45 minutes, T2: 50 minutes, and T3: 55 minutes). The two factors were combined to produce 12 treatment combinations. Each treatment was repeated three times and used ten seeds, so the total seeds used were 360 seeds. The results showed that there was an interaction between the concentration of sulfuric acid (H_2SO_4) with soaking time length, where the combination of 75% sulfuric acid (H_2SO_4) concentration and 45 minutes of soaking time gave higher results than other treatments, so it can be said that this combination is better at breaking teak seed dormancy.

Keywords: Teak; seeds germination; concentration; soaking time length; sulfuric acid

INTRODUCTION

Teak (Tectona grandis L.f.) is a plant that produces raw materials for the timber industry which is very popular because it has a very high quality and selling value. According to Kurniawan (2018), this plant belongs to the durable class of wood and high strength class, so it is much needed in the property industry. Teak plants in Indonesia are spread across several islands but the largest number is on the island of Java. Rahmawati, et al. (2019), stated that teak trees are widely spread in Indonesia, especially the Java region, but in its development teak is also cultivated outside the Java area such as Kalimantan, Sumatra, Bali and Nusa Tenggara. The existence of teak plants can make some forests and the surrounding land fertile, loose, and cool. Land areas that have teak forests are able to retain groundwater so that groundwater can be maintained and can be utilized as a water source (Purwanta, et al., 2015).

Teak seedling propagation can be done in two ways, namely generatively and vegetatively. Generatively, teak seedlings are propagated using seeds. Teak cultivation often encounters obstacles, namely seeds that are slow to germinate because the seeds have thick, hard skin and have impermeable sidat (difficult to penetrate) water and gas so that they can inhibit germination (Kusumawardani, et al., 2021). This causes teak seeds to experience dormancy. In addition to physical factors, other causes of seed dormancy can be caused by physiological factors (immature embryos) and seeds that contain germination inhibitors. Several treatments can be given to seeds, so that the level of dormancy can be reduced and the percentage of germination remains high (Zanzibar, 2017).

One technique that can be used to break seed dormancy is chemical treatment using chemicals. One of the chemicals is a strong acid such as sulfuric acid (H_2SO_4). Sulfuric acid is very effective for breaking dormancy in teak seeds that have a hard skin structure (Latue, et al., 2019). Sulfuric acid (H_2SO_4) is very effective for breaking dormancy in seeds that have a very hard skin structure (Latue, et al., 2019). Chemically breaking dormancy can be done by soaking seeds in sulfuric acid with an adjusted time based on the shape of the seeds (Hedty et al., 2014).

According to Fajrina and Soetopo (2018), soaking seeds in sulfuric acid with a concentration of 90% with 25 minutes and 30 minutes gives high results on germination, growth speed and germination rate of teak seeds. Mali'ah (2014) states that soaking using sulfuric acid (H_2SO_4) for less than 1-10 minutes will not be able to break seed dormancy while soaking with 60 minutes or more will damage the seeds. Based on the problems previously described, it is necessary to conduct research to find out what concentration of sulfuric acid and soaking time are appropriate to break the dormancy of teak seeds. This study aims to determine the concentration of sulfuric acid (H_2SO_4) and the length of soaking time using sulfuric acid (H_2SO_4) which is appropriate to break the dormancy of teak seeds.

METHOD

The research was conducted for 2 (two) months at the Permanent Nursery of the Forestry Department of Kupang State Agricultural Polytechnic from November 15, 2022 to January 15, 2023. The tools used were trays (5 L jerry cans) as seed germination sites, sieves to separate dirt in the planting media, shovels to move the media, rulers to measure the height of the plumula, calipers to measure the diameter of the seeds, 220 ml plastic cups for watering plants, drop pipettes to transfer sulfuric acid (H_2SO_4), measuring cups to measure the volume of sulfuric acid (H_2SO_4), bottle of distilled water to put the diluted, machete, crowbar, saw, hammer and net to make a shade measuring 6 m x 4 m, clear plastic to make a lid so that the plants are not exposed to rainwater, writing tools, documentation camera, Microsoft Excel software for processing raw data, and IBM SPSS version 26 application for data analysis. The materials used were sulfuric acid (H_2SO_4), distilled water to dilute the sulfuric acid (H_2SO_4), gloves and masks when diluting the sulfuric acid (H_2SO_4), sifted and roasted sand as media, 360 teak seeds, label paper to mark each diluted sulfuric acid, and water to water the plants.

