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THE ACCELERATION OF SEED GERMINATION OF MUCUNA (*Mucuna bracteata*) AS TREATED WITH DIFFERENTS WATER TEMPERATURE AND SOAKING TIME

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ABSTRACT

Generative propagation of Mucuna bracteata is complicated and requires special treatment to germinate. Mucuna has a thick, rigid, and impermeable seed coat, which becomes a mechanical barrier to water or gas entry, making the imbibition process challenging to occur. Breaking dormancy in mucuna seeds aims to increase germination. This study aims to determine the effect of soaking time for mucuna seeds (*Mucuna bracteata*) at different water temperatures on breaking dormancy. This study used a completely randomized design factorial. This study consists of 2 treatment factors. The first factor is the length of soaking (L), which consists of 3 levels: 30 minutes, 60 minutes and 90 minutes. The second factor is water temperature (K), which consists of 3 levels: 30 °C, 60 °C and 90° C. Data analysis used variance analysis and simple regression analysis. The results of the study showed that water temperature had a significant effect on increasing germination power, accelerating germination, increasing the number of normal sprouts, and the dry weight of mucuna (*Mucuna bracteata*) sprouts..

Keyword: *mucuna seeds, soaking seeds, water temperature*

ABSTRAK

[PERCEPATAN PERKECAMBAHAN BENIH MUCUNA (*Mucuna bracteata*) DENGAN PERLAKUAN SUHU AIR DAN LAMA PERENDAMAN YANG BERBEDA]. Perbanyakan *Mucuna bracteata* secara generatif sangat sulit dilakukan dan memerlukan perlakuan khusus untuk berkecambah. Mucuna memiliki kulit biji yang tebal, keras dan kedap yang menjadi penghalang mekanis masuknya air atau gas sehingga proses imbibisi sulit terjadi. Pematahan dormansi pada biji mucuna bertujuan untuk meningkatkan daya berkecambah. Penelitian ini bertujuan untuk mengetahui pengaruh lama perendaman benih mucuna pada suhu air yang berbeda terhadap pematahan dormansi. Penelitian ini menggunakan Rancangan Acak Lengkap (RAL) faktorial. Penelitian ini terdiri atas 2 faktor perlakuan. Faktor pertama adalah lama perendaman (L) yang terdiri dari 3 taraf yaitu: 30 menit, 60 menit dan 90 menit. Faktor kedua adalah suhu air (K) terdiri atas 3 taraf yaitu: 30 °C, 60 °C dan 90 °C. Analisis data menggunakan sidik ragam dan analisis regresi sederhana. Hasil penelitian menunjukkan bahwa suhu air berpengaruh nyata meningkatkan daya kecambah, mempercepat perkecambahan, meningkatkan jumlah kecambah normal, dan bobot kering kecambah mucuna.

Kata kunci: *benih mucuna, perendaman benih, suhu air*

INTRODUCTION

Mucuna bracteata is a Leguminosae Cover Crop (LCC) widely used in Indonesian plantations to protect the soil from erosion and prevent loss of soil nutrients due to erosion (Sinurat *et al*., 2018), maintain soil moisture and suppress the growth of weeds (Tarigan *et al*., 2020). Root nodules due to symbiosis with *Rhizobium* for fast growth and large amounts of biomass, which will also produce large amounts of organic material. Besides that, *Mucuna bracteata* creates better microclimate conditions around plants to support the growth and development of plants and soil microorganisms (Sasvita *et al*., 2023).

Mucuna plantings in plantations are propagated vegetatively and generatively. Mucuna plants are propagated vegetatively, namely through cuttings. Apart from being propagated vegetatively, mukuna is also propagated generatively using seeds. Germination of Mucuna with seeds has several advantages compared to cuttings, including: having a stronger root system, faster growth, better plant quality, better adaptability (Setyorini *et al*., 2018). One of the most serious complaints about planting mukuna is that mukuna seeds have very low germination capacity. Mucuna has a hard seed coat so that its germination power is low. The hard seed coat is a barrier to the entry of water and gas into the seed. If germinated, the germination percentage is only around 12% (Sari *et al*., 2017). The dormancy period of mucuna is around 1-2 months. According to Kamila (2021), Mucuna seeds have physical dormancy caused by a hard seed coat. This makes it difficult for water and gas to enter the seed, thus disrupting the growth and development of the embryo. This hard seed coat is composed of thick cell walls on the outside and a layer of wax on the inside.

