CHAPTER 1

PRELIMINARY

1.1 Introduction.

Development and demand of vegetables currently showing an upward trend. However, it is not directly proportional to the productivity of vegetables produced; according to the research Institute of Vegetables (2009) the productivity of vegetables crops is still very low. This can happen due to lack of maximum plant in absorbing nutrients with the right amount or lack of specific nutrient.

Soil is fundamental to life on Earth. It is central to sustainable development and the future we want. Soil has critical relevance to global issues such as food and water security and climate regulation (Koch *et al*., 2013; Lal, 2004; McBratney*et al*., 2014), and it is increasingly recognized as major contributors to a wide range of ecosystem services (Dominati *et al*., 2010). But soil takes up so many space of farmland, requires a lot of manpower and has open outdoor which is naked and vulnerable to pests and diseases no one can prevent that, so adaptable humans thought of soilless culture.

Soilless culture is the technique of growing plants in soil-less condition with their roots immersed in nutrient solution (Maharana & Koul, 2004). Soilless culture systems of cultivation can be classified according to the techniques employed. It supplies fresh vegetables in countries with limited arable land as well as in small countries with large populations. It could be useful to provide sufficient fresh vegetables for the indigenous population as well as for tourists in countries where tourism plays a vital role in their economy (Resh, 1993). In soilless culture some cultural practices like soil cultivation and weed control are avoided, and land not suitable for soil cultivation can be used (Polycarpou *et al.,* 2005). Plants grown by hydroponics have consistently superior quality, high yield, rapid harvest, and high nutrient content.

A wide variety of green leafy crops can be produced hydroponically using food grade channels or gullies with a thin film of nutrient flowing through them. This method is called the Nutrient Film Technique or NFT Hydroponic System. Leafy greens can be efficiently grown using this method where all the necessary nutrients are being delivered directly to the root system of the plants. To assist the grower with production optimization, the nutrient film technique (NFT) was developed during the late 1960's by Dr Allan Cooper at the Glasshouse Crops Research Institute in the U.K. With the NFT system, a thin film of nutrient solution flows through plastic channels, which contain the plant roots with no solid planting media. The root mat develops partly in the shallow stream of recirculating solution and partly above it. It is extremely important to maintain this basic principle of a nutrient film because it ensures the root system has access to adequate oxygen levels(Cooper, 1996).One of the plants that grow well in hydroponic NFT system is Pakchoy. It is a Chinese origin green leafy vegetable that is widely consumed in many parts of Asia.

The main key in the provision of nutrients or fertilizer solutions on the hydroponic method is the control of the flow of electricity or Electrical Conductivity (EC) in the water by using the EC meter tool. Electrical Conductivity (EC) is to determine whether or not the nutrient solution is suitable to the plant, because the quality of nutrient solution is crucial to the success of production, while the quality of nutrient or fertilizer solution depends on the concentration (Rini, 2005).

In an effort to concoct the ABmix nutrient for the plant can be processed its concentration according to the requirement of the plant, of course by continuing to balance the nutrient solution after plant growth phase by regulating the electrical conductivity (EC) of the plant, while the need for various nutrient concentrations is usually expressed in parts per million (ppm) (Roedhy, 2013).

The electrical conductivity (EC) is measured using EC meter as an indirect indication of the strength of nutrient solution. The ideal EC range for hydroponics is between 1.5 to 2.5 dS/m and higher EC hinders nutrient absorption due to the increase of osmotic pressure whereas lower EC may severely effects plant health and yield (Anano, 2002).

The value of EC in the solution affects the metabolism of the plant, i.e. in terms of the photosynthesis debate, enzyme activity, and the potential absorption of ions by the roots. Concentration of nutrient solution will also determine the duration of the use of nutrient solution in hydroponic system (Sutanto, 2002).

The nutrient formulations that are made have different amounts of dissolved salt with other hydroponic nutrition formulations. The difference in the amount of salt is very influential on the EC value of the solution to be made. The Pakchoy plant needs the EC that is suitable for its growth and contains the ideal nutrition on the EC level so that the plant can grow well. The level of conformity of EC values on the Pakchoy plant using this formulation must be known ahead.

