I. INTRODUCTION

1.1 Background

Honey Water Guava (Syzygium equaeum Burn F. Alston) is an introduced fruit plant that was released as a variant of "*Jambu Merah kesuma*" (Watery Rose Apple) in 2012 but has yet to be widely cultivated for commercial purposes. The advantages of honey water guava are its high yield (productivity), produces fruit throughout the year, the (ripened) fruit tastes honey-like sweet, its flesh has a crisp texture, grows well at altitudes of 0-500 m above sea level, 200-360 fruit/tree/year and weighs 150 – 200 g per fruit (UPT. BPSB IV SUMUT, 2015). Furthermore, according to the results of this study, honey water contains 81.59% water, 12.4˚brix sugar, and 210,463 mgvitamin C per 100 g.

To get a good quality honey water guava, pruning must be done at least once a year, i.e., secondary pruning, tertiary branches, and reducing the number of leaves to ensure that sunlight can penetrate the guava tree canopy and illuminate the developing guava fruit. Water guava tress that are around 10 years old can produce wet stover weighing approximately 90 kg/tree. However, currently the leaves of the pruning branches have only been utilized for animal feed, while the pruning branches are solely used as firewood branches consisting of secondary and tertiary branches (with cuttings length of 25 cm) of approximately 450 cuttings/tree. (Anonymous, 2012).

Cuttings are a technique of vegetative propagation by cutting the vegetative parts to grow into mature plants having similar characteristics of the main plant (Danu and Agus, 2006).

Based on the source, plant growth regulator (PGR) can be obtained both naturally and synthetically. The use of Atonic is one of the most commonly used synthetic growth regulators, in addition to its relatively cheaper price compared to IAA and IBA hormones. The presence is also relatively easy to find in the market. Rootone-F is in powder form, white in color, contains naphthalene acetamide 0.067%, 2 methyl naphthalene acetamide 0.03%, 2 methyl naphthalene acetate 0.03%, indole 3 butyrate (IBA) 0.057% and oyster 4%. Several studies have stated that the use of Atonic is able to initiate roots in woody plants at a concentration of 0-200 ppm with a minimum of 3 hours of immersion and a maximum of 20 hours on plants that are difficult to initiate roots (Purwantoro, 2006).

However, PGR will be effective only if used at certain concentrations. If the concentration used is too high, it will damage the cuttings because cell division and callus will be excessive so that it inhibits the growth of flowers and roots, whereas if the concentration used is below the optimum then the PGR is not effective. Therefore, it is necessary to compare the response caused to the administration of synthetic Atonic PGR and natural PGR from shallot extract and to find the right concentration of the use of the PGR on the growth of the water-honey guava plant cuttings (Syzygium equaeum Burn F. Alston).

Based on the description above, this study aims to compare the growth response of the shoot cuttings of the red honey guava plant to the administration of synthetic growth regulators and natural growth regulators.

1.2 Research Objectives

This study aims to compare the effectiveness of giving synthetic growth regulators and natural growth regulators to shoot cuttings of the honey water guava plant.

1.3 Research Hypothesis

There is a growth response of shoot cuttings of honey water guava plant (*Syzygiumaqueum*) which is different between the administration of synthetic growth regulators and natural growth regulators.

1.4 Research Benefits

1. As one of the reference materials in writing the thesis to fulfill the bachelor's degree requirements in the Agrotechnology Study Program, Faculty of Agriculture, University of Medan Area.

2. Utilization of red onion and banana weevil extract as a substitute for PGR, to stimulate the growth of honey water guava shoot cuttings.

II. LITERATURE REVIEW

2.1. Honey Water Guava Plant (Syzygium equaeum Burn F. Alston)

Honey water guava plant *kesuma* variety belongs to Kingdom: Plantae, Division: Spermatophyta, Subdivision: Angiospermae, Class: Dycotyledoneae, Order: Myrtales, Family: Myrtaceae, Genus: Syzygium, Species: Syzygium aquaeum Water guava Syzygium equaeum is a plant in the guava family or Myrtaceae originating from Indonesia and Malaysia. Water guava trees and fruits are not much different from other water guava (S. aqueum), some of the cultivars are even difficult to distinguish, so they are often named by the common name of water guava or just guava. (Cahyono, 2010).

