Dormancy Breaking of Kimalaka Seeds (Phyllanthus emblica L.) at Various Concentrations of Sulfuric Acid

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Abstract. The kimalaka plant (Phyllanthus emblica L.), known as "balakka", by the people of North Sumatra, with the English translation is called indian gooseberry [1] and is called “popok melaka” in Malaysia [2]. The kimalaka plant is a commodity with great potential to be developed, one of which is due to the high content of vitamin C so that the kimalaka plant has many health benefits. Especially in the Padangsidimpuan area and its surroundings, this kimalaka plant is more widely known as a mixture of traditional cooking spices, with the name of the food being called "holat". The widespread conversion of land into smallholder plantations with commodities such as rubber and oil palm is one of the threats to the extinction of the kimalaka plant. Lack of information about the kimalaka plant is also the cause of the underdevelopment of this kimalaka cultivation. Kimalaka seed with a very hard seed coat is a factor causing kimalaka seed dormancy. So before planting, there must be a treatment to break dormancy. This study aims to see and observe the effect of various sulfuric acid concentrations to break the dormancy of kimalaka seeds. This study used a non-factorial randomized block design (RBD) with one factor, namely the concentration of sulfuric acid with 4 levels, namely: A0 = Control, A1 = 4%, A2 = 6%, A3 = 8%. The observation variables were the percentage of germination (%), plant height (cm), and the number of leaves. Based on the results of this study, it was found that the treatment of sulfuric acid concentration was significantly different in all observation variables. The treatment that gave the best effect on all observation parameters was sulfuric acid at a concentration of 8%. In future research, it is suggested to increase the sulfuric acid concentration.

1. Introduction
Phyllanthus emblica, known in Indonesia as kimalaka [1]. The people of North Sumatra call this plant "balakka". In English, this plant is called Indian gooseberry [2], while in Malaysia it is called “Popok Melaka” [3] and Thailand is known as Ma-kham-pom [4]. The Indian state called the milan plant by various names, for example, Aonia, Amla, Amlika, Dhotri, Embelica, and Usuri [5]. Phyllanthus embelica generally grows in tropical and subtropical areas including in India, China, Indonesia, Peninsular Malaysia, Thailand [4]. Kimalaka fruit contains a high source of vitamin C [6]. According to [7], every 100 grams of kimalaka fruit contains approximately 600-1300 vitamin C.
The kimalaka plant is a commodity with great potential to be developed, one of which is due to the high content of vitamin C so that the kimalaka plant has many health benefits. Especially in the Padangsidimpuan area and its surroundings, this kimalaka plant is more widely known as a mixture of traditional cooking spices, with the name of the food being called "holat".

The widespread conversion of land into smallholder plantations with commodities such as rubber and oil palm is one of the threats to the extinction of the kimalaka plant. Lack of information about the kimalaka plant is also the cause of the underdevelopment of this kimalaka cultivation. Kimalaka seed with a very hard seed coat is a factor causing kimalaka seed dormancy. So before planting, there must be a treatment to break dormancy.

The hard seed coat is impermeable to water and air, which prevents the germination process of the seed. To speed up the process of breaking dormancy and the germination process of thick and hard-skinned seeds, several ways must be done, one of which is by soaking the seeds in chemical solutions such as sulfuric acid (H2SO4), nitric acid (HNO3) and hydrochloric acid (HCl) [8].

Sulfuric acid is a solid mineral (inorganic) acid. This substance dissolves in water at all ratios. H2SO4 can break down the cell wall components of the seeds, so that the cell walls are more permeable and the water absorption process in the seeds runs well [9]. Sulfuric acid (H2SO4) at the appropriate concentration can soften the waxy layer on the hard and thick seed coat [10]. The cell wall is composed of cellulose microfibrils which consist of polysaccharides. Treatment with sulfuric acid can break the bonds of cellulose microfibrils causing the cell wall to be more permeable, so that water and oxygen can easily enter the seed cells. Water and oxygen that enter the seed cells are needed for embryonic respiration in the seeds [11]; [12].

Based on the above background, this study aims to study and see the effect of sulfuric acid immersion at various concentrations on germination and growth in kimalaka seeds. The implementation of this research is one of the efforts to solve the kimalaka plant cultivation problem, especially in the kimalaka seed dormancy problem.

2. Methods

This research was conducted in October-December 2018. The location of the research was carried out in the screen house of the Faculty of Agriculture, Graha Nusantara University, Padangsidimpuan, with an altitude of about 480 m above sea level.

The materials used in this study were Kimalaka seeds (Phyllanthus emblica L), sulfuric acid (H2SO4), topsoil, water, and sand. The tools used in this study were knives, trays, hoes, wood, digital scales, labels, cameras, and other stationery.