The study used a completely randomized design (CRD) with two factors.The first factor is the concentration of sulfuric acid (H_2S_O4) with 4 levels namely K0 (0%), K1 (75%), K2 (80%), K3 (85%), while the second factor is the length of soaking time with 3 levels namely T1 (45 minutes), T2 (50 minutes) and T3 (55 minutes).Each treatment was repeated 3 (three) times using 10 seeds.The teak seeds used were non-defective and uniform in size (Fajrina and Soetope, 2018) with a diameter of 0.14 cm. Determination of seed size uniformity by measuring with a caliper.

Systematic placement of the sowing trays (sequentially starting from K0T1.U1 to K3T3.U3) from east to west with a distance between rows of 50 cm (Figure 1).

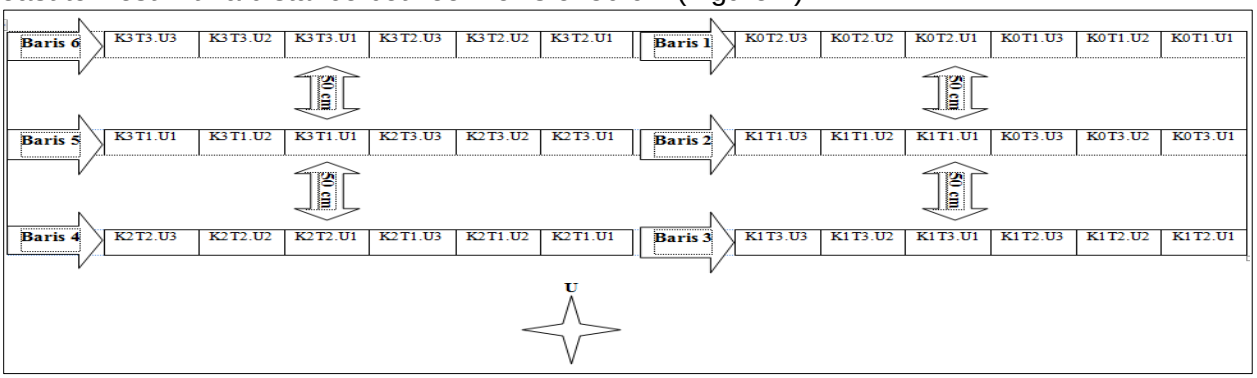

Figure 1. Sowing Tray (Plastic Jerrycan) Placement Design

Observations were made once a week for eight weeks, with observation variables:

1. Germination energy (GE), obtained by counting normal germinated seeds, using the formula (Darma, et al., 2015):

$$\%\ \mathrm{GE}\ = \frac{\text{Number of germinated seeds}}{\text{Total benih yang dikecambahkan}}\ \mathrm{X}\ 100\%$$

2. Speed Of germination speed, obtained by counting the seeds that germinate normally from the first to the last observation, using the formula (Saputra, et al., 2017).

$$= \frac{\%\mathrm{KN1}}{\mathrm{T1}} + \frac{\%\mathrm{KN2}}{\mathrm{T2}} + \cdots + \frac{\%\mathrm{KN8}}{\mathrm{T8}}$$

where:

%KN = Percentage of normal germination
T = Day of observation

3. Plumula height, obtained by measuring the height from the base of the stem (ground level) to the growing point using a ruler at the end of the observation (Darma, et al., 2015).
4. Number of leaves, obtained by counting the number of leaves that have opened completely, and done at the end of the observation.