1.2 Problem formation

Based on the above, the problem in this study can be formulated as follows:

1. Does Electrical Conductivity (EC) effect the growth and yield of pakchoy in hydroponic NFT system?
2. Which Electrical Conductivity (EC) value that is most appropriate for growth and yield on the cultivation of Pakchoy plant using NFT hydroponic system?

1.3. Research Objectives

This research was aimed to find which EC level that has the most effect on growth and yield of pakchoy *(Brassica rapa* L.*)* using NFT hydroponic system.

1.4 Benefit of the research

This research is expected to be useful for:

1. Adding the scientific discourse that by regulating the value of Electrical Conductivity (EC) each plant growth phase can enhance the growth and yield on Pakchoy *(Brassica rapa* L.*)* using NFT hydroponic system.
2. Increase insight into best value of Electrical Conductivity (EC) for growth and yield on cultivation of Pakchoy *(Brassica rapa* L.*)* using NFT hydroponic system.

1.5 Framework

Pakchoy plant is a nutritious vegetable that has high economic value. The use of hydroponics system can improve the growth production and quality of Pakchoy plants. Many variables that determine the success of Pakchoy cultivation with this system include the nutrients and EC values used at the time of plant cultivation.

Giving the right hydroponic nutrients will provide optimal results for plant growth (Mas'ud, 2009). According to Resh (2013) all the nutrients contained in the hydroponic nutrient solution is the essential element that plants need in their growth and development. Macro nutrients are N, P, K, Ca, Mg, S. and micro nutrients are Fe, Mn, Cu, B, Zn, Mo, and Na. If macro and micro nutrients are incomplete, they can inhibit growth and planting.

According to Engel *et al.*(2001) in addition to proper plant nutrients it is also necessary to determine the exact concentration of nutrients. At too low concentrations the effect of nutrient solution is not real. On the other hand if the concentrations is too high in addition to wasting it, it will also result in plants experiencing plasmolysis, namely the discharge of cell fluids as attracted by the more concentrated nutrient solution, especially in the root zone. So it is necessary to determine the exact concentration, in addition to determining the exact amount of nutrients. One way to determine that is to control and keep an eye on the EC values.

According to the results of the study Utomo *et al*. (2014) using the Resh and Peckenpaugh nutrient formulations that were tested in Indonesia. The result is that Peckenpaugh nutrition is superior to Resh nutrition. However, these results are obtained from different EC values between Resh and Peckenpaugh formulations. In the formulation of Resh EC used is 2.0 while Peckenpaugh used 1.5, so it is probably one of the factors that make the Peckenpaugh nutrient better in terms of the number of leaves and also in terms of fresh weight of the Pakchoy plant. Therefore in any way these two nutrients are summed up to the most optimal conditions for the plant.

According to Sutiyoso (2009) ideal EC for vegetable crops is between 1.5-2.5 mS cm^{-1}.However the number is not a sure thing for every plant, because every plant has different response in different conditions. With the application of EC values to normal limits can improve the quality of vegetables. Pakchoy plants require EC value of 1.5-2.0 mS cm^{-1}. If the EC is too small it will make the plant growth disturbed due to nutrient deficiency but if the EC is too high it will damage the growth of plant. (Hendra&Andoko2014)

High EC can cause the nutrient solution gets thicker, so the nutrient content increases. Vice versa, if the EC is low it can make the concentration of nutrient solution low so that the nutrient content is less (Phallus, 2005). The EC value of the nutrient solution should be adjusted to the age of the plant and its growth phase (Suhardiyanto, 2009).Electrical conductivity (EC) for young plants ranging from 1 to 1.5 mS cm^{-1}, while for adult plants ranging from 2.5-4 mS cm^{-1} (Untung, 2004).Based on that it is necessary to determine the most appropriate level of EC for the formulation of new nutrients that have different nutrient content.

1.6 Hypothesis

Based on framework explanation, the hypothesis are :

1. The value stages of Electrical Conductivity (EC) can affect growth and yield on the Cultivation of Pakchoy *(Brassica rapa* L.*)* in NFT hydroponic system.
2. There is one level of EC that gives best effect on growth and yield of Pakchoy.