The genus Syzygium was formerly included in the genus Eugenia. Some experts then carefully looked at the striking differences between several plants in that genus. Therefore, some plants with similar characteristics are grouped into another genus, namely Syzygium. Flowers are morphological characters that distinguish Syzygium from Eugenia. Syzygium has flowers that grow in the armpits of leaves or at the ends of twigs, while Eugenia has flowers that grow in the armpits of small and short twigs (Hariyanto, 2003).

While the most commercial varieties are Cincalo and Semarang, each of which consists of 2 kinds (red and white). Meanwhile, in North Sumatra, the water guava that is widely cultivated is the Deli Hijau variety, which comes from Paya Roba Village, West Binjai District, Binjai City, North Sumatra Province (UPT.BPSB IV SUMUT, 2015).

According to Cahyono (2010), the water guava plant is very easy to recognize from the physical form of the plant and its fruit. The guava plant is classified as an annual plant that lives perennially. The age of the plant reaches decades, and the tree can grow large and tall. The guava plant bears fruit throughout the year (grows flower throughout every season). Morphologically, the important organs of the water guava plant consist of roots, stems (wood), leaves, flowers, fruits, and seeds.

Water guava plants can grow in almost every place in Indonesia. This plant easily adapts to all types of soil if it is fertile, loose and has plenty of water. Another feature of honey water guava plants is that they are easy to obtain and do not require too expensive maintenance (Haryanto, 2003).

Water guava flowers grow in clusters arranged in panicles and are clustered by protective leaves, shaped like a cup where in a bunch or one panicle may consist of 10-18 flowers depending on the variety. The flowers are rather large and consist of 4 white petals greenish or reddish white, and the stamens are very numerous. The stamens have a spikes-like shape. Water guava flowers when blooming spread a fragrant aroma, but will quickly wither (Cahyono, 2010).

Honey water guava fruit is fleshy and juicy and tastes sweet like honey, the color of the skin of the fruit is red, light green with reddish, white, green, etc., the skin of the fruit is smooth, and shiny and the flesh of the fruit has a slightly dense texture (Cahyono, 2010).

Meanwhile, honey water guava seeds are large, and some are seedless, white, and irregularly round and the inside has a purple color (Cahyono, 2010).

2.1.1. Growing Conditions Requirements

Honey water guava (*Syzygium equaeum* Burn F. Alston) is very suitable for planting in areas with an altitude of 3 – 500 meters above sea level (asl) at a temperature of 27^{o}C – 32^{o}C, rainfall is around 500 – 3,000 mm/year, air humidity ranges from 50 - 70%. Sunlight affects the quality of the fruit to be produced. The ideal intensity of sunlight in the growth of guava honey water is 40-80%. (Cahyono, 2010).

Water guava plants prefer a loose soil structure, well drained, sufficient water, nutrients, sufficient organic matter must be available with an ideal degree of acidity (pH) ranging from 6-7 and an effective depth of groundwater, i.e., if the planting area has a depth of shallow to moderate groundwater, i.e., 0.5 – 1.5 meters (Cahyono, 2010).

2.2. Vegetative Propagation of Honey Water Guava (Top Cuttings)

Water guava plants (*Syzygium equaeum* Burn F. Alston) can be propagated generatively (through seeds) and vegetatively (grafting, grafting and cuttings). Propagation of plants by seeds often results in failure because of the long fruiting age, as well as the deviations in the characteristics of the parent tree. Therefore, propagation of water guava plants by seeds is only recommended to produce rootstock as grafting material (Rukmana, 2011).

Vegetative propagation in fruit plants is intended to maintain superior parental characteristics, shorten the vegetative period, so that production is faster. Vegetative propagation by cuttings is the most efficient propagation because it does not require rootstock as is the case with grafting and grafting and the time required is relatively short when compared to generative propagation which requires a longer time.

Shoot cuttings is one of the propagation of plants by using the tips or shoots of the plant. The material for cuttings is twig shoots, branch shoots, or stem shoots. The length of the cuttings is about 8-20 cm or has 3-5 segments, some leaves are removed and left 2- 4 leaves at the very end (Raharja and Wiryanta, 2003).

