Faculty of Resource Science and Technology

GERMINATION OF *Solanum lasiocarpum* Dunal SEEDS FOLLOWING CHEMOPRIMING TREATMENT

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Bachelor of Science with Honours
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Germination of *Solanum lasiocarpum* Dunal Seeds

Following Chemopriming Treatment

Raja Nur Mastura binti R. Arifin

This Project is submitted in partial fulfillment of the requirements for the degree of

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I hereby declare that no portion of this project work has been submitted in support of an application for another degree of qualification of this or any other university or institution of higher learning.

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List of Abbreviations

CRD	Completely Randomized Design
ANOVA	Analysis of Variance
HSD	Honestly Significant Difference
AOSA	Association of Official Seed Analysts
KOH	Potassium hydroxide

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Germination of *Solanum lasiocarpum* Dunal Seeds Following Chemopriming Treatment

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ABSTRACT

A study was conducted to evaluate the effectiveness of chemopriming treatments in enhancing the germination of *S. lasiocarpum* seeds. Seeds were primed with three priming agents: ascorbic acid ethanol, and sucrose for different priming periods, respectively. There were significant differences in concentration and priming periods, respectively for sucrose, ascorbic acid, and ethanol. However, no significant difference exists between these two factors: concentration and priming period, for sucrose priming. Sucrose priming was observed effectively enhancing seed germination compared to ascorbic acid and ethanol priming. The highest germination was obtained with sucrose priming at 1% sucrose concentration for 3 hours (M=65%) compared to others in 3% ascorbic acid concentration at 12 hours (M=48%) and 2% ethanol concentration at 3 hours (M=47%). Moisture content have major influenced on enhancing germination. Germination has a proportional relation with seed moisture content.

Key words: *S. lasiocarpum* seeds, chemopriming treatments, moisture content, germination

ABSTRAK

Satu kajian telah dijalankan untuk menilai keberkesanan rawatan pembaikan kimia biji benih dalam meningkatkan percambahan biji benih S. lasiocarpum. Biji benih telah direndam dengan tiga agen pembaikan biji benih yang berbeza: asid askorbik, etanol, dan sukrosa untuk tempoh rendaman masing-masing yang berbeza. Terdapat perbezaan yang signifikan dalam kepekatan dan tempoh pembaikan, masing-masing untuk sukrosa, asid askorbik, dan etanol. Walaubagaimanapun, tiada perbezaan yang signifikan wujud di antara kedua-dua faktor: kepekatan dan tempoh pembaikan, untuk pembaikan sukrosa. Pembaikan sukrosa diperhatikan berkesan meningkatkan percambahan biji benih berbanding pembaikan asid askorbik dan etanol. Percambahan tertinggi didapati daripada pembaikan sukrosa pada 1% kepekatan sukrosa selama 3 jam (M = 65%) berbanding dengan yang lain dalam 3% kepekatan asid askorbik pada 12 jam (M = 48%) dan 2% kepekatan etanol pada 3 jam (M = 47%). Kandungan lembapan mempunyai pengaruh besar kepada peningkatan percambahan. Percambahan mempunyai hubungan berkadar dengan kandungan kelembapan biji benih.

Kata kunci: Biji benih S. lasiocarpum, rawatan pembaikan kimia biji benih, kandungan kelembapan, percambahan

1.0 INTRODUCTION

1.1 Background

Solanum lasiocarpum Dunal, of family Solanaceae, is basically a wild or semi-wild species occasionally cultivated for its edible fruits in Southeast Asia, especially New Guinea and Sarawak. Since formerly known as Terung Asam or Terung Dayak, it is a popular native vegetable in Sarawak (Shariah, n.d).

The Terung Asam plant is a thorny and woody perennial herb, 1.0 – 2.5 m tall, densely pubescent throughout the plant. It has erect and spreading shoots bearing large green leaves, shallowly lobed, and alternate arranged. The inflorescence consists of 2 – 6 flowers. Flower is small, white with star-like petals arrangement. It develops into a small to large, round to oval sourish fruit. Immature fruit is green and turns into normally yellow to orange when ripe. Some varieties have fruit with tints of dark purple colour while other varieties have fruit that are purplish black or cream to brownish black in colour (Shariah, n.d).

