

I. INTRODUCTION

1.1 Background

Hydroponic is a method of planting without the use of soil but enrich mineral nutrient solution in water media (Nguyen, 2016; Jones, 1982; Son *et al.*, 2016). Hydroponic cultivated system becoming popular all over the world (Qurrohman, 2019), it is an alternative system also called the future of agriculture because the concepts of higher productivity, superior quality, and high sanitation also improved water efficiencies, land and fertilizer (Susilawati, 2019).

Hydroponic cultivation is increasingly in demand because it is more profitable than conventional that would overcome problems in the field such as soil acidity, salinity, soil borne-diseases, pests or disease inoculums that would decrease profit in crop production and saving land (Masduki, 2017; Salas *et al.*, 2020) for crop yields will higher, cleanliness, not depending on the season, more practical maintenance, more efficient use of fertilizers, dead plants are easy to replace, do not need harsh labor, continuous yields, relatively high selling prices, plants grow more rapidly and ecofriendly (Roidah, 2014; Steven 2019). Nevertheless lack of hydroponic cultivation is the availability of nutrient solutions and the price is still relatively expensive (Subiksa, 2017)

The dependency on the use of inorganic fertilizers as a source of plant nutrients has increased from year to year (FAOSTAT, 2013). One of the users of inorganic fertilizers on a large scale is hydroponic cultivation (Djamhari, 2013). In worldwide a leafy vegetable plant, the use of biostimulant can reduce and also

can increased leaf pigments (chlorophyll and carotenoid) and stimulate antioxidant potential (Bulgari *et al.*, 2015)

Biostimulant is natural compound enhanced plant growth and absorption of plant nutrient efficiency (Conselvan *et al.*, 2017), increased tolerance to biotic and abiotic stress, improve plant quality, and increased hormone production or plant growth promoters (La Torre *et al.*, 2016). Sources of biostimulants such as microbial inoculants, humic acid, fulvic acid, seaweed extracts, amino acids, and plant extracts (Calvo *et al.*, 2014; Jardin, 2015)

The plants considered of most natural and ecofriendly biostimulants can be applied is Kelor (*Moringa oleifera* L.) due to its remarkable medicinal properties is known as ‘‘The Miracle Tress’’ with scientifically proven a good source of nutrition (Abd Rani *et al.*, 2018; Rodríguez-Pérez *et al.*, 2015), important role as a source of cytokinins like zeatin, antioxidants such as ascorbic acid, amino acid, and macro as well as micronutrients that balance among metabolism and photosynthesis in adulthood phase leaves (Farooq and Koul, 2020), Kelor extract could be recommended as an organic fertilizer for all various plant (Krisnadi, 2015; Abd El-hack *et al.*, 2018)

Several factors were known the effectiveness of using plant extracts as biostimulants, including the concentration of the extract used. Culver *et al.* (2013) reported that the use of 3.2% kelor extract can promote the growth and yield of maize and common beans, application of 3% kelor leaf extract increased radish growth better than giving 5% and 10% (Ashraf, 2016), the used of 3% kelor extract increased growth, quality and yield of fressia flowers (Ahmad *et al.*, 2019), increased in mineral nutrients, chlorophyll a and ascorbic acid in mandarin oranges after being

given 3% kelor extract (Nasir, 2016) and fertilization with 2% and 3% kelor extract increased all measured growth criteria, photosynthetic rate, stomatal conductance, stimulated the production of biomass, improving biochemistry, as well as growth-promoting hormones and essential elements in plants rocket plant (Abdalla, 2013). In addition to increasing growth, yield, biochemical and growth hormones in plants, spraying biostimulant of kelor extract also serves to improved the efficiency of fertilizer on tomato plants (Culver *et al.*, 2012)

Kale (*Brassica oleracea* L. var. *acephala*) was used as a leafy vegetable belonging populer Bassassaceae family, commonly used as a diet food for several people in Europe, the United States, and Asia (Migliozzi *et al.*, 2015). High levels of vitamins and phytochemicals contained in kale, especially carotenoid, glucosinolate, and polyphenol which are responsible for improving health (Becerra-Moreno *et al.*, 2014). Kale is a source of antioxidants that protect against ROS (*Reactive Oxygen Species*) and free radicals, and prevention against chronic diseases in the body (Samec *et al.*, 2019)

Therefore it is necessary to research the potential effects of kelor extract as a biostimulant on the growth, biochemical content and reducing inorganic fertilizer of kale (*Brassica oleracea* L. var. *acephala*) cultivated under hydroponic system.

1.2 Problem Formulation

The problem formulation in this research is:

1. Is the application of kelor extract effect the growth of kale cultivated under hydroponic system?
2. Is the application of kelor extract effect the biochemical content of kale cultivated under hydroponic system?

3. Is the application of kelor extract efficient to reduce the use of inorganic fertilizers in kale under hydroponic system?

1.3 Research Objectives

Based on the formulation of the problem above, the research objectives in this research is:

1. To determine the potential effect of kelor extract on the growth of kale cultivated under hydroponic system
2. To determine the potential effect of kelor extract on the biochemical content of kale cultivated under hydroponic system
3. To investigate the efficiency of kelor extract in reducing the use of inorganic fertilizers in hydroponic cultivated system of kale.

1.4 Research Benefits

The research benefits in this research are:

1. Contributing to the development of science to determine the potential effect of kelor extract as a biostimulant to the growth of kale cultivated under hydroponic system
2. As the alternative that can be used by farmers communities to improve the growth and biochemical content of kale cultivated in hydroponics
3. As information for the public to use organic fertilizers most cheaper and natural eco-friendly to reduce the use of inorganic fertilizers