Water guava seeds from cuttings have several advantages, including: (1) the nature and growth of the crop in the field is uniform and in accordance with the nature of the parent, (2) the seeds can be available and throughout the year in large quantities (bulk) and in a short time, and (3) the cost of seed production can be reduced because the cutting material comes from pruning waste. However, propagation through shoot cuttings often encounters obstacles, namely the difficulty of forming roots (Ashari, 2006).

To stimulate the root growth of the honey water guava cuttings, the base of the cuttings needs to be given a growth regulator and the use of PGR, so that it can directly improve the

quality of the seeds and reduce the number of seedlings that grow abnormally. Growth regulators are non-nutritive organic compounds at low concentrations that can promote, inhibit, or qualitatively alter plant growth and development (Gaba, 2005).

2.3 Factors Affecting Cutting Root Formation

Factors affecting the growth of cuttings the formation of roots on cuttings is an indication of the success of cuttings.

2.3.1. Environmental factor

Environmental factors that affect the success of cuttings growth are root media, temperature, humidity, and light intensity (Hartman, 2003). Root media serves as a support for cuttings during root formation, provides moisture to the cuttings, and facilitates air penetration at the base of the cuttings. A good rooting medium according to Hartman (2003) is one that can provide sufficient aeration and humidity, is well drained, and is free from elements that can damage the cuttings. The root media for cuttings commonly used are soil and sand. Optimal root temperature for cuttings rooting ranges from 21°C to 27°C in the morning and afternoon and 15°C at night. Temperatures that are too high can encourage shoot development beyond root development and increase the rate of transpiration (Hartman, 2003).

2.3.2. Plant factor

The rooting medium for cuttings serves as a support for cuttings during root formation, an element of moisture in the cuttings, and facilitates air penetration at the base of the cuttings. According to Hartman (2003) a good rooting medium is one that can provide sufficient aeration and moisture, is well drained, and is free from elements that can damage the cuttings. Some of the cutting media used are subsoil soil, topsoil soil, manure, and compost. improve the physical properties of the soil so that it can support the growth and development of plant roots in nurseries. The role of this manure can be in developing several nutrient elements such as phosphorus, nitrogen, sulfur, and potassium, and increasing the cation-resistant capacity of the soil. Besides that, cow manure can release P from Fe and Al oxides, and can improve physical properties and soil structure, and can form complex compounds with macro and micro elements to reduce the element leaching process (Hartman, 2003).

2.3.3 Treatment factors

The implementation of cuttings starting from cuttings material, planting to maintenance will affect the success of cuttings. In addition, in cutting, clean and sterile equipment is needed so as to minimize the possibility of cuttings being attacked by pests and diseases. The best time for cutting cuttings is when the humidity is high, and the plant is not growing.

2.4 Plant Growth Regulators (PGR)

PGR which contains this hormone is naturally found in plant parts both in roots, leaves, and stems. The application of PGR has a significant effect in stimulating, inhibiting, or changing the growth, development, and movement of plants.

2.5 Synthetic Growth Regulators (Atonic)

Atonic growth regulator is one of the growth regulators available on the market. Auxin is a growth regulator that functions to: (1) stimulate callus growth; (2) stimulate cell enlargement and root growth; and (3) morphogenesis mainly interacts with cytokinin. Wirawati (2007) states that the Plant root growth is influenced both by internal and external factors. Internal factors that affect plant root growth are root morphology and hormone auxin content. The hormone auxin contained in the roots and translocated to the roots functions to encourage the growth of plant roots (Rineksane, 2005).

2.6 Natural Growth Regulators (Shallot Extract)

The use of Synthetic PGR is very expensive. Therefore, it is necessary to find alternative materials that can replace the PGR, remembering that the use of Synthetic PGR can inflict stress on explants and reap pros and cons, especially in the aspect of drug production (Ying, 2013).