Soaking seeds using high-temperature water has been proven effective in removing germination inhibitors (ammonia, abscisic acid and alkaloids) (Rumahorbo *et al*., 2020), making it easier for the embryo to absorb water/the imbibition process occurs (Sriwigati *et al*., 2021). The length of time for soaking the seeds is adjusted to the type of seed that will be soaked because each seed has a different adequate soaking time (Rusdy, 2020; Nurhaliza *et al*., 2023).

MATERIALS AND METHODS

This study was carried out in January–March 2023 at the Seed Technology Laboratory of the Indonesian Methodist University, Tanjung Sari, Medan Selayang District, Medan City. This study was arranged in a factorial Completely Randomized Design (CRD) involving 2 factors with 5 replications. Factor I was soaking time (L), consisting of L_1 = 30 minutes, L_2 = 60 minutes, L_3 = 90 minutes, and factor II was water temperature (S), consisting of S_1 = 30 °C; S_2 = 60 °C; S_3 = 90 °C. The mucuna seeds used in this study were of uniform size and had nophysical defects such as broken, shriveled, wrinkled and moldy. The number of seeds used in each experimental unit was 10. The seeds were soaked in a beaker glass containing 1000 mL hot water according to the temperature treatment. The seeds are were removed from the beaker glass as the soaking duration reached the specified time and the seeds were air-dried on germination paper for further transferred to the planting medium with a regular watering The observations were made on germination capacity (%), germination time (days), number of normal sprouts, and dry weight of sprouts (g). The analysis of variance was performed on the collected to indicate the significance of the treatment in affecting the observed variables. A simple regression analysis was used to indicated the response of the observed variable along the treatment gradient.

RESULTS AND DISCUSSION

The analysis of variance revealed that soaking duration had no significant effect on the germination rate of *M. bracteata* seeds. In contrast, water temperature treatment significantly influenced seed germination. The interaction between soaking duration and water temperature did not show a significant effect on germination rate. The effect of water temperature on seed germination is illustrated in Figure 1. Figure 1 presents data on the germination response of *M. bracteata* seeds under different soaking durations and water temperatures. The variance analysis confirmed that water temperature had a statistically significant impact on seed germination, whereas soaking duration and the interaction between the two factors were not statistically significant. The influence of water temperature treatment is further demonstrated in Figure 1.

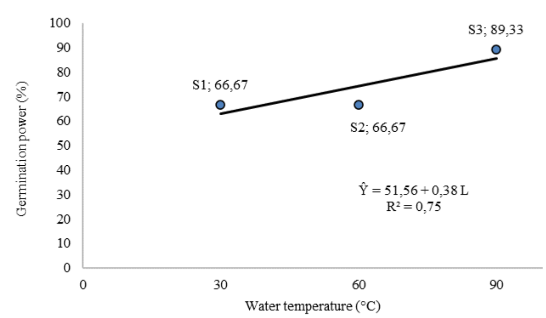

Figure 1. Effect of water temperature on the germination of *Mucuna bracteata* seeds

Figure 1 shows that the higher the water temperature, the more the seed germination increases following a positive linear regression curve. The results showed that water temperature significantly affected the germination of mucuna seeds. The highest germination capacity was in the S_3 treatment at 89.33%, and the lowest was in the S_1 treatment at 77.33%. The higher the temperature of the soaking water, the greater the germination capacity. The higher the temperature of the water used in soaking the seeds, the easier it will be for the seed coat to soften. The softer the skin, the more water will enter the seeds quickly. This is in line with research from Alghofar *et al*. (2017), namely that the highest germination power of second seeds was found in the treatment of seed soaking at a temperature of 90 °C, namely 87.5%. The lowest was found in the treatment of seed soaking in room-temperature water (25°C), namely 41.25%. (Rumahorbo *et al*., 2020) The temperature of soaking water can break physical formation in Leguminosae through tension, which causes the microsclerotia layer or palisade layer to break; tension in the outer cells causes cracks so that O_2 and water can quickly enter the seeds. This is the statement (Yuniarti *et al*., 2018), which states that one effective treatment for seeds is to hydrate them by soaking thems in water for a certain period.