The fruit, with its distinctive sour taste, is a favourite to the locals as a vegetable or flavouring in many dishes. It can be prepared with fish, made into 'kerabu' or cooked in curry. This species has some medicinal value as well. With increasing demand and good market prices, Terung Asam has good prospect to be promoted as one of the specialty fruit vegetable of Sarawak, especially among tourists (Shariah, n.d).

Research work has been done by Department of Agriculture Sarawak to support the development of this crop and in 1997, an elite variety called 'Terung Mas' was launched which has potential for commercial production. The only drawback to the intensive production of Terung Asam is bacterial wilt disease. However, research has come up with solution to overcome this problem by grafting the Terung Asam onto disease resistant *Solanum* species such as Terung Unggul (*Solanum melongena*) as rootstock. Further improvement and development of Terung Asam cultivation system is being carried out by the Department of Agriculture to increase its production and quality (Shariah, n.d).

Besides fresh consumption, Terung Asam fruit has potential to be developed into downstream products such as jam, cordial, juice, canned or confectionery. This will add value for commercialisation. Research work on product development is being conducted by the Postharvest and Food Technology Centre at the Agriculture Research Centre, Semongok (Shariah, n.d).

Given its uniqueness in Sarawak and good prospect for commercial production, GI certification for Terung Asam Sarawak will further add value to the product. This will effectively increase farmers' income and subsequently create greater demand at home and even abroad (Shariah, n.d).

According to Voon & Kueh (1999), Terung Asam Sarawak is comparable to egg plant and has better mineral content but lower vitamin C compared with its cultivated relative. Besides that, Terung Asam which are free of pesticide residue are important food sources for rural populations. Nutritious indigenous fruit vegetables of Terung Asam have the potential to be promoted for wider use, domestication, and commercialization. Moreover, given that indigenous fruits vegetables are better adapted to the local ecology, they are easier to grow and have few pests and diseases compared with introduced varieties. Many other vegetables of native origin could be popularized to add variety to the diets of the urban residents.

1.2 Problems Statement

Seeds of *S. lasiocarpum* have become an important source of planting material which has good prospect to be developed and promoted as a cash crop. Currently, *S. lasiocarpum* is propagated by seeds. Since *S. lasiocarpum* seeds were orthodox and have poor seed germination which limits the use of different species for culture or plant breeding, thus *S. lasiocarpum* seeds are tested with treatments for improving the germination. Besides that, the production of high quality seeds of *S. lasiocarpum* are needed for gaining the good and high quality produces and also for conservation and use of germplasm resources . In this study, the seed germination of *S. lasiocarpum* has been accessed by three different type of chemopriming treatments.

1.3 Objectives

The main objective of this study was to determine the effects of seed priming using different concentration of sucrose, ascorbic acid, and ethanol on *S. lasiocarpum* seed germination. Besides that, this study also aimed to determine optimum moisture content for germination of *S. lasiocarpum* seed using different chemopriming materials.

2.0 LITERATURE REVIEW

2.1 Orthodox Seed

S. lasiocarpum seed is classified as orthodox seed which means that it can be dried to lower moisture content without damaged and over a wide range of conditions. By dessication to decrease seed storage moisture content and temperature (Roberts, 1973; Robert & Ellis *et al.*, 1983) to around-350Mpa (Ellis *et al.*, 1989), orthodox seed longevity can be improved. Conversely, as for recalcitrant seed, the seeds are killed if the water potential drops below about-1.5 to 5.0Mpa.

Orthodox seeds can be further classified into two groups: non-dormant and dormant orthodox. Dormant seeds may be imbibed for some or all of the time. The maintenance of viability depends upon the regular repair of deteriorative changes during period spent at high water potentials. Longevity depends upon the primary dormancy being present at shedding either still remaining or being reinforced by secondary dormancy (Fenner, 2000).

2.2 Seed Moisture Content

Moisture content of seed is the amount of the water in the seed usually expressed in percentage. It can be expressed either a wet-weight basis, where it is expressed as a percentage of the fresh weight of the seed or on a dry weight basis, where it is expressed as a percentage of the dry weight of the seed. It will give effect to the storage life of the seeds if there is any small change in the seed moisture content. Hanson (1985) reported that is important to know the moisture content in order to make a reasonably accurate prediction of the possible storage life of each accession.

