UNIVERSITI PUTRA MALAYSIA

SEED QUALITY OF LABLAB BEAN [Lablab purpureus (L.) Sweet] INFLUENCED BY SEED MATURITY AND DRYING METHODS

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By

NURUL FATIN HANANI BT HANAPIAH

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Master of Science

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Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

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September 2020

Chairman : Uma Rani Sinniah, PhD
Faculty : Agriculture

Lablab bean or 'Kacang sepat' is a food crop originating from India and commonly found in tropical area such as Indonesia, Thailand and Philippine due to its adaptability. However, in Malaysia lablab is grown as a backyard crop and area cultivation with this crop is still limited. Due to the high protein content (18-25%) and multipurpose nature of the crop whereby as all parts can be consumed except the roots, lablab can be one potential commercial vegetables. Therefore, to increase lablab cultivation, good quality seeds should be a prerequisite. Harvesting at the ideal development stages produces high quality seeds. The first part of the study was conducted to access pod and seed physical characteristics of two types of lablab bean, dark purple (MDI 12839) and green with purple edge (MDI 12842). Plants were grown using standard cultural practices. Pods and seeds were collected at ten different maturity stages (5, 10, 15, 20, 25, 30, 35, 40, 45, and 50 Day after anthesis (DAA). Seed moisture content and seed dry weight was carried out to know the quality of seeds. The results showed significance between different maturity stages in all parameter studied. Pods and seeds showed significant different in size, colour and protein content. Seeds harvested at 20 DAA (Day after anthesis) showed maximum seed size and pod. The seeds from both types of lablab had attained physiological maturity (PM) at 30 DAA with moisture content was 27.3% for lablab dark purple and 23.3% for lablab green with purple edge. Lablab dark purple was not used in the second study. In this study, both types of drying, sun and oven drying managed to reduce seed moisture content. Harvested seeds at PM (30 DAA) and subjected to sun and oven method obtained maximum germination percentage, 89% and 91% respectively, while fresh seeds only 78%. Result indicated that the germination percentage of lablab improved, regardless of

the using any drying methods. In addition, seed vigour and seedling growth also showed significant different on interaction between maturity stages and drying method.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

KUALITI BIJI BENIH KACANG LABLAB [*Lablab purpureus* (L.) Sweet] YANG DIPENGARUHI OLEH KEMATANGAN BIJI BENIH DAN KAEDAH PENGERINGAN

Oleh

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Kacang lablab atau kacang sepat adalah tanaman makanan yang berasal dari India and kebiasaannya ditemui di kawasan tropika seperti Indonesia, Thailand, Filipina kerana kebolehsesuaian tempat. Walau bagaimanpun, tanaman lablab di Malaysia hanya ditanam sebagai tanaman halaman dan kawasan penanaman lablab adalah terhad. Disebabkan oleh kandungan protein yang tinggi (18-25%) dan bersifat tanaman serbaguna di mana kesemua bahagian boleh dimakan kecuali akar, pengambilan lablab boleh menjadi satu sayuran komersial yang berpotensi. Oleh itu, bagi meningkatkan penanaman lablab, pengeluaran biji benih yang berkualiti tinggi amatlah diperlukan. Penuaian pada peringkat yang ideal boleh menghasilkan biji benih yang berkualiti tinggi. Kajian pertama dijalankan bagi memperolehi ciri- ciri fizikal lengai dan biji benih bagi dua jenis kacang lablab, ungu gelap (MDI 12839) dan hijau dengan sisi ungu (MDI 12842). Pokok ditanam dengan menggunakan amalan penanaman piawaian yang telah ditetapkan. Lenggai dan biji benih telah dikumpulkan pada sepuluh peringkat kematangan yang berbeza (5, 10, 15, 20, 25, 30, 35, 40, 45 dan 50 DAA). Kandungan kelembapan biji benih dan berat kering biji benih dilakukan untuk mengetahui kualiti biji benih tersebut. Keputusan menunjukkan bahawa terdapat perbezaan yang signifikan di antara perbezaan peringkat kematangan yang berbeza pada semua parameter. Lenggai dan biji benih menunjukkan perbezaan signifikan pada saiz, warna dan kandungan protein. Biji benih yang dituai pada 20 hari selepas antesis (DAA) menunjukkan saiz lenggai biji benih yang maksimum. Biji benih dari kedua-dua jenis kacang lablab telah mencapai kematangan fisiologi (PM) pada 30 DAA dengan kandungan kelembapan 27.3% bagi lablab ungu gelap dan 23.3% bagi

