Structure and germination pattern mangosteen seed (*Garcinia mangostana* L)

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Abstract. Mangosteen is one of the most famous tropical fruits. In addition, mangosteen is also used as medicine, including as an anti-inflammatory, antibacterial. Mangosteen is apomictic so that plants that come from seeds will be genetically similar to their mother. Apomixis is an asexual method of reproduction through seeds where seeds are formed without reducing chromosome numbers and fertilization. Polyembryony is the event that there are more than one embryo in one seed. Seed structure is a component of a seed that has different functions with the aim of breeding plants. The structure of the plant seeds that must be known is the seed as a reproduction tool, the spread, and the survival of a plant. In addition, for seed plants, seeds are the beginning of new plant life outside the parent. Results showed that mangosteen seeds had polyembryonic properties which had more than one embryo scattered around the embryo axis. The structure of the mangosteen seeds consists of testa, endosperm and embryo axis and after the seeds are planted for 7 days there appears a red line (Micropyle) from the shaft of the embryo to exit the seeds which will become buds. Mangosteen seed germination begins with the appearance of red colored buds that come out randomly around the surface of the mangosteen seeds sourced from the embryo axis, then after a few days red plumules appear and are followed by the appearance of radicles.

Keywords: mangosteen seed, structure, germination pattern

1. Introduction
Mangosteen is one of the most famous tropical fruits, and is called the Queen of Fruits because of its delicious and much loved taste fruit. In addition, mangosteen is also used as medicine, including as an anti-inflammatory and bacterial as treatment for infection and injury [1]. Mangosteen is one of the leading export commodities with a contribution 34.4% of Indonesia total exports [2]. Export destination countries for mangosteen are China, Japan, Singapore, Hong Kong and parts of the Middle East [3].

Increased production of the mangosteen continues to pursued. One support of efficient and adequate cultivation technology is need starting from seed [4]. One way to maximize plant propagation is to use seeds. Propagation of mangosteen through seeds is the most common way farmers do because it’s cheap and more practical. Propagation of mangosteen by using seeds, producing strong and lush plants, high survival on average can reach hundreds of years and have a longer life cycle can also produce about 1000 fruit per tree depending on the number of shoots, compared to multiplication vegetative such as grafting, bud grafting, cutting and tissue culture [5].
Mangosteen is apomictic so that plants that come from seeds will be genetically similar to their mother. Apomixis is an asexual method of reproduction through seeds where the seeds are formed without reducing the number of chromosomes and fertilization [4]. But seed propagation faces various obstacles, one of which is only available in certain seasons when the fruiting season is 1-2 times a year. Then each fruit only produces 1-2 seeds that are large and which are suitable for seed. Mangosteen seeds are recalcitrant so that the seeds cannot last long and propagation cannot be done throughout the year [6]. So one of the solutions is to do a seed cleavage technique to get a lot of mangosteen plant material that is related to the polyembryonic properties of the mangosteen seeds. Polyembryony is an event where there are more than one embryo in one seed [7]. Based on this, it is possible to obtain a large and uniform amount of mangosteen seeds by means of seeds being split into several parts of the same size.

Seed structure is a component of a seed that has different functions with the aim of breeding plants. The seed structure consists of an embryo, endosperm and seed coat. In the agronomic context, seeds are required to be of high quality because the seeds must be able to produce maximum production plants with advanced technological means. Some of the advantages of using quality seeds include saving the use of seeds of broad unity, response to fertilization and the influence of agronomic treatment, high productivity due to high yield potential, quality of results will be guaranteed both through good post harvest, have soil data on pests and diseases, age and other properties are clear and the harvest time is more easily determined because the cooking is simultaneous [8].

Plant breeding is one of them by using seeds, the plant seed structure that must be known is the seed as a reproduction tool, the spread, and the survival of a plant. In addition, for seed plants, seeds are the beginning of new plant life outside the parent. Parts of the seed structure are generally plumula, hypocotyl, radicle, cotyledon and embryo. The parts of the seeds have their respective functions for plant growth. In seeds of dicotyledonous and monocotyledonous plants, the plumula is the shaft of the embryo that grows upwards which in turn will grow into the first leaf, while the radicle is the axis of the embryo that grows downward and will become the primary root [9].

The problems that occur in mangosteen seeds are classified as recalculation seed types with a short shelf life and lack of seeds available on fruit and seasonality, so knowing the structure of the mangosteen seeds can maximize the number of shoots that can grow in 1 seed with the polyembryonic properties found in mangosteen seeds Then the germination pattern is seen to determine the position of mangosteen seed germination with physical changes that occur from the mangosteen seeds. These problems are important for the sustainability of mangosteen cultivation and the availability of mangosteen seeds every year [10].

This study aims to determine the structure mangosteen seed which are polyembryonic and the germination of mangosteen seeds. The usefulness of writing as information material for researchers and mangosteen farmers in knowing about the structure and germination pattern of mangosteen seeds to find out about the germination process of the mangosteen seeds.

2. Methodology
This research was conducted at the Seed Technology Laboratory of the Faculty of Agriculture, Sumatera Utara University in April 2016. The material used in this study was mangosteen seeds harvested on smallholder plantations in Sibolangit village, worshiping as germination, sterile sand, aquades, labels, and water. The tools used in this study were sprouts, knives, hand sprayers, scissors, labels, buckets, thermometers, cameras, laptops and stationery.