Shallots contain essential oils, cycloalliin, methylation, dehydroalanine, flavonglycosides, quercetin, saponins, peptides, phytohormones, vitamins and starch substances. Subsequently, shallots contain the PGR that acts like Indo1 Acetic Acid (IAA) (Anonymous, 2008 in Muswita. 2011). Furthermore, Anonymous (2009) in Muswita (2011) also adds that the phytohormones contained in shallots are auxin and gibberellins. Auxins function to affect the increase in stem length, growth, differentiation, and root branching. Gibberellins function to encourage seed development, bud development, stem elongation, leaf growth, influence root growth and differentiation.

2.7 Natural growth regulators (Banana Weevil)

Banana weevil can be used to make compost. In this case the banana weevil is called a starter/decomposer. And can also be used as a liquid fertilizer in fertilizing applications. It can also be used as a growth regulator; besides that, it can also act as a decomposer or fertilizer factory so that nutrients can be absorbed by plant roots. The banana hump contains growth regulators Gibberellins and Cytokinins. In addition, the banana hump also contains 6 microorganisms that are very useful for plants, including, Rhizobium sp, Azospirillium sp, Azotobacter sp, Pseudomonas sp, Bacillus sp, and phosphate solubilizing bacteria (Wullandari, et al 2009).

III. MATERIALS AND METHOD

3.1. Location and Time of Research

This research was conducted in the experimental garden of the Faculty of Agriculture, University of Medan Area, Jl. Pool No. 1 Medan Estate, Percut Sei Tuan District with a height of 25 meters above sea level (asl). The research time is from May-July 2017.

Materials and Tools.

The materials used in this study consist of honey water guava top shoots, Atonic, shallots, banana hump, distilled water (aquadest), cow manure, EM4, brown sugar and rice water. While the tools used are cuttings scissors, polybags, cutting media, hoes, cover houses, and large buckets.

3.2. Research Method

This research was conducted using a non-factorial Completely Randomized Design (CRD), namely:

A0 = Shallot extract with a concentration of 0.5% (5ml / 1 l Aquadest)

AI= Shallot extract with a concentration of 1.0% (10 ml / 1 l Aquadest)

A2= Shallot extract with a concentration of 1.5% (15 ml / 1 l Aquadest)

B0= Banana weevil with a concentration of 0.5% (5 ml/1 l Aquadest)

B1= Banana weevil with a concentration of 1.0% (10 ml/l l Aquadest)

B2=Banana weevil with a concentration of 1.5% (15 ml/l l Aquadest)

C0 = Atonic with a concentration of 0.5% (5 gr/1 l aquadest)

C1 = Atonic with a concentration of 1.0% (10 gr/1 l aquadest)

C2 = Atonic with a concentration of 1.5% (15 gr/1 l aquadest)

Units of research:

Total Repetition: 3 repetitions

Number of cuttings per treatment: 5 plants

Number of sample plants: 5 plants

Number of plots: 27 plots

Planting depth: ± 5 cm

The number of cuttings per polybag: 1 plant

Total number of cuttings: 135 plants

3.3. Analysis Method

The analytical method used in this non-factorial Completely Randomized Design (CRD) is as follows:

$$Yij = \mu + \alpha j + \beta k + \sum ij$$

Yij = The results of the observation of the j-level treatment and the i-level replication

μ = the effect of the mean (NT) / general mean

αi = Effect of treatment level j

∑ij = The effect of experimental error due to the j-level treatment placed in the i-level replication

If the results of the analysis of treatment variance show a significant effect, then the test is continued with a different test of the average treatment with Duncan's distance test (Sastrosupadi, 2000).

3.4. Research Implementation

3.4.1. Cutting Materials Collection

The cutting material used is twig shoots that are not too old and not too young, and not when new leaves appear. The material for cuttings comes from “Source Farmers” for Horticultural and Plantation Plant Seed Breeding” Jl. Sudirman, Hamlet I Village Tg. Jati, Binjai District.

Plant material is taken by cutting the stems/twigs using a sharp knife with the criteria of cuttings length of about ± 20 cm or having 3-5 segments, some leaves are removed, and 3 leaves are left at the end (Raharja and Wiryanta, 2003). The size of the leaves is reduced by removing 2/3 of the leaves. Leaf cutting aims to ensure that the water needs with the water absorption capacity of the cuttings are balanced. The finished cuttings are collected and then collected. To keep the cuttings fresh until they reach the planting site, the ends of the cuttings are wrapped using a tissue that has been moistened with aquadest. The mother tree used as a source of cutting material in this study was a water-honey guava plant that was ± 5 years old and had produced 8 times of harvest.