When moisture content is higher than 30%, the non-dormant seeds may germinate, and from 18 - 30% moisture content rapid deterioration by microorganisms can occur (Bewley and Black, 1994). Seed stored at moisture content higher than 18 - 20% will respire, and in poor ventilation the generated heat will kill them. For the seeds that are below 8 - 9% moisture content, there is little or no insect activity, and for those below 4 - 5% moisture content seeds are immune from attack by insect and storage fungi but may deteriorate faster than those maintained at slightly higher moisture content.

Seed have to be stored at a critical moisture content which is usually little lower than the seed moisture content at harvest and lost viability with decrease in their moisture content (Mittal *et al.*, 1998). At critical moisture content, seeds are physiologically mature and are at optimum and maximum viability at germination and storage.

2.3 Seed Viability

The definition of viability is the ability of a seed to germinate and produce a "normal" seedling (Copeland and McDonald, 1995). Viability also indicates the degree to which a seed is alive, metabolically active, and possesses enzymes capable of catalyzing metabolic reactions needed for germination and seedling growth. Seed viability is probably highest at the time of physiological maturity though environment conditions on the parent plant may not permit germination. After physiological maturity, the viability of seeds gradually declines. Their longevity depends on the environmental conditions to which they are exposed. Viability needs to be determined at the start of storage and at regular intervals during storage to predict the correct time for regeneration of the accession (Hanson, 1985). The viability test takes from a few days to weeks or even months to give an accurate result.

There are numerous tests for determining seed viability. The tetrazolium (TZ) test is widely recognized as an accurate means of estimating seed viability (Copeland and McDonald, 1995) and this test is very useful for rapidly obtaining an indication of germination potential and viability of samples and is widely used (Agrawal, 1980). The advantage of TZ test is the rapidity of the test and its use may be justified when speed is important. Other than that, it also can be useful for testing dormant seed when used in combination with a germination test. The germination test tells the percentage of immediate germination while the TZ test tells the percentage of live seeds. The difference between these two tests represents the percentage of dormant seed (Copeland and McDonald, 1995).

2.4 Seed Germination

According to Fenner and Thompson (2005), germination is a process that involves the imbibitions of water, a rapid increase in respiratory activity, the mobilization of nutrient reserves and the initiation of growth in the embryo. This process is irreversible which once germination has started; the embryo is committed permenantly to growth or death. The seed physiologist defined germination as the emergence of the radical through the seed coat. For the seed analyst, germination is "the emergence and development from the seed embryo of those essential structures which, for the kind of seed in question, are indicative of the ability to produce a normal plant under favourable conditions" (AOSA, 1991). Germination test is conducted to estimate the maximum number of seeds that can be germinated in optimum condition. The high quality seeds are germinating maximum at physiological maturity. Otherwise, deterioration will occur due to ageing, effect of environmental conditions, and any damage sustained during collection, processing and storage.

2.5 Seed Storage

The purpose of seed storage is to preserve planting stocks from one season to the next and also to maintain the seed quality for the longest duration possible. This will create a greater diversity in seed inventory and provides a guarantee of seed supply in years when acceptable seed quality and production is low (Copeland and McDonald, 1995). The maintenance of high speed germination and storage vigor from harvest until planting is very important (Agrawal, 1980). Seeds are practically worthless if upon planting, they fail to give adequate plant stands. Therefore, good seed storage is a basic requirement in seed production. According to Ells *et al.* (2009), conditions essential to good seed storage are just the opposite of those required for good germination; good germination occurs when water and oxygen are present at a favorable temperature. Good seed storage results when seeds are kept dry, below 8°C is kept low and below 40°C.

2.6 Seed Dormancy

Leadem (1997) stated that many plants have dormant seeds as a biological mechanism to ensure that seed will germinate at a time and under conditions that are favourable for the growth and survival of the next generations. There are two types of dormancy: exogenous (seed coat dormancy) and endogenous (embryo dormancy). Seeds of some species have hard seed coats preventing imbibitions of water and the exchanges of gases. Without imbibitions and gaseous exchange, germination would be impossible. Physical seed coat dormancy occurs frequently in species adapted to alternating dry and wet seasons, including leguminous genera (Willan, 1985). There are several treatments to break dormancy for the purpose of inducing germination.

