ASSESSMENT OF GERMINATION, SEEDLING SUBSTRATE, AND GROWTH OF *Plukenetia volubilis L.* (SACHA INCHI)

LIYANA AFIQAH BINTI ABD RAHMAN

SULTAN IDRIS EDUCATION UNIVERSITY

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ABSTRACT

Plukenetia volubilis L. is an Amazon species commonly known as sacha inchi, considered a high agro-industrial potential plant due to high nutritional values. Despite some published propagation studies of sacha inchi, to the best of our knowledge, there is little information about its dormancy and growth pattern, especially from Malaysia. Thus, this study aimed was to assess seed germination, seedling substrate requirement and growth pattern of sacha inchi. The germination test was using four different treatments: acid scarification, mechanical scarification, an overnight soak in water, and hot water. Two different scarification methods were conducted using sulphuric acid with a concentration of 20% (98.08g/mol) and mechanical scarification using sandpaper (grade 80) sanding gently about 30 sec to 1 min. Hot water treatment was done by soaking the seeds in 82ºC of hot water until the temperature drops to room temperature and control treatment, an overnight soak in water. Seedling substrate requirement test was using sand and peat moss, seedlings were placed at the temperature of 25-30ºC with continuous light for 15 days. The growth pattern test was conducted under shade house with no treatment to study its habitat. In this study, the best way to break the seed dormancy of *Plukenetia volubilis* L. was by using mechanical scarification (64% germinated seeds) to promote germination and considered a feasible method. For seedling substrate requirement, peatmoss stimulated leaves growth and sand promoted root growth. The growth pattern of *Plukenetia volubilis* L. was obtained in a positive quadratic equation for the number of leaves, leaf area (cm^2) and height (cm) over day after transplant (DAT).

PENILAIAN PERCAMBAHAN, SUBSTRAT ANAK BENIH, DAN PERTUMBUHAN *Plukenetia volubilis* L. (SACHA INCHI)

ABSTRAK

Plukenetia volubilis L. adalah spesies Amazon yang dikenali sebagai sacha inchi, merupakan tanaman yang berpotensi dalam agro-industri kerana mempunyai nilai pemakanan yang tinggi. Walaupun terdapat beberapa kajian pembiakan sacha inchi yang diterbitkan, sepanjang pengetahuan kami, hanya terdapat sedikit maklumat mengenai dorman dan corak pertumbuhannya, terutamanya kajian dari Malaysia. Oleh itu, kajian ini bertujuan untuk menguji percambahan biji benih, keperluan substrat benih dan pola pertumbuhan. Kajian percambahan menggunakan empat rawatan berbeza; skarifikasi asid, skarifikasi mekanikal, rendam semalaman dalam air, dan air panas. Dua kaedah skarifikasi berbeza dilakukan dengan menggunakan asid sulfurik dengan kepekatan 20% (98.08g / mol) dan skarifikasi mekanikal menggunakan kertas pasir (gred 80) pengamplasan dengan lembut kira-kira 30 saat hingga 1 minit. Rawatan air panas dilakukan dengan merendam benih dalam air panas dengan suhu 82ºC hingga suhu air turun ke suhu bilik dan rawatan terkawal iaitu biji benih direndam semalaman dalam air suling. Kajian keperluan substrat benih menggunakan pasir dan tanah gambut dimana anak benih ditempatkan pada suhu 25-30ºC dengan cahaya berterusan selama 15 hari. Kajian ke atas corak pertumbuhan dilakukan di bawah naungan tanpa rawatan untuk mengkaji habitatnya. Dalam kajian ini, cara terbaik untuk memecahkan dormansi benih *Plukenetia volubilis* L. adalah dengan menggunakan skarifikasi mekanikal (64% benih tercambah) untuk menggalakkan percambahan dan dianggap kaedah yang terbaik untuk percambahan. Untuk keperluan substrat benih, gambut merangsang pertumbuhan daun dan pasir mendorong pertumbuhan akar. Corak pertumbuhan *Plukenetia volubilis* L. diperoleh dalam persamaan kuadratik positif untuk jumlah daun, luas daun (cm^2) dan tinggi (cm) sehari setelah pemindahan (DAT).

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cm	centimeter
etc	et cetera
mm	millimeter
^{o}C	celcius
%	percentage

CHAPTER 1

INTRODUCTION

1.1 Introduction

The plant species *Plukenetia volubilis* L.*,* which belongs to the Euphorbiaceae family, was first discovered in the Amazon region. This plant is also known as sacha inchi by a number of different names. This highly prized plant can be located in the countries of Peru, Venezuela, Brazil, and Colombia (Céspedes, 2006). The seeds of sacha inchi have a high content of fatty acids, specifically linolenic acid (omega-3) and linoleic acid (omega-6). This is one of the reasons why sacha inchi is considered to have agro-industrial potential (Follegatti-Romero et al., 2009). According to a previous study, these fatty acids have the potential to prevent illnesses such as antithrombotic action, cardiovascular disorders, and lower glyceride levels (Cardinal-McTeague et al., 2019).

The seed and oil extracts are utilized extensively in different processed forms for the trade market for cosmetics (oil), dietary supplements or food, and medicinal (drug), primarily. A qualitative discovery has been made regarding the presence of secondary metabolites in the seed. In the seed, the levels of the chemical compounds

coumarins and saponins range from moderate to abundant (Rabanal, 2015). There is a significant quantity of alkaloids present in both the ethanolic and the aqueous extracts of the seed (Pariona-Mendoza, 2008). The species has also been proposed as a choice for family farming programmes and to restore damaged or degraded areas since it possesses important characteristics, particularly for slope fortification and replantation (Bordignon, Ambrosano, & Rodrigues, 2012).