Observation data were analyzed with analysis of variance (ANOVA) using the formula (Lamanda, 2018):

$$\mathrm{Yij}\ =\ \mu\mathrm{i}\ +\ \mathrm{ti}\ +\ \mathrm{Ɛij}\ \text{atau}\ \mathrm{Yij}\ =\ \mu\mathrm{i}\ +\ \mathrm{Ɛij}$$

where:

i = 1, 2, …, n
j = 1, 2, …, n
Yij = The treatment-i dan group in the-j
μ = Common average
ti = Effect of treatment in the-i
Ɛij = Effect of experimental error at the level-i dan level ke-j

The hypothesis is:

H0 : All treatments had no significant effect on teak seed germination.
H1 : All treatments had a significant effect on teak seed germination.

The criteria for drawing conclusions are:

a. If the value of Sig. > 0,05 then H0 retrieved.
b. If the value of Sig. < 0,05 then H0 rejected.

If the analysis of variance shows that the treatment has a real effect, the test is continued with the Honestly Significance Diffrence Test (HSD Test)

RESULTS and DISCUSSION

A. Appropriate Concentration of Sulfuric Acid (H_2SO_4) to Break Teak Seed Dormancy

Sulfuric acid (H_2SO_4) concentration of 75% gave the highest results on germination (Figure 2), germination speed (Figure 3), plumula height (Figure 4) and number of teak leaves (Figure 5) compared to concentrations of 0%, 80% and 85%. The 80% concentration showed higher results than the 0% and 85% concentrations for all variables tested. Thus, the best concentration of sulfuric acid to break the dormancy of teak seeds is 75%.

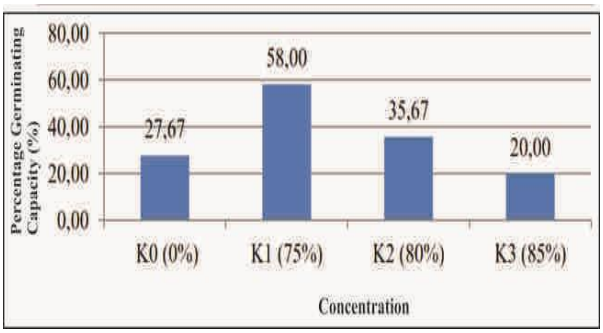

Figure 2. Percentage of Teak Seed Germinating Capacity at Various Sulfuric Acid (H_2SO_4)

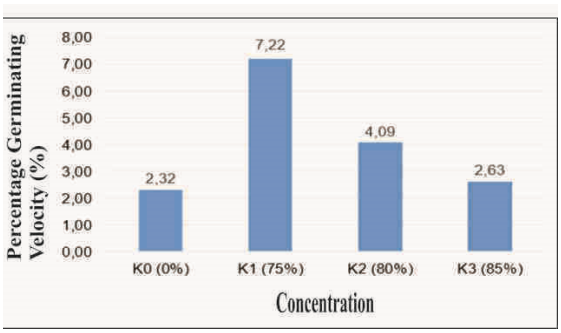

Figure 3. Percentage of Teak Seed Germinating Velocity at Various Sulfuric Acid (H_2SO_4)

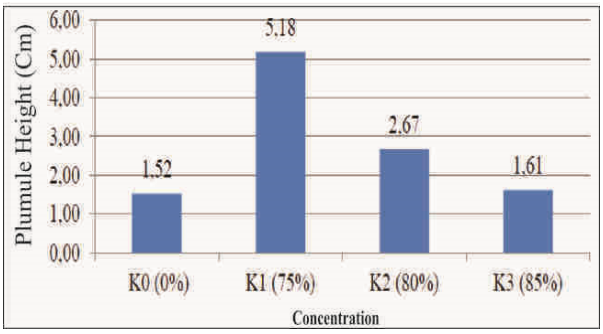

Figure 4. Teak Plumule Height at Various Sulfuric Acid (H_2SO_4)

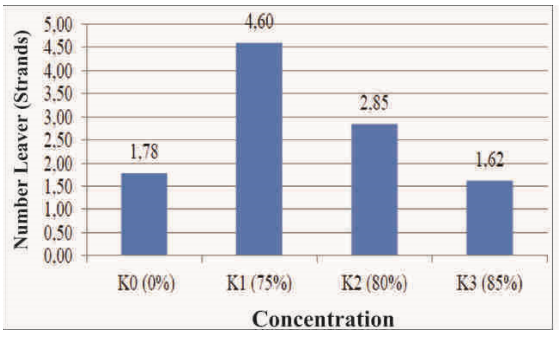

Figure 5. Teak Leaves Number at Various Sulfuric Acid (H_2SO_4)