The research was conducted to observe the structure of mangosteen seeds by taking some physiologically mature mangosteen fruit and then taking the seeds and dividing them into 2 parts transversely and longitudinally, observing the structure of the seeds, after that the whole seeds were taken and planted with sterile sand media. after 7 days of planting, the red shoot eyes appear, then the seeds are taken and split into 2 parts transversely and longitudinally and observed and the germination pattern is observed to find the mangosteen seed germination pattern is prepared mangosteen fruit which the fruit has ripe with the fruit has blackish purple color with maturity and the same fruit weight.
taken from the trees that grow and then taken to the research site for seeds. After harvesting the mangosteen fruit, the seeds of the same size are removed and the seeds contained in the mangosteen fruit are formed in the form of white segments in which there are only 1-2 seeds in the mangosteen fruit. The seeds are then cleaned from the flesh with water and husk ash after clean followed by germination.

Before the germination was carried out the germination media preparation used was sand media with a thickness of ± 4 cm. Before being used first the sand is sterilized by stirring for 30 minutes to remove contamination from fungi and bacteria. Germination was carried out on seed germination plants with a size of 30 cm x 22 cm x 4 cm as many as 20 seeds per germination plant with a depth of planting holes in sand media of ± 4 cm. Watering is carried out in the morning and evening by using hand sprayer until the media becomes moist and under conditions of field capacity, maintenance is carried out every day to 50 days after planting in the germination plant. Observation variables observed were the structure of mangosteen seeds and the germination pattern of mangosteen seeds.

3. Results and discussion

3.1 Fruit and Mangosteen Meat

Mangosteen fruit comes from Sembah village, Deli Serdang regency, ± 40 years old, ± 15 meters tall plant and 75 cm trunks. Mangosteen fruit is blackish purple fruit skin with a number of fruit segments 7-8 white segments and consists of 1-2 seeds that can be used for plant propagation.

3.2 Mangosteen Seed

Mangosteen seeds are taken from a large mangosteen fruit with a weight of 2.70 grams, then before splitting the mangosteen seeds are cleaned from the flesh.
3.3 Mangosteen Seed Cut Transversal and Longitudinal

![Mangosteen Seed Cut](image)

**Figure 3.** Picture of mangosteen seed cut transversal and longitudinal

After the mangosteen seeds are cleaned, the seeds are split transversely and longitudinally into 2 parts to see the structure seeds.

3.4 Structure Mangosteen Seed

![Mangosteen Seed](image)

**Figure 4.** Mangosteen seed split 2 parts

After the mangosteen seeds are split transversely and longitudinally, the structure of the mangosteen seeds is obtained which consists of Testa or the outer part of the mangosteen seeds, then Endosperm namely the food reserves of the mangosteen seeds and Embryo axis namely prospective new plants that surround the mangosteen seeds. So the number of prospective plants in the mangosteen seeds is more than 1 and the embryo is located around the shaft of the embryo.

3.5 Structure Mangosteen Seed After Planting 7 Days

![Mangosteen Seed](image)

**Figure 5.** Mangosteen seed split 2 parts
Mangosteen seeds that have been cleaned from the flesh are planted in sterile sand, then after 7 days the dark red buds appear and the seeds are taken and split into 2 parts. After dividing it into 2 parts, the seed structure is observed again, the results are testa or the outer part of the mangosteen seeds, then Endosperm namely the food reserves of the mangosteen seeds and Embryo Axis, namely the prospective new plants that surround the mangosteen seeds and Micropyle which is the connecting part between the mangosteen seeds the embryo or ovule with Testa or the outer part of the seed and the micropyle section appears buds.

3.6 Germination Pattern Mangosteen Seed

![Germination pattern mangosteen seed](image)

The pattern of seed germination was observed from the beginning of growth to the age of 50 days in which germination patterns were observed starting from the age of 7 days after planting, 10 days after planting, 12 days after planting, 15 days after planting, 25 days after planting, 27 days after planting, 30 days after planting, 35 days after planting, 45 days after planting and 50 days after planting. Changes in the growth of mangosteen were characterized by the appearance of dark red buds at the age of 7 days after planting, then the length of shoots occurred at the age of 15 days after planting. After perfect opening of the mangosteen leaves, there was an increase in size at the age of 35 days after planting and the length of the stem, then the increase in the number of leaves and changes in leaf color from red to green at the age of 45-50 DAP.
The occurrence of germination process on mangosteen seeds is inseparable from the initial process, namely the treatment of the mangosteen seeds from fruit flesh and the imbibition process supported by the theory of Wachid (2006) which states that the mechanism of water absorption can take place due to process, diffusion, osmosis, active transport, and imbibisi. Imbibisi is the entry of water in the intercellular space from low concentration to high concentration. In this immersion event occurs the imbibition process by the seed coat of the plant. The imbibition process also has a different water absorption rate for each type of plant seed. Mangosteen seed germination is unique because the appearance of buds on mangosteen seeds is more than 1 bud because it is classified as a type of polyembrioni which has more than 1 shoots in seeds, this is supported by the statement of Turhadi and Indriyani (2015) namely polyembrioni phenomenon, namely the emergence of more than one shoots from the germination of the seeds. Percentage of seeds that have polylembrionic properties vary from each treatment. Then the buds that appear initially are dark red and after 45 days turn green they are related to the physiological processes of the mangosteen seeds and plants.

Research of structure and germination patterns, it was found that knowing the part of the structure of the mangosteen seeds could determine the spread of the embryo, the number and position of the buds in the mangosteen seeds and the germination pattern to see changes in the form of mangosteen germination from the appearance of shoots to plant seeds. The structure and pattern of germination does not affect the germination of the mangosteen seeds.

4. Conclusion

Structure of the mangosteen seeds consists are testa, endosperm, embryo exis and after seedsplanted for 7 days form micropyle.mangosteen seed germination pattern consisting of the appearance of buds, shoots extension,will appear leaves and roots, leaves open the perfect, increase the size and numberleaves and roots extension. Occurred during the 50 days after planting.

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