This research was conducted in a non-factorial randomized block design (RBD) with different concentrations of sulfuric acid and the same immersion time for 45 minutes. The treatment of this study consisted of 4 levels, namely: A0: Control, A1 = 4% sulfuric acid, A2 = 6% sulfuric acid, A3 = 8%Sulfuric acid. Observation variable in this study: percentage of germination (%) plant height (cm), and number of leaves (strands).

3. Results and Discussion

3.1 Germination percentage (%)

Based on the analysis of variance and continued with the 5% LSD test, it can be seen that the application of sulfuric acid with different concentrations has a significant effect on kimalaka seed germination. The average percentage of plant germination can be seen in Table 1.

Based on Table 1, from the results of the 5% LSD test, it can be seen that the percentage of plant germination has a significant effect; it can be seen from the A0 treatment (control) significantly different from all treatments A1 (H2SO4 4%), A2 (H2SO4 6%), and A3 (H2SO4 8%). From the results of the research, the best treatment was treatment A3 (8%) with a percentage of germination 61.108%. The results of this study are supported by the statement of [13] which states that strong acids are very effective in breaking dormancy in seeds that have a hard seed coat structure.
Table 1. Average Percentage of Kimalaka seed germination (7 WAP)

| Sulfuric acid concentration (%) | Percentage of germination(%) |
|--------------------------------|-----------------------------|
| 0                              | 20.83 a                     |
| 4                              | 38.88 b                     |
| 6                              | 51.38 c                     |
| 8                              | 61.10 d                     |

Note: The numbers followed by the same letter in the same column show no significant difference based on a 5% variance analysis.

3.2 Plant Height (cm)

Based on the results of analysis of variance at the age of 5 to 8 weeks after planting (WAP), it was found that the treatment of sulfuric acid with different concentrations on plant height parameters showed a significant effect. The average plant height can be seen in Table 2.

Table 2. The Average Kimalaka Plant Height (cm)

| Sulfuric acid concentration (%) | Height Plant (cm) |
|--------------------------------|-------------------|
|                                | 5 WAP  | 6 WAP  | 7 WAP  | 8 WAP  |
| 0                              | 1.18 a  | 2.36 a  | 3.43 a  | 4.81 a  |
| 4                              | 2.21 b  | 3.02 b  | 5.50 b  | 6.36 b  |
| 6                              | 2.70 b  | 3.11 b  | 6.09 b  | 7.00 b  |
| 8                              | 3.18 c  | 3.76 c  | 6.75 c  | 7.98 c  |

Based on the analysis of Table 2, from the results of the LSD 5%, it can be seen that the plant height produces a significant difference. Treatment A0 was significantly different from all treatments, treatment A1 was significantly different from treatment A0, and A3, but not significantly different from treatment A2. Treatment A3 was significantly different from treatment A0 and A1.

Based on the research results, it is known that the best average kimalaka plant height is found in treatment A3, while the lowest treatment is in treatment A0. Plant height is closely related to the rate of germination. If the rate of germination is fast, the seeds will grow quickly so that the plant will grow taller. In addition, the increase in plant height is influenced by the water content around the medium where the seeds are grown. According to [14], water is an important condition for the continuity of plant growth.

Kimalaka plant height increase is indeed influenced by the conditions of the seedlings. The better the treatment given, the better the growth of the kimalaka seedlings, so the better the height of the seedlings. This is in accordance with the research of [15], which shows that the seeds that have germinated will direct their growth for root extension in obtaining more water and nutrients which will be used for growth and development.

3.3 The Number of Leaves (Strands)

Based on the analysis of variance, it was found that the treatment of sulfuric acid with different concentrations had a significant effect on the number of leaves of the kimalaka plant.

Observation of the leaf number parameters in Table 3 above can be seen that treatment A0 is significantly different from treatment A1, A2 and A3. The highest average number of leaves was found in treatment A3 (8% concentration), namely 114,666 leaves and the lowest was in treatment A0 (control), namely 48,666. The treatment of sulfuric acid with different concentrations showed that the higher the concentration, the more the number of leaves.

The treatment of sulfuric acid with different concentrations of A3 (8%), namely 114,666 leaves was significantly different from other treatments due to optimal plant metabolism at a concentration of 8% starting from the germination percentage and plant height so that leaf growth increased. This is in accordance with the statement of [16], that the plant metabolic process will increase plant growth which is relatively more perfect in plant growth, which will promote better growth, including an
increase in the number of leaves. Supported by the opinion of [14] and [17], in the seeds there is a food reserve which will later be overhauled at the germination metabolic stage, the better the quality of the seeds is followed by a good food reserve, then the germination metabolism will be optimal.