3.4.2. Cover Making

The construction of the hood is carried out by plugging bamboo rods in an inverted U-shaped with approximately 2 meters facing each other straight like a tunnel, then tying the long bamboo to each bamboo with plastic rope, then strengthening the attachment of each bamboo stem with a peg that is plugged in and tied to each bamboo stick. the base of the bamboo stem stuck in the ground, attaching a plastic cover that can cover the entire hood. For the hood to be protected from excessive sunlight and rain, a roof of nipa material was made above the hood.

3.4.3. Planting Medium Installation and Polybags Filling

The planting medium used for red honey guava cuttings was a mixture of soil and manure with a ratio of 2:1. The soil used was topsoil soil obtained from the experimental land located on Jalan Pool Medan Estate, precisely in the Experimental Garden of the University of Medan Area which has been cleaned of garbage, plant roots and others. The soil and manure are stirred until evenly mixed; mixing is done using a hoe. The mixed media is put into polybags, then arranged into a lid. The polybags used are polybags with a diameter of ± 9 cm (volume 600 grams of soil). So that in one baby polybag it takes 400 grams of soil and 200 grams of cow manure. Inside the lid, polybags were arranged on a bed where the distance between polybags was 20 cm, the distance between treatments was 30 cm, where in one treatment there were 5 polybags arranged each in two rows of polybags.

3.4.4. Preparation of Growth Regulatory Solution

3.5.4.1. Preparation of Atonic Growth Regulator Solution

Atonic is applied by adding a little alcohol to dissolve then adding water so that it becomes a solution. To meet the needs of all treatments, 5 grams of Atonic and 1 liter of aquadest are needed.

3.5.4.2. Preparation of Shallot Extract Growth Regulator Solution

The working stages of making natural ZPT onion extract are: The onion is cleaned of dry skin, then rinsed with water, the onion is blended until smooth. The results of the blender are filtered with a cloth, then squeezed. The onion extract is accommodated in a basin, the extract will be used as a natural growth regulator (ZPT). Making onion filtrate with a concentration of 100% by weighing 150 grams of red onion plus 15 ml of distilled water, mashed using a blender, then filtered and the filtrate is 30 ml. Then it is enough to dilute the stock solution according to the treatment. Soaking in a solution of onion extract (Allium cepa L.) was carried out for ± 6 hours.

3.5.4.3 Preparation of Solutions Banana weevil growth regulator (MOL banana weevil)

MOL (Local Organism Microorganisms) Bananas contain Gibberellins and Cytokinins Growth Regulators. In addition, the banana hump MOL also contains 7 microorganisms that are very useful for plants, namely: Azospirillim, Azotobacter, Bacillus, Aeromonas, Aspergillus, phosphate solubilizing microbes and cellulosic microbes. Not only that, MOL banana weevil can also be used for decomposers or to speed up the composting process.

Materials for making MOL banana weevil:

1. 3 kg of banana hump
2. 2 ounces of brown sugar
3. 2 liters of rice water.

How to make a banana hump MOL:

1. Banana hump, cut into small pieces and then finely ground

2. Slice the brown sugar then adds it to the rice rinse water and stir until dissolved

3. Rice rinse water containing sugar is put into the banana hump

4. After that, put in a jerry can and tightly closed, open the lid every 2 days or if it bubbles.

5. After 15 days MOL banana weevil is ready to use.

3.4.5. PGR Application

After each natural PGR, onion extract, banana weevil and atonic synthetic PGR were prepared, they were ready to be immersed in cuttings. The shoot cuttings of the red honey water guava shoots were soaked with each treatment. The immersion time for each PGR was 6 hours, after 6 hours the shoot cuttings were ready to be planted.

