Productivity and growth performance of edamame (*Glycin Max* L Merril) due to the addition of sitokinin

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**Abstract.** Global market demand towards edamame is quite high, but production of edamame is still very low. Edamame have to increased its production. Many researchers stated that sitokinin effect on the activities of enzymes in metabolic processes of plants. This research aims to analyze response of plant physiological Edamame applied with hormones sitokinin especially in aspects of growth and productivity. The research was carried out in March-May 2017. This study used a Randomized Complete Design method with three treatment factors that is A (unannounced sitokinin hormone), B (hormone siokinin 0.5 mL) C (hormone sitokinin 1 mL) with 5 repetitions. The parameters observed were higher plants, number of leaves, and the weight of the fruit. Research shows that treatment with hormone sitokinin effect on the growth and the production of edamame. The addition of the sitokinin hormones can increase the growth of leaves, stems, and fruit productivity. Results of the study showed treatment C (sitokinin 1 mL) gives significant effect. At the age of 48 HST by administering hormones 1 mL, has an average height of 28.8 cm, average number of leaves 15, and heavy weight fruit 17.43 grams.

**Keywords:** Edamame (*Glycin max* L Merril), growth, productivity, sitokinin

1. **INTRODUCTION**

Edamame is soybean plants that come from Japan has been successfully developed in Indonesia. This plant is a superior commodity consumed as fresh soy bean, namely soy plants that are harvested at the time of seed has grown to 80-90% and fill the space seeds at the moment is still fresh green peas, soybeans boiled as the food side [17]. Edamame can grow and produce well in Asian countries such as Thailand, India, China and Indonesia ([12]; [4]).

The success of the cultivation of Edamame with the preparation phase quality seeds, while planting and selection of appropriate land, balanced fertilization, pest control, plant maintenance intensive as well as determine the productivity of Edamame [6]. The increase of the population, then the needs of soy is also increasing. In the meantime, the production of soybean in Indonesia has not been able to keep up so the Government still needs imports because domestic production is only able to meet the national needs of 30-40% [13]. National soybean production in recent years has continued to decline. In 2009 the national production has already reached 9.75 million tonnes in the year 2012 is down to 7.83 million tons due to extensive harvesting of 7.23 million ha became a 5.70 million ha [2].

Efforts that can be done to improve the results of which are soybean intensification or extensification. The market food needs require the efforts of both the increase in production quantity as well as quality so that it can compete with other exporting countries particularly China and Taiwan.
which is the largest exporting country of Edamame. The success of the cultivation of plants with quality seed preparation, planting time and the selection of an appropriate land, balanced fertilization, pest control, plant maintenance-intensive as well as determine the productivity of Edamame (Goldsworthy and Fisher, 1992).

The soybean crop is included in the season, which can be harvested several times a year. The soy plant taxonomy is the Family: Leguminosae, Subfamily: Papilionoidae, Genus: Glycine, species: *Glycine max* L. Edamame are well suited to life in the regions of tropical sub, but still able to adapt well in the tropics. Soybean plants able to grow optimally with rainfall above 500 mm a year, the optimal temperature of 25-30°C humidity averaging 65%. Planting with a height of more than 750 m above sea level will be hampered and can still produce a good at a height of 110 m above sea level. So, it will be better and more appropriate if soybean plants should preferably be cultivated at altitudes of 110-750 m above sea level [16].

Edamame is a type of plant from Japan which is included into the category of vegetables. Edamame and vegetables as snacks health [3]. Edamame is a plant crop export commodity which was shorter than regular soy, peas soaked in harvest ready at the age of 58-70 days after planting. Edamame contain high nutritional values/100 g seeds contains 583 kkal, protein 11.4 g, carbohydrate 7.4 g, fat 6.6 g, vitamin A or beta carotene 100 mg, B1 0.27 mg, B2 0.14, B3 1 mg, and vitamin C 27, as well as minerals such as phosphorous 140 mg, calcium 70 mg, and potassium 140 mg.

Sitokinin adenine derivative compounds and is instrumental in setting the cell division and "morphogenesis". Sitokinin is used to stimulate the formation of buds, affect in the metabolism of the cells, and stimulates cells activity as well as its main dorman is pushing cell division. Many researchers stated that the sitokinin effect on the activities the enzymes in the metabolic processes of plants ([19]; [9]).

Based on explanation above, the aim of the research was to analyze the physiological response of Edamame (*Glycin max* L. Merril) applied with hormones sitokinin especially in the aspects of growth and productivity.