lablab hijau dengan sisi ungu. Lablab ungu gelap tidak digunakan dalam kajian kedua. Dalam kajian yang kedua, dua jenis pengeringan berjaya mengurangkan kandungan kelembapan. Biji benih yang dituai pada peringkat PM (30 DAA) dan melalui kaedah pengeringan cahaya matahari dan ketuhar mencapai peratus percambangan yang maksimum, masing-masing 89% and 91%. Keputusan menunjukkan bahawa peratusan percambahan kacang lablab mampu ditingkatkan dengan mengunakan mana- mana kaedah pengeringan antara cahaya matahari dan ketuhar. Tambahan pula, kecergasan biji benih dan pertumbuhan anak pokok juga menunjukkan perbezaan signifikan antara interkasi pada peringkat kematangan dan kaedah pengeringan.

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This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Science. The members of the Supervisory Committee were as follows:

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LIST OF ABBREVIATIONS

Mt	Metric Tonne
%	Percentage
DAA	Day After Anthesis
℃	Temperature
mm	Millimeters
ft	Feet
g	gram
ml	Millimeter
cm	centimeter
NRC	National Research Council
PM	Physiological maturity
SVI	Seed Vigour Index
GA	Gibberellic acid
ABA	Abscisic acid
mRNA	Messenger RNA
CAT	catalase changes
POD	peroxidase
EC	Electrical Conductivity
h	Hours
DAT	day after planting
DAF	Day after flowering
UPM	Universiti Putra Malaysia
RHS	Royal Horticultural Society
ISTA	International Seed Testing Association
CRD	Completely Randomised Design
SAS	Statistical Analysis Software

CHAPTER 1

INTRODUCTION

Beans, often known as legumes, are the second most important food source in the human diet, as they contain numerous essential nutrients including proteins, carbohydrates, fibers, vitamins and minerals (Rudrappa, 2019). In Malaysia, a few types of beans namely, long beans, french beans, and four-angled beans are amongst the most popular, with a total production of 58,808, 12,304, and 4,644 Mt/year, respectively (Department of Agriculture, 2017). The above-mentioned beans have been reported to contain 3-12% protein (Rudrappa, 2019), hence its popularity. However, many indigenous and underutilized beans exist with much higher protein content, Lablab bean or "Kacang Sepat" with the scientific name *Lablab purpureus* L. being one of them. It is a crop commonly found in the tropical area with its seeds containing very high protein (18-25%) as highlighted in the study by Subagio (2006).

Lablab bean is a crop originating from India and known to be a versatile tropical legume due to its adaptability. It is not only drought resistant, but it is able to grow in a diverse range of environmental conditions worldwide (Salim et al., 2013). To date this bean can be found in countries such as Thailand, Vietnam, Indonesia and Philippines with variations in size, colour and shape. All parts of the plant, except the roots can be used either as a vegetable (pod and seed), as forage for animal feed (leaf, pods and seeds) and as herbal medicine (seeds, flowers and pods). Another more innovative means of using these beans are to make 'tempeh' (traditionally fermented food) which is usually made from soybean in Indonesia (Subagio & Morita, 2008). Due to multiple uses of this bean and based on the high protein content, this crop can be a potential commercial leguminous crop in Malaysia. Lablab bean is grown in Malaysia only as a backyard crop, with the current area cultivated being very low. In order to increase lablab bean cultivation to a commercial scale, good quality seeds should be made available locally.