3.4.6. Cuttings Material

After the ZPT application, the cuttings were then sown on the prepared media, with a depth of one eye (± 5 cm) immersed. Each polybag was filled with 1 cutting. The polybags were arranged on a bed with a bed height of approximately 30 cm from the soil surface. How to plant the cuttings is to make a hole with bamboo blades with a depth of ± 5 cm which aims to make it easier to plant the cuttings, then the base of the cuttings is inserted into the hole, then the soil around the base of the cuttings is pressed to make it denser. Then the media was watered with clean water using a hand sprayer until the soil conditions became field capacity. Furthermore, the polybags were arranged (according to the experimental unit) in the lid and then covered with a plastic lid for 1 month (4 WAP).

3.5. Cutting Material Maintenance

3.5.1. Sprinkling

To maintain the humidity of the media and cuttings material, watering is carried out once a week or during observation and depends on the condition of the plant. The media and cuttings were sprayed with clean water using a hand sprayer. If the media is still moist, watering is not carried out.

3.5.2. Temperature in the Cover

The average temperature in the cover or canopy that will be used in this setting is as follows, in the morning 27.8oC, afternoon 32.2oC, and night 29.2oC. If the temperature is not reached, treatment will be carried out by thickening the plastic/cover, and when the temperature exceeds the provisions, air circulation holes will be made.

3.5.3. Pest and Disease Control

In the research that I conducted in the Experimental Garden of the Medan Area University, I did not get any pests, while the spots on the leaves were controlled by removing the affected leaves.

3.6 Observation parameters

3.6 .1. Cuttings Growth Percentage (%)

The percentage of cuttings growth seen from the growing cuttings criteria was calculated by comparing the living plant material on each plant plot with the total amount of plant material multiplied by 100%. The calculation of the growth percentage was carried out starting at 4 weeks after planting (MST) with an interval of 1 week for 8 weeks of observation.

3.6.2. Plant Height (cm)

Plant height was calculated for each sample plant by measuring from the base of the shoot growth to the highest growing point. The shoots measured were the longest shoots. Plant height measurements were carried out starting at 4 weeks after planting (MST), with an interval of once a week for 8 weeks of observation.

3.6.3. Number of Leaves (strands)

The number of leaves was counted on each sample plant by counting the fully opened leaves. The number of leaves was counted starting at the age of 4 weeks after planting (MST) with an interval of 1 week for 8 weeks of observation.

3.6.4. Primary Root Length (cm)

Root length was measured in one sample per plot by measuring the length of the longest root from the base of the cutting to the tip of the root using a ruler. Measurements were made at the end of the observation (8 MST).

3.6.5. Number of Primary Roots

The number of primary roots was calculated in one sample per plot by manually counting the number of roots closest to the base of the cuttings. Measurements were made at the end of the observation (8 MST).

3.6.6. Root Volume

The volume of roots was measured using a glass beaker, the calculation was carried out at the end of the observation (8 WAP), the roots counted were one sample per plot. The method of measuring root volume was, the roots were cleaned first then put 100 ml of water into the glass beaker, then the roots are added if the water rises by about 120 it means that the volume of the roots is 20 ml.

PROOFREADING

1.	Variety	:	Variant
2.	Not been	:	Yet to be
3.	Altitude	:	Altitudes
4.	Moreover	:	Furthermore
5.	Is	:	Are
6.	About	:	Around
7.	Only	:	Solely
8.	Its	:	The
9.	So	:	Therefore
10.	Bears	:	Grows
11.	Tress	:	Wood
12.	Squeezed	:	Clustered
13.	Cause	:	Inflict
14.	Washing	:	Rinse
15.	All	:	Each
16.	Hood	:	Cover
17.	Percentage growing	:	Growth percentage
18.	Rhizokaline	:	Rhizocaline
19.	Honey waterred	:	Honey water
20.	Has	:	Had
21.	Levici	:	Lovici
22.	Cause	:	Caused by
23.	Added	:	Adds
24.	Adding	:	Adds
25.	ZPT	:	PGR
26.	WAT	:	WAP
27.	Were	:	Are
28.	Was	:	Is
29.	Presumably	:	Likely
30.	Thing	:	Claim
31.	Appeared	:	Present
32.	Namely	:	i.e.
33.	Stated	:	States
34.	Save	:	Give
35.	Has	:	Possessed
36.	Existence	:	Presence
37.	Can	:	Ability to
38.	That allow	:	Allowing
39.	Increasing	:	Increase
40.	Sucking	:	Absorbing