2. Research Methods

The research was carried out in March-May 2017 at Green House Education Biology University of PGRI Semarang. Research using Randomized Complete Design with one factor treatment that is the adding of sitokinin hormone concentrations (0.5 mL and 1 mL) with 5 repetitions. The materials used in this research is edamame seeds, fertilizer, animal waste, hormones sitokinin, insecticides, and the media. Tools used in this research were 30x30 size ¾ polybag volume, sprayer, bucket, measuring cup, shovels, digital scales, rulers, and stationery. Research was done in several stages: land preparation, planting the seed of edamame, stitching, weeding, irrigation, application of organic substances and hormones, control of plant pest organisms, harvest and post-harvest.

3. Results and Discussion

The research took place with average daily temperatures range between 20°C to 33°C with a humidity between 57% to 91%. This condition is still within the range of conditions of growing edamame, so in general the plants can grow normal. During the 48 days of planting edamame with the use of the hormone sitokinin, high plant is one of the growth variables showed a strain or agronomic characters of varieties of plants. The use of hormones sitokinin much affect plant growth, hormones also stimulate the function sitokinin cell division in the meristem tissue, stimulates the formation of shoots and are able to break down the beans rest period as well as stimulating the growth of the embryo.
Based on the graph the observations have been made, it was known that the height of the plant affected by the hormone sitokinin. The growth of the stem did not escape from the hormones as well as land that has a media source nutrient element. The land was previously mixed with some of the elements required by plants. Moreover, the addition of sitokinin hormone is able to increase productivity and accelerate the growth of the fruit by plant cell division more quickly and continuously. After planting in the first week showed results different from each plant. Hormonal treatment with edamame beans sitokinin 1 mL experiencing growth. It indicates the presence of the influence of environmental factors on treatment or concentration.

As the influence of environmental parameters, the height of the plant is sensitive to environmental factors [15]. The addition of hormones sitokinin able to sufficient nutrient elements both macro and micro on the ground are able to make faster plant growth and increases. This can be due to a plant nutrient element and get Edamame substances that are needed are enough, so that with the addition of sitokinin hormones can increase the growth of the stem rapidly because the crop more quickly experience the cell division.

**Figure 1. Growth of Average High the Stem of Edamame**

The leaf is the primary fotosintat producing organ, then the leaves are indispensable observation and as a parameter to describe the occurrence of growth the growth process [10]. Based on these data it can be noted that the amount of edamame leaves each treatment has increased, but between the treatment did not show the difference.

**Figure 2. Average Number of Edamame Leaves**
The results showed that Edamame had a number of different leaves of any polybag. The number of leaves is most numerous with hormone treatment sitokinin 1 mL. It is caused to the addition of the sitokinin hormones that act to speed up plant cell division. Sitokinin hormone sprayed every 2 weeks one time give effect directly on the plant cells to accelerate cell division. The addition of a number of leaves is suspected due to increased cell division cell differentiation and leaf primordia tip stem [7].

![Figure 3. Average value of weight nut](image)

According to Padjar (2010), pods of soy was first formed around 7 – 10 days after the appearance of the first flowers or after 28 – 35 HST. The number of pods normally ranges from 50 to hundreds the formation of pods and seeds will be enlargement more quickly after the formation of the flower stop. This is in accordance with Adisarwanto [1], which explained that the establishment of pods will more quickly after the formation of the interest stops. The size and shape of the pods become a maximum at the time of the initial period of ripening seeds. This was then followed by a color change from green pods, becoming tawny at time cook. Edamame is divided into two main parts, namely skin seeds and fetus (embryonic).

The amount of fruit produced each hormone concentration 0.5 mL and 1 mL is the same that is 17 grams. While in the control treatments only 5 grams. The difference in weight of the plants is obtained at the time of harvest is also influenced by the hormone sitokinin and some other elements. Because the hormone sitokinin are capable of accelerating the growth and development of plants from the elements contained in these hormones.

4. Conclusion

Based on these research results, can be concluded that treatment with concentration of sitokinin hormone affect significantly towards the growth and production of edamame. The addition of hormones sitokinin was able to increase the growth of leaves, stems, and fruit productivity. Sitokinin 1 mL gives a real effect. At the age of 48 HST by administering hormones 1 mL, has an average height of 28.8 cm, average number of leaves 15, and heavy weight fruit 17.43 grams.

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