CHAPTER I. INTRODUCTION

A. Background

Shallot (*Allium cepa L.*) is a crucial crop distributed widely in tropical regions. During the growing process, various diseases appear to reduce the yield and quality of shallot. The *Xanthomonas axonopodis* pv. *allii* (Xaa), which causes bacterial leaf blight, is one of the factors contributing to low production (Yanti *et al*., 2007). It is among the most harmful diseases that affect crop producing regions in the nation and many other around the world. The disease progresses rapidly leading to significant yield loss due to the destruction of leaves in the environment with high relative humidity, persistent rain and warm temperatures (Conn *et al*., 2012). If no control methods are used, yield losses might reach 100%, especially in the rainy season (Picard *et al*., 2008).

Besides using chemical pesticides, people also use antibiotics to prevent disease-causing bacteria. This can lead to increased antibiotic resistance in the environment that has led to bans or restrictions on their use, while this is limited use in agriculture due to the antibiotic content that can remain in the product (Sharma *et al*., 2020). Pesticides should not be used continuously or improperly since they might harm the environment. Instead, biological control is used using microorganisms from native plants that encourage disease-resistant growth, where the *Bacillus thuringiensis* group is used to make plants more resistant to pathogens (Rosliani *et al*., 2013). By secreting extracellular compounds such as antibiotics, cell wall hydrolases, and accessory cells, *Bacillus thuringiensis* engaged in antagonistic activities (Sansinenea, 2012). These bacteria have the capacity to create a large amount of secondary metabolites, each having a very distinct nature, structure, and range of activity. These metabolites were first created to help the bacteria survive in its natural environment and include antibiotics, pigments, poisons, growth promoters, ecological competition effectors, pheromones, enzyme inhibitors, and other bioactive substances. The majority of *Bacillus* species and the products they produce are thought to be environmentally friendly. Hence, disease control strategies with antagonistic bacteria or botanical pesticides with relatively lower negative effects than synthetic pesticides have received attention. One of the means of pest control that meets these criteria is botanical pesticides (Stein, 2005).

This kind of pesticides uses selected natural active components that are easily broken down in nature and derived from plants, making them safe for the environment and non-target organisms. Other advantages are that it does not cause rapid resistance if used as a raw extract, can be used in combination with other types of pesticides, and easy preparation can lessen reliance on products and synthetic pesticides (Prakash and Rao, 2018). According to Lina (2014), nanoemulsion mixture of *Piper aduncum* fruit and *Tephrosia* vogelii leaves was used, an active plant insecticide against the larvae of *Crocidolomia pavonana*. Inhibitory feeding is an active form of mixed extracts. At a concentration of 0.06%, the inhibition of feeding reached 94.82%. In addition to its insecticidal activity, dilapiol isolated from the *Piper aduncum* leaves essential oil has antifungal and antibacterial properties. *Cymbopogon nardus* contains citronellal as its main constituent and the other active compounds citronellol. The antibacterial activity of its at concentrations of 20, 30, and 50 mg/ml was shown that it inhibited the growth of *Staphylococcus aureus* and *Bacillus cereus*. Its antibacterial action is enhanced by higher doses (Jafari *et al*., 2012). Furthermore, applying pesticides directly to the target will lessen the development of insect resistance mechanisms and the mortality of natural enemies. In addition to its ability to fight disease-causing insects, the antibacterial activity of *P. aduncum* leaf extracts suppress pathogenic bacteria (*Streptococcus mutans*) and health-related bacteria (*Streptococcus sanguinis*). Extracts from *P. aduncum* against *S. mutans* compared with *S. sanguinis*, furthermore inhibiting sucrose-dependent adhesion and reducing acid production by *S. mutans*, suggest that this plant species may have the potential to prevent pathogenic bacteria (*Streptococcus mutans*). Due to the improper use of pesticides in the past, there have been several instances when particular pests have exploded, which will undoubtedly have a beneficial effect on agricultural productivity. Thus, biological control is recognized as an additional or alternative method of decreasing the use of synthetic pesticides in agriculture (Chaiana *et al*., 2016).

Pathogens and herbivore attacks on plants can cause stress that results in biochemical and physiological changes in the plants. Stimulate systemic reactions in plants induce the activity of protective enzymes, such as the activity of phenylalanine ammonium lyase (PAL), peroxidase (PO), polyphenol oxidase (PPO), as well as accumulation levels of phenol further reducing the infectivity of biological stress (Huang, 2001). An enzyme called peroxidase contributes to plant resilience, including hypersensitive responses, evaporation, phenol synthesis, glycoproteins, suberization, and phytoalexin production. Another crucial plant enzyme is phenylalanine ammonia-lyase (PAL), which encourages the formation of trans-cinnamic acid from phenylalanine, a precursor to lignin, flavonoids, and coumarins. The enzyme PPO has a role in catalyzing the oxidation of phenolic compounds to highly reactive quinones. It has been demonstrated that infections and wounds affect a large number of PPO genes. The function of certain PPO genes in plant defense against pests and diseases is the most noticeable aspect (Gandía-Herrero *et al*., 2005). Thus, to increase the defensive activities of enzymes in plants introduced by microorganisms and botanical pesticides, a combination from two plants can reduce reliance on a single type of plant and improve the plant's ability to defend against diseases. Based on these issues, the research was conducted on "**Nanoemulsion of mixture *P. aduncum* essential oil, hydrosol of *C. nardus* and *B. thuringiensis* to control baterial leaf blight on shallot (Xaa)**".

B. Objectives

The purpose of the research was to find the optimal concentration of nanoemulsion from *P. aduncum* and hydrosol from *C. nardus* to test their ability to inhibit Xaa. Moreover, to determine the activity of peroxidase, polyphenol oxidase and phenylalanine ammonia lyase enzymes in shallots was performed by introducing nanoemulsion and *B. thuringiensis strain* MRSNR3.1 in the inhibition of Xaa.

C. Benefits of research

The benefit of the study is as a source of information that can be used to control Xaa by the activity of the nanoemulsion formulation from *P. aduncum* essential oil and hydrosol of *C. nardus* whereby it served as a reference for further studies about botanical pesticides.