Sulfuric acid (H_2SO_4) with a concentration of 75% is best in breaking the dormancy of teak seeds because at that concentration it is not too concentrated, so it only softens the seed coat and does not damage the seed embryo. This is supported by the statement of Suyatmi, et al. (2009) that sulfuric acid (H_2SO_4) with a concentration of 70% is a concentration that is not too concentrated so that it only softens the seed coat while concentrations of 80% and 90% are too concentrated which causes denaturation of enzyme proteins. This is also supported by Halimursyadah, et al. (2018) which suggests that the increased permeability on the surface of

the seed coat is caused by the dissolution of some of the lignin components of the seed coat, so that water more easily enters the seed to stimulate embryo growth in the germination process.

B. Appropriate Soaking Time Using Sulfuric Acid (H_2SO_4) to Break Teak Seed Dormancy

The best soaking time using sulfuric acid (H_2SO_4) to break the dormancy of teak seeds is 45 minutes. The results showed that the germination rate (Figure 6), germination speed (Figure 7), plumula height (Figure 8) and number of teak leaves (Figure 9) were higher than the soaking times of 50 minutes and 55 minutes.

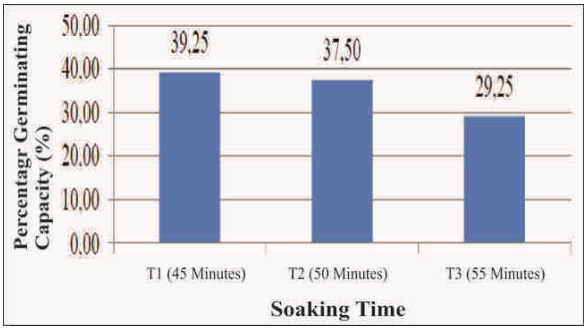

Figure 6. Percentage of Teak Seed Germinating Capacity at Various Soaking Time Length

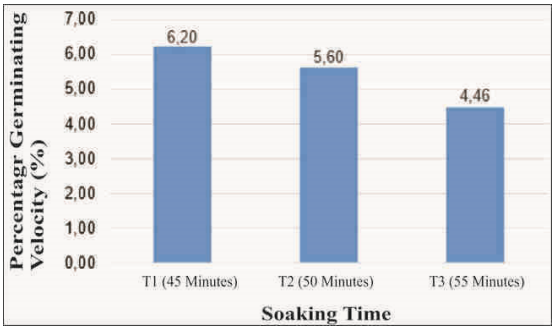

Figure 7. Percentage of Teak Seed Germinating Velocity at Various Soaking Time Length