The list of variance analysis shows that the treatment of soaking time and water temperature significantly affects the germination time of *M. bracteata* seeds. In contrast, the interaction between the two treatments has no significant effect. The effect of water temperature treatment on the germination time of *M. bracteata* seeds can be seen in Figure 2. Figure 2 presents data on the germination time of *M. bracteata* seeds due to soaking time and water temperature. The list of variances shows that water temperature treatment significantly affects the germination time of *M. bracteata* seeds.

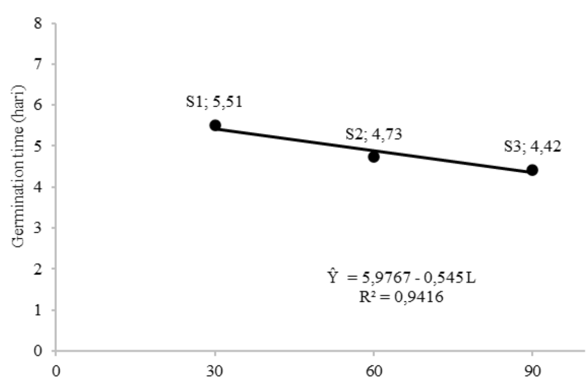

Figure 2. Effect of water temperature on the germination time of *Mucuna bracteata* seeds

The length of soaking and the interaction between the two treatments had no significant effect on the germination time of *M. bracteata* seeds.

Figure 2 shows that the higher the water temperature, the faster seed germination follows a negative linear regression curve. The results showed that water temperature had a significant effect on germination time. The fastest germination time was in treatment S_3 at 4.42 days, and the longest was in treatment S_1 at 5.51 days. Increasing the temperature of the water used in soaking will make the chemical reaction process in the germination process occur more quickly. This will make the seed germination process faster. Increasing water temperature will increase enzyme activity, where enzymes, including amylase, lipase, and proteinase, play a role in germination. The imbibition, hydrolysis of food reserves, respiration and other processes have different cardinal temperatures, so the response to temperature can change during germination. Seed response to germination temperature varies by species (Rusmin *et al*., 2016).

The list of variance analysis shows that the treatment of soaking time has no significant effect on the number of normal sprouts. The treatment of water temperature has a significant effect on the number of normal sprouts. The interaction between the two treatments has no significant effect on the number of normal sprouts. The effect of water temperature treatment on the number of normal *M. bracteata* seed sprouts can be seen in Figure 3. Data on the number of regular sprouts of Mucuna bracteata seeds due to soaking time and water temperature is presented in Figure 3. The list of variances shows that the water temperature treatment significantly affects the number of regular sprouts of *M. bracteata* seeds. The length of soaking and the interaction between the two treatments did not significantly affect the number of regular sprouts of *M. bracteata* seeds. The effect of water temperature treatment on the number of regular sprouts of *M. bracteata* seeds can be seen in Figure 3.

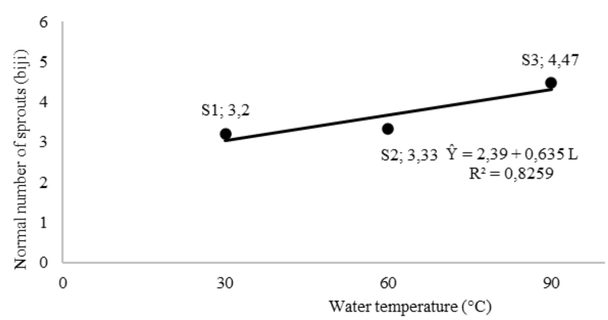

Figure 3. Effect of water temperature on the number of normal *Mucuna bracteata* sprouts

Figure 3 shows that the higher the water temperature, the more sprouts increase, following a positive linear regression curve. The results showed that water temperature significantly affected the number of regular sprouts. The highest number of regular sprouts was found in treatment S_3 at 4.47 seeds, and the lowest was in treatment S_1 at 3.20 seeds. This is because the higher the temperature, the greater the fungus contained in the seeds will die, thereby increasing the viability of the seeds, which makes the seeds usually grow. Factors within the seed itself influence seed viability. Seed viability can also be affected by temperature. Each plant usually requires a different temperature range to germinate (Rusmin *et al*., 2016).