Good quality seeds are an important factor for crop cultivation and to ensure high yields. Hasanuzzaman (2015) defined seed quality as having varietal purity with high germination percentage, free from disease and organisms, and with a proper moisture content and weight. Harvesting pods at the optimum maturity stage will result in high seed quality. Other factors such as seed size, seed weight, seed position on the plant and position of seeds within pods are also factors that may lead to variations in seed quality in terms of germination, seedling performance and uniformity in stand establishment.

Seeds must be harvested at the correct timing because it is crucial to avoid seed loss. Harvesting seeds too early before full maturity may lead to low seed quality and yield because of the high percentage of immature seeds produced. While over matured seeds can cause biological and physical losses by consistent wetting and drying of the crop (Kiaya, 2014). In many crop species, high seed quality is achieved when seeds attain maximum seed dry weight known as physiological maturity, PM (Harington, 1972; Browne, 1978; Tekrony & Egli, 1997; TeKrony & Hunter, 1995). Several researchers reported that physiological maturity is the best indicator to ensure that seed quality is maximum, for example in studies by (Lwin, 2010) in oil palm seeds, Kumar et al. (2014) in pumpkin seeds, Muasya et al. (2008) in common bean and Fakir et al. (2013) in ligosus bean. However, in a study carried out by Bedane et al. (2006), they mentioned that harvesting at physiological maturity is not practical and cannot be applied in the field as it is time consuming. In their opinion, growing degree-days (GDD) or days after flowering (DAF) is the fastest and more accurate indicator for seed maturity. Thus, in order to produce high quality seeds, seed producers or farmers should have sufficient information and knowledge on the correct time for harvesting seeds by using several indicators. Indicators are particularly important for judgement on when to harvest as seeds undergo deterioration after maximum seed quality is attained, leading to a progressive reduction in the physiological quality of the seeds.

Seed production of indeterminate crops such as Lablab bean, is more difficult as, at any point of time they can have flowers, young pods and over mature pods on the same plant. The continuous nature of flowering contributes to pods of varying maturity and complicates the process of selection of good quality seeds. Therefore, seed producers or farmers must have a simple indicator for harvesting seeds at the right time such as days after anthesis (DAA), moisture content and change in pod or seed colour. Some physical parameters are generally adapted and changes in colour has been most widely used as the indicator by farmers as legumes can change colour from early development until late harvesting. Cianzio & Ortiz (1993) researched soybean, an indeterminate crop and concluded that pod colour is the most reliable method to determine the correct time for harvesting the pods.

In addition, post-harvest handling of the pods harvested at the appropriate stage, especially drying of the seeds right after harvest is a crucial part in seed production. Based on the report from Yousaf et al. (2016), up to 30% losses can occur due to post-harvest handling and drying is one of them. Seed drying is intended to reduce the seed moisture content to safe limits for maintaining its viability and vigour during storage (Opondo, 2011), which otherwise deteriorate quickly due to mold growth, heating and enhanced microbial activity (Chala & Bekana, 2017). At physiological maturity seeds usually have 35-45% moisture content, much higher than that desirable for

safe storage, 14% (McLean, 1989). Other than to reduce seed respiration, drying can affect the seed quality for long term storage. In addition, Rao (2012) mentioned that freshly harvested seeds had lower germination percentage and desiccation appears to trigger the switch from development to germination mode, resulting in increased germination (Bewley et al., 2013). Several studies have proven that desiccation improved seed quality, for example in *Vicia sativa* by Samarah (2006) and *Ceiba pentandra* by Lima et al. (2005).

Therefore, it is important to understand the stages during seed growth and development process particularly in indeterminate crop species in order to identify important stages of seed development for example physiological maturity and harvest maturity. Seeds harvested at the appropriate stages have to be subjected to drying hence the most suitable drying method must be studied with reference to seed quality. Therefore, the objectives of this study were:

1. To determine the ideal developmental stage for harvesting seeds of two varieties of Lablab bean for maximum seed quality.
2. To evaluate the effect of drying on viability of Lablab seeds harvested at different maturity stages.

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