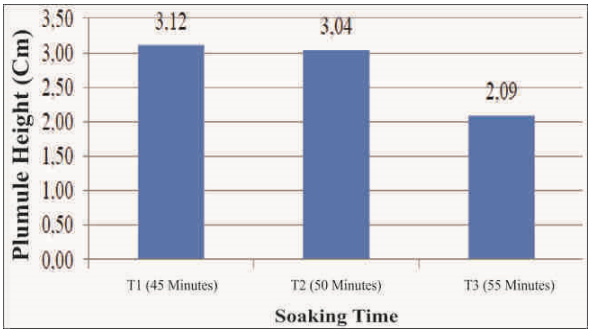

Figure 8. Teak Plumule Height at Various Soaking Time Length

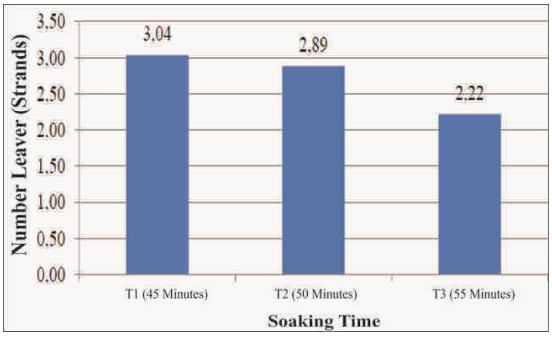

Figure 9. Teak Leaves Number at Various Soaking Time Length

The length of soaking time using sulfuric acid (H_2SO_4) which is good for breaking the dormancy of teak seeds depends on the concentration of sulfuric acid (H_2SO_4) used, the higher the concentration of sulfuric acid (H_2SO_4) used, the lower the soaking time and the lower the concentration of sulfuric acid (H_2SO_4) used, the higher the soaking time used. Filho (2011), said that the treatment of breaking dormancy using sulfuric acid (H_2SO_4) soaking should pay attention to the concentration and length of soaking time given. Germination will decrease if the soaking time given is longer, this situation is caused by the concentration of sulfuric acid (H_2SO_4) which is concentrated and hard can burn the seed skin so that the seeds become damaged. The germination of a seed is the development of important parts of an embryo that shows its ability to grow normally (Azahra, et al., 2022).

C. Combination of Concentration and Soaking Time Using Sulfuric Acid (H_2SO_4) to Break Teak Seed Dormancy

The results of the analysis of variance showed that the treatment combination of sulfuric acid concentration (H_2SO_4) and the length of soaking time gave no significant effect on the germination of teak seeds (Sig.=0.74>0.05) (Table 1), teak seed germination speed (Sig.=0.97>0.05) (Table 2), teak plumule height (Sig.=0.92>0.05) (Table 3) and the number of teak leaves (Sig.=0.69>0.05) (Table 4).

Table 1. ANOVA Result of The Effect of Treatment Combination to Teak Seed Germinating Capacity

	Sums of Squares	Degrees of Freedom	Means Squares	F	Significance
Between Treatments	172,22	2	86,11	0,292	0,74
In Treatment	9725,00	33	294,70		
Total	9897,22	35			

Source: Primary Data Analysis Result, 2023

Table 2. ANOVA Result of The Effect of Treatment Combination to Teak Seed Germinating Velocity

	Sums of Squares	Degrees of Freedom	Means Squares	F	Significance
Between Treatments	0,032	2	0,016	0,023	0,97
In Treatment	23,422	33	0,710		
Total	23,455	35			

Source: Primary Data Analysis Result, 2023

Table 3. ANOVA Result of The Effect of Treatment Combination to Teak Plumule Height

	Sums of Squares	Degrees of Freedom	Means Squares	F	Significance
Between Treatments	0,647	2	0,323	0,084	0,92
In Treatment	127,164	33	3,853		
Total	127,811	35			

Source: Primary Data Analysis Result, 2023

Table 4. ANOVA Result of The Effect of Treatment Combination to Teak Leaves Number

	Sums of Squares	Degrees of Freedom	Means Squares	F	Significance
Between Treatments	1,502	2	0,751	0,371	0,69
In Treatment	66,853	33	2,026		
Total	68,356	35			

Source: Primary Data Analysis Result, 2023

However, there was an interaction between the concentration of sulfuric acid solution (H2SO4) and the length of soaking time so that the combination of treatments with various concentrations of sulfuric acid (H2SO4) and the length of soaking time showed different results on seed germination (Figure 10), seed germination speed (Figure 11), plumula height (Figure 12) and the number of teak leaves (Figure 13).

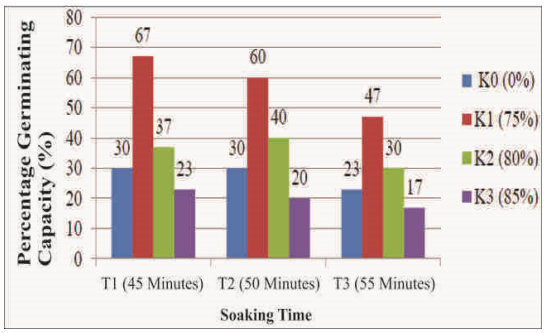

Figure 10. Percentage of Teak Seed Germinating Capacity at Sulfuric Acid (H_2SO_4) Concentration and Soaking Time Length Combination