The list of variance analysis shows that the treatment of soaking time has no significant effect on the number of normal sprouts. The treatment of water temperature has a significant effect on the number of normal sprouts. The interaction between the two treatments has no significant effect on the number of normal sprouts. The effect of water temperature treatment on the number of normal sprouts of Mucuna bracteata can be seen in Figure 4. Figure 4 presents data on the dry weight of *M. bracteata* sprouts due to soaking time and water temperature. The list of variances shows that water temperature treatment significantly affects the dry weight of *M. bracteata* sprouts. The length of soaking and the interaction between the two treatments had no significant effect on the dry weight of *M. bracteata* sprouts. The effect of water temperature treatment on the dry weight of *M. bracteata* sprouts can be seen in Figure 4.

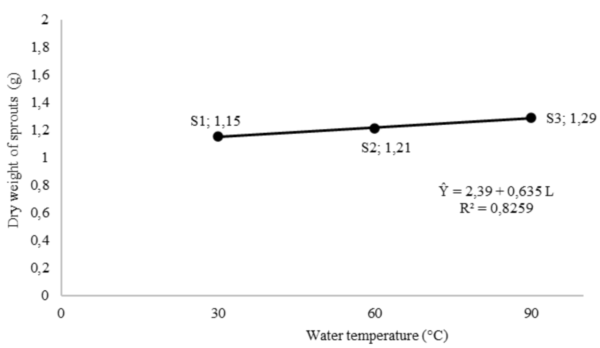

Figure 4. Effect of water temperature on dry weight of *Mucuna bracteata* sprouts

Figure 4 shows that the higher the water temperature, the higher the dry weight of the sprouts increases, following a positive linear regression curve. The results showed that water temperature significantly affected the dry weight of the sprouts. The heaviest dry weight of sprouts was in treatment S_3 at 1.29 g, and the lowest was in treatment S_1 at 1.15 g. During germination and leaf growth, water functions as a solvent that will dissolve nutrient elements that will later be used for photosynthesis to benefit plant growth. The higher the water temperature, the faster the seed germination process. The faster the seeds germinate, the more quickly they grow and develop; there is also an increase in the formation of the number of plant organs, which can increase the wet weight of the sprouts (Nugraha *et al*., 2014). Increasing plant growth will further increase the photosynthesis process in plants, where photosynthesis will produce photosynthesis, which will be stored in plant parts. With sufficient nutrient availability, photosynthesis occurs well, and photosynthate (the product of photosynthesis) is produced. Some of this photosynthate is then used to form roots, stems, and leaves. Increasing photosynthate will increase dry weight (Azahra *et al*., 2022). The dry weight of sprouts is greatly influenced by how quickly the seeds germinate and carry out photosynthetic activity. Seeds germinating more quickly will grow and develop more quickly, resulting in a heavier, dry weight. Dry weight is closely related to plant tissue's dry matter content and reflects the production produced. The higher the temperature for soaking the seeds, the faster the seeds will germinate; water with a temperature of 90 °C can soften the seed coat, making it easier for the plumules and roots to emerge from the seed coat. The speed of seed germination will also affect the results of plant photosynthesis, which are used for growth; this is reflected in the plant's increase in size and dry weight. Seeds germinating more quickly tend to be larger, so they will have a heavier dry weight (Murrinie *et al*., 2021).

CONCLUSION

Soaking duration has a significant effect on the germination time of *Mucuna bracteata* seeds; however, it does not significantly influence germination percentage, the number of normal seedlings, or the dry weight of seedlings. Water temperature significantly affects germination percentage, the number of normal seedlings, and the dry weight of seedlings, but it does not have a significant effect on germination time. The interaction between soaking duration and water temperature has no significant effect on germination time, germination percentage, the number of normal seedlings, or the dry weight of seedlings.

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