2.7 Seed Priming

Priming is a process applied on seed to strengthening or increase vitality of seed whereas hydration is known as process of supplying water to seed to maintain the fluid or moisture content in seed. Germination rates of seed can be accelerated through the process of priming where this treatment would improve seed vigor as it produce uniform seeding with faster germination rates (Walters, 1998).

Yoon *et al.* (1997) reported that seed priming has been used to improve vegetable and ornamental seed performance by increasing the speed of germination as well as improving germination seed uniformity. Priming also can help seeds overcome environmental stresses such as germination under extremely high temperatures or salt and water stress (Atheron and Farooque, 1983). Priming has been widely reported to enhance seed germination performance of various species of field crops, vegetables, and other plants (Welbaum *et al.*, 1998).

2.7.1 Hydropriming

Hydropriming is a mechanism whereby seed hydration in a solution whose osmotic potential is sufficient to permit initial germination events, but not enough for radical protrusion (Bradford, 1986). Hydropriming clearly improved speed of emergence, vigor index and seedling dry weight. The results showed that hydropriming is more efficient for cold rather than temperate area (Ahmadi *et al.*, 2007). Prehydration in water has emerged as a useful and effective priming technique that is cheaper and manageable in comparison to osmopriming.

2.7.2 Osmopriming

Osmopriming or osmoconditioning is another way of priming of germplasm such as seeds to enhance their viability, germination, and longevity. According to Doty *et al.* (1985), osmoconditioning is a technique which allows seed to absorb water very slowly from an aerated solution that containing the osmotic agents such as salts, mannitol and polyethylene glycol (PEG), potassium hydroxide (KOH), sucrose and hydrated-media. These agents are prepared in suitable concentrations which can help to condition the seeds to a level of vigor. Then, the seeds will be able to germinate early and therefore can have a better opportunity to compete in the environment in which they are growing.

The benefit of those agents is to supply the seed with nitrogen and other nutrient that are essential for protein synthesis during germination (Copeland and McDonald, 1995). However, there are also disadvantages of the osmoconditioning agents with their occasional toxicity to the germinating seedlings. According to Song (1996), osmoconditioning agents can be used to control the process of water absorption, so that cells can have enough time to rehabilitate membrane and synthesize big molecular. Polyethylene glycol (PEG) osmoconditioning is one method for seed treatment which has more advantages in promoting seed germination by keeping regular germinating and increasing disease resistance and biomass production (Song, 1996). Michel and Kaufmann (1973) stated that PEG is a high molecular weight, from 6000 to 8000 Daltons, inert compound which large molecular size precludes it from entering the seed and creating toxic side effects associated with the use of salts.

2.7.3 Chemopriming

This priming treatment of scarification technique use various chemical solutions such as ascorbic acid, ethanol, sulphuric acid, and salicylicate. Conducting with chemicals on this technique is by threatening the seeds on different concentrations.

2.7.3.1 Sucrose Priming

Sucrose is an important carbohydrate in most plants and is the major carbon form translocated in higher plants. It has multiple functions such as works as an important signaling molecule that regulates genes involved in photosynthesis, metabolism, and developmental processes serving as storage compound and helping to maintain the osmotic pressure in the cytosol (Teixeira, 2005). Many studies focused on glucose, normal decomposed product of sucrose, demonstrated that glucose resulted in a delay of germination and an inhibition of seedling development (Feng *et al.*, 2010).

2.7.3.2 Ascorbic Acid Priming

Priming by using ascorbic acid is one of the hormonal or growth promoters which are more specified under the classification of vitamin priming approaches. Heydecker and Coolbear (1977) stated that the concept of hormonal priming by 'permissively' influencing the matris of enzyme activities so that their net result either by emergence or dormancy breaking.

A study done by Farooq *et al.* (2007) indicated that the possibility of seed invigoration by seeds treatment using either salicylicate and ascorbic acid have shown some difference