Table 3. The Average Number of Leaves (strands)

| The sulfuric acid concentration (%) | The Average number of leaves (strands) |
|-------------------------------------|---------------------------------------|
| 0                                   | 48.66 a                               |
| 4                                   | 60.66 b                               |
| 6                                   | 82.83 b                               |
| 8                                   | 114.66 c                              |

Note: The numbers followed by the same letter in the same column show no significant difference based on a 5% variance analysis.

4. Conclusions

The sulfuric acid treatment with different concentrations had a significant effect on the germination percentage, plant height, and number of leaves. The treatment with the best effect was obtained at the 8% sulfuric acid treatment and the lowest treatment effect was on the control treatment.

References

[1] Uji, T. Review: Keanekaragaman Jenis Buah-Buahan Ash Indonesia dan Potensinya. Puslit Biologi LIPI. Jurnal. Vol: 8(2):157-167, 2006.
[2] Bhandari, P.R., and M.A. Kamdod. Emblica officinalis (Amla): A review of Potential therapeutic application. International Journal of Green Farmacy. Vol. 6: 257-269, 2013.
[3] Khan, K.H. and K. Khan. Roles of Emblica officinalis in Medicine - A Review. Botany Research International Vol.2, No 4 pp. 218-228, 2009.
[4] Charoenteeraboon, J., Ngamkitidechakul, C., Soonthorncharoennnon, N., Jaijoi, K., Sireratawong, S. Antioxidant ActiviesofThe Standardized Water Extract from Fruit of Phyllanthusemblica Linn. Songklanakarin Journal of Science and Technology. Vol. 32 (6):599-604, 2010.
[5] Nayaka, D.G. Propagation Studies in Aonla (Phyllanthus emblica L. Thesis. Department of Horticulture College of Agriculture. University of Agricultural Sciences. Dharward, 2006.
[6] Qureshi, S. A., Asad W., Sultana, V. The Effect of Phyllanthusemblica Linn on Type- II Diabetes, Triglycerides and Liver- Specific Enzyme. Pakistan Journal of Nutrition. Vol. 8(2):125-128, 2009.
[7] Yulistyarini, T., Ariyanti, E.E., Yulia, N.D. Jenis-jenis Tanaman Buah yang Bermannfaat untuk Usaha Konservasi Lahan Kering. Prosiding Seminar Hari Cinta Puspa dan Satwa Nasional. Kebun Raya Purwodadi-LIPI. Purwodadi. Pasuruan. Jawa Timur, 2000.
[8] Purnomosidhi P., J. M. Roshetko, A. Prahmono, A. Suryadi, I. N. Ismawan, and M. Surgana. Perlakuan benih sebelum disemai untuk beberapa jenis tanaman prioritas kehutanan, mulutiga, buah-buahan, dan perkebunan. Presowing treatments for some priority timber and multipurpose tree species, fruit species, and estate crops. Lembar Informasi Ag For no. 4 Februari. Bogor, Indonesia: World Agroforestry Centre (ICRAF) Southeast Asia Regional Program, 2013.
[9] Suyatmi, E., Hastuti dan S. Darmanti. Pengaruh Lama Perendaman dan Konsentrasi Asam Sulfat (H2SO4) terhadap Perkecambahan Benih Jati (Tectona grandis Linn.). F.MIPA, UNDIP, 2008.
[10] Sagala, J., Perlakuan Benih cendana Dengan Air, asam Sulfat, GA3, Jurnal Departemen Kehutanan, Bogor, 1990.
[11] Wareing, P. F. dan I. D. Phillips. Growth and defferntiation Plants, 3’d edition, Pergamon Press, Chicago, 1989.
[12] Sumanto dan Sriwahyuni. Pengembangan Perlakuan Benih Terhadap Perkecambahan. Pusat Penelitian Dan Perkembangan Tanaman Industri, 1993.
[13] Schmid L. Pedoman Penanganan Benih Tanaman Hutan Tropis dan Sub Tropis (terjemahan) Dr. Mohammad Na’iem dkk. Bandung, 2002.
[14] Sutopo, L. Teknologi Benih. Buku. Rajawali Pres. Jakarta, 2004.
[15] Isbandi. Pertumbuhan dan Perkembangan Tanaman, UGM Press. Yogyakarta, 1989.
[16] Villers, T. A. Seed Dormancy, p 220-282. In T. T. Kozlowski (ed). Seed Biology. Vol II. Academic Press. New York, 2006.
[17] Usmanji, C. E. Studi Dormansi Benih dan Berbagai Cara Pematahannya. Fakultas Pertanian. IPB. Bogor. Hal 63, 1990.