1.2 Background of Study

Plant propagation is a process of increasing the number of plants of particular species. There are two primary forms of propagation; sexual and asexual. Sexual propagation used seed to produce new plants. The seeds will germinate once it is exposed to favorable environmental conditions. There are three important factors that regulate the germination process which are moisture, temperature, and oxygen (Rafael & Jane, 2013). Apart from that, other factors that affect the seeds germination are seed coat and dormancy (Mousavi, Rezaei & Mousavi, 2011). Sacha inchi is one of underutilized plants with a hard seed coat problem (Sethuraman, et al., 2020). To date, sacha inchi has its own potential market where people benefit a lot from its precious oil, including in Malaysia.

Many studies have shown that seeds and nuts provide various health benefits, such as reducing risk factors for metabolic syndrome and the risk of other chronic diseases (Balakrishna, Bjørnerud, Bemanian, Aune & Fadnes, 2022). In 2017, small farmers in Perak, Malaysia, were introduced to a new imported plant, sacha inchi

which originated from the Amazon rainforest. Sacha inchi is one of the government's efforts to increase small farmers' incomes (BERNAMA, 2017).

Sacha inchi has been domesticated by humans in South America and highly valued for its medicinal and nutritional properties. Its remarkable benefits have started to gain acknowledgement worldwide. Advantages in sacha inchi cultivation comprise a high crop yield, rapid return to investment, and rigorous cultivation. Sacha inchi is being cropped commercially in the Peruvian Amazon. One of the biggest productions is in Brazil. Brazil has the potential to produce this plant because of the climate. The seeds contain 41.4% oil and 24-29% protein (Gutiérrez, Rosada, & Jiménez, 2011; Souza, Gohara, Rodrigues, Souza, & Matsushita, 2013; Rodríguez, Villanueva, Glorio, & Baquerizo, 2015) and elevated levels of vitamin E and A (Fanali, et al., 2011), in which it is proper for dietary use. Sacha inchi oil contains omega 3 (linolenic acid) which is highly nutritious (Guillén et al., 2003; Céspedes, 2006; Clavijo, Rodríguez, & Estupiñán, 2015). These fatty acids are said to have the ability to preclude lower glyceride levels, antithrombotic action, and cardiovascular disorders (Garmendia, Pandos, & Ronceros, 2011).

Since sacha inchi is quite famous and has been acknowledged in other parts of the world as a bearable crop with feasible commercial applications, sacha inchi will become one of the crucial crops yields in Malaysia (BERNAMA, 2017).

1.3 Problem Statement

Sacha inchi is one of underutilized plants that recently became popular in Malaysia. This climbing plant produced very valuable seeds containing oil which reported to have high antioxidant properties such as phenols, tocopherols and carotenoids (Kodahl and Sorensen, 2021). In 2017, Rubber Industry Smallholder Development Authority (RISDA) introduced sacha inchi to small farmers in Perak (Berita Harian, 2017). RISDA encouraged the farmers to plant sacha inchi because the demand on this plant increased tremendously. To date, sacha inchi is cultivated by seeds. The germination rate of the seeds is low due to the hard seed coat problem. The seed is water impermeable. Normally, the farmers will soak the seeds in water for 24 hours to break the dormancy (Supriyanto, et al., 2022). This orthodox method has barely managed to make the seed germinate on the 14th days after the seed sown (Plants Database, 2019). Consequently, the propagation takes longer times and may affect the cultivation process that is not convenient and not efficient. Aside from that, the seed is expensive where the cost of 1kg of seed is RM100. If the seeds fail to germinate, farmers need to bear huge losses and need to repeat the process again.

1.4 Objective of Study

The objectives of these study were:

1. To identify the best treatment to break the seed dormancy of *Plukenetia volubilis* L.
2. To investigate the best substrate for seedling growth of *Plukenetia volubilis* L.

3. To observe the growth pattern of *Plukenetia volubilis* L.

1.5 Significance of Study

The properties and composition of sacha inchi seeds are comparatively well known but, there is a lack of detailed information about cultivation potentials (Cai, et al., 2012). Although there have been some published studies on sacha inchi in vitro propagation, the information on seed germination and seedling growth is still in its early stages, to the best of our knowledge (Bordignon et al., 2012; Rosa & Quijada, 2013). Therefore, this study can be a future reference in the cultivation and agricultural application of sacha inchi in Malaysia. It can help the small farmers to get the best way of cultivating sacha inchi efficiently.

1.6 Scope and Limitation of Study

This study was focused on pretreatments of seed dormancy, substrate requirement for seedling growth, and the growth of *Plukenetia volubilis* L. There are few limitations of this study where only few treatments of seed dormancy were used. The selected treatments were chemical scarification by using sulphuric acid, mechanical scarification, dipping in hot water, and soaked the seed overnight in distilled water. Furthermore, only two types of substrates which were sand and peat moss were used to identify the best growing media for sacha inchi seedling growth. During the progress of the study, seedlings that were being attacked and infested by pests and diseases were eliminated, hence affecting the data collection process. Apart from that, for growth study, the plants were planted following the Euphorbiaceae recommended agronomy

practices. There were no fertilizer comparisons treatments applied in this study. Therefore, the information about the best fertilizer types for sacha inchi plantation were not discovered.