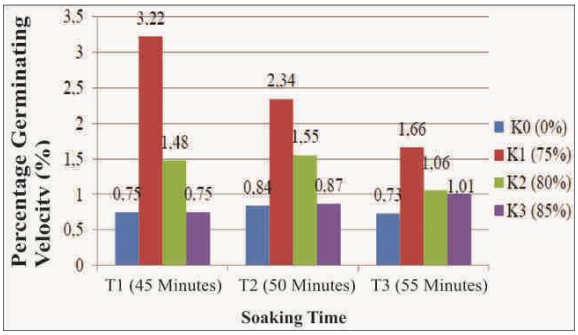

Figure 11. Percentage of Teak Seed Germinating Velocity at Sulfuric Acid (H_2SO_4) Concentration and Soaking Time Length Combination

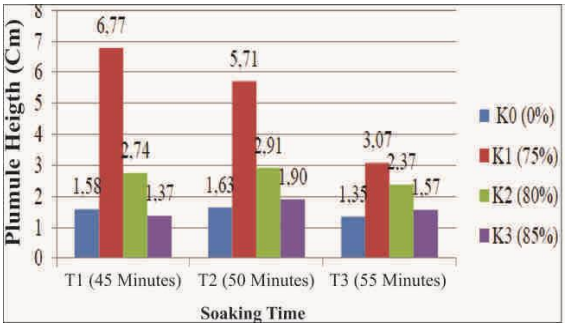

Figure 12. Teak Plumule Height at Sulfuric Acid (H_2SO_4) Concentration and Soaking Time Length Combination

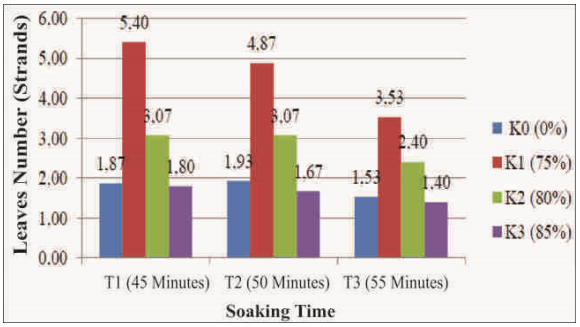

Figure 13. Teak Leaves Number at Sulfuric Acid (H_2SO_4) Concentration and Soaking Time Length Combination

Tanjung (2017) stated that the combination of H_2SO_4 treatment with optimal concentration and soaking time can break the dormancy of the seed coat so that germination can occur. The treatment combination that has the highest value for seed germination (Figure 10), seed germination speed (Figure 11), teak plumula height (Figure 12) and number of teak leaves (Figure 13) is K1T1, where K1T1 is a treatment combination between 75% concentration of sulfuric acid (H_2SO_4) and 45 minutes soaking time. Thus it can be seen that a good combination to break the dormancy of teak seeds is a combination of treatments with a concentration of sulfuric acid (H_2SO_4) that is not too concentrated and a high soaking time or a combination of treatments with a concentrated concentration of sulfuric acid (H_2SO_4) and a low soaking time. This is also in line with the results of research by Fajrina and Soetopo (2018) who used a concentrated concentration of sulfuric acid (H_2SO_4) of 90% and combined with a low soaking time of 25 minutes had higher results than other treatments, and the results of research by Suyatmi, et al. (2009) who combined a less concentrated sulfuric acid (H_2SO_4) of 70% with a high soaking time of 40 minutes gave higher results than other treatments.

CONCLUSION

The treatment of concentration and soaking time using sulfuric acid (H_2SO_4) had no significant effect on teak seed germination, but there was an interaction between concentration and soaking time on germination, germination speed, plumula height and number of teak leaves, so it can be said that treatment using concentration and soaking time using sulfuric acid (H_2SO_4) can break the dormancy of teak seeds and can increase the percentage of teak seed germination. Soaking

using sulfuric acid (H_2SO_4) with a concentration of 75% with a soaking time of 45 minutes is better in breaking the dormancy of teak seeds than other treatments because it gives the highest results on germination, germination speed, plumula height and number of teak leaves.

It is recommended to conduct further research by applying chemical other than sulfuric acid (H_2SO_4), with variations in concentration and different lengths of soaking time and by adding other observation parameters.

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