I. INTRODUCTION

1.1 Background

Agriculture is the most important sector in supporting the Indonesian economy, especially on the island of Sumatra. The agricultural sector on the island of Sumatra is very important, especially because of the tropical weather that is very supportive for agricultural activities. Singgalang cabbage (*Brassica oleracea L. var. capitata*) is a local cabbage grown by farmers on the slopes of Mount Singgalang in Agam district, West Sumatra. This type of cabbage is a popular vegetable among the people of West Sumatra, Riau, and Jambi. Singgalang cabbage is one of the types of vegetables exported to Singapore (Marimbo, 2004). Singgalang cabbage productivity has started to decline, as it is rarely planted by local farmers, due to its lower productivity compared to new cultivars. Local cultivars are generally classified as cultivars that are adaptable to the specific microclimate of the growing area (Shrestha & Shakya, 2004).

Singgalang cabbage is a biennial cabbage that is propagated through shoot cuttings in tropical areas. There are three types of cultivated singgalang cabbage i.e. ,Batang Hitam, Senggan, and Biaso. According to the farmers, singgalang cabbage can only be harvested as a vegetable when it is about 2 months old after planting. According to research (Afdi, 2005), the harvesting age of singgalang cabbage with mulch treatment ranged from 100-115 day after plant (DAP), and without mulch treatment ranged from 105-115 DAP. Singgalang cabbage production has decreased when compared to the previous year, according to data from the Institute of Statistics Center (2004). These

figures show that cabbage production in Indonesia, particularly in West Sumatra, is insufficient to meet both export and domestic demand.

Plants respond to the quantity, quality, and direction of light. Typically, normal plant growth requires optimal light irradiance and wavelengths, which are critical to plant productivity and can therefore severely limit plant growth. The most common light sources used for plant culture are high-pressure sodium lamps, incandescent lamps, fluorescent lamps, and metal halide lamps (Kim *et al*., 2004). These lamps have a wide range of wavelengths that seem excessive and of poor quality to promote plant growth, and consume a lot of electrical energy while generating heat in confined spaces (Dutta & Jatothu, 2013). For example, compact fluorescent lamps emit very little far-red light and delay flowering in some long-lived plants, while high-pressure sodium lamps emit light in the full visible part of the spectrum and also in the infrared where much energy is lost in the form of heat. Therefore, efficient light sources with high energy conversion efficiency and spectral adjustment are required to increase production potential, improve quality and reduce costs.

A light-emitting diode (LED) is a semiconductor device that produces incoherent, narrow-spectrum light when a forward voltage is applied. The wavelength of the light emitted is determined by the material used to form the semiconductor junction. LEDs produce more light per watt of electricity than incandescent bulbs with the latest devices rivaling fluorescent tubes in terms of energy efficiency. They are solid-state devices, which are much more powerful than glass casing lamps and do not contain hazardous materials like fluorescent lamps. LEDs also have a longer life than incandescent, fluorescent, and high-density lamps (Bourget, 2008). It is a promising technology for the

greenhouse industry that has potential benefits over traditional lighting systems (Mitchell *et al.*, 2012). Due to its specific wavelength, smaller size, durability, long lifetime, and cool light-emitting surface. LEDs can have peak emission wavelengths from ~250 (UV) to ~1000 nm (infrared) with more efficient performance and longer lifetimes than traditional lighting systems (Bourget, 2008).

Firnanda (2017) states that plants only use about 0.5 - 2.0% of the available energy for photosynthesis. The amount of light energy provided is determined by the quality, intensity, and duration of irradiation. Since chlorophyll absorbs light at wavelengths between 400 - 700 nm, artificial light must emit appropriate wavelengths to affect photosynthesis. LEDs can emit colors of light that can accelerate photosynthesis in plants. In addition, LEDs have several advantages such as a specific light spectrum, small heat production, low power consumption, and emitting the wavelength required by plants, which is in the range of 400 - 700 nm.

(Matsuda *et al*., 2004) found that rice plants grown under a combination of blue (470nm) and red (660nm) LEDs had a higher leaf photosynthesis rate than single color LEDs. A subsequent study by (Harun *et al*., 2013) found that lighting with a ratio oof 16 red : 4 blue light was more effective in promoting higher photosynthetic activity, resulting in an increasing the number of shoots and leaves. Red light is critical for increasing the rate of photosynthesis, whereas blue light influences chlorophyll biosynthesis, chloroplast development, and stomata movement, as well as participating in photomorphogenesis (Paradiso *et al*., 2009). As a result, red and blue light are required for growth (Li *et al*., 2012).

Based on the explanation above, it is necessary to conduct research that clearly examine the effect of light-controlled environmental on the grow of singgalang cabbage. in the reseach, light source of blue and red LED was used as main factor to observe the growth response of singgalang cabbage.

1.2 Formulation of Research Problems

This research was conducted to answer the following question :

1. How is effecting the growth of singgalang cabbage under light-controlled environment?
2. Which treatment of light-controlled environment by using LED gave the best result in the growth of singgalang cabbage?

1.3 Research Objectives

There were to main objective of this research 1.e.

1. To find out how light-controlled environment effecting the growth of singgalang cabbage.
2. To find out which light-controlled environment gave the best result in the growth of singgalang cabbage.

1.4 Research Benefits

Based of explanation above this research was expected to give a benefit for :

1. Sourcing of information in development of urban farming technique under light-controlled environment.
2. Sourcing of reference in managging the growth of singgalang cabbage under light-controlled environment.