Journal of Agriculture (JoA)
Volume: 4 | Number 01 | March 2025
E-ISSN: 2829-2421
https://doi.org/10.47709/joa.v4i01.5951

Intercropping Growth Response of Edamame Plants on Oil Palm Land with the Application of Biosaka

Hari Gunawan[1], Marzuti Isra[2], Maisarah[3], Purjianto[4], Eka Bobby Febrianto[5]
[1,2,5]Prodi Budidaya Perkebunan, Institut Teknologi Sawit Indonesia, Medan, Indonesia
[3]Prodi Teknik Kimia, Institut Teknologi Sawit Indonesia, Medan, Indonesia
[4]Prodi Teknologi Pengolahan Hasil Perkebunan, Institut Teknologi Sawit Indonesia, Medan, Indonesia

maisarah@itsi.ac.id

Received: 2025-05-24
Accepted: 2025-06-03
Publication: 2025-06-03

Abstract
Oil palm is an essential commodity in Indonesia with excellent development potential, but the long waiting time required to produce oil palm plantations is a problem. Combining with multi-purpose tree species (MPTS) plants can solve this problem. Maximizing resources efficiently and environmentally friendly, the concept of plant intercropping entrepreneurship can be used with Edamame. The intercropping of edamame plants on oil palm plants must be carried out optimally to produce good-quality fruit. So, this study was conducted on the growth response of intercropping edamame plants on oil palm plantations with the provision of biosaka. This study aimed to determine the effect of biosaka and NPK fertilizer on the growth and yield of edamame plants. Based on the research that has been done, Biosaka has the potential to increase the productivity of edamame plants. The best dose for edamame plant production is in the P3B1 treatment (NPK 30gr/polybag + 20 ml/L/Polybag) as much as 100.97 g/plant, which can increase the weight of pods/plant, pod weight, and number of pods/plant. The fastest flower emergence age is in the B3 treatment, which is 40.55 days. The study results showed that the interaction between Biosaka and NPK fertilizer had no significant effect on the variable of plant height. The use of Biosaka on edamame plant variables that are not much different from the use of NPK fertilizer can be considered.

Keywords— Biosaka; Edamame; Intercropping; Oil_Palm; Growth

Introduction

Palm oil commodities are a source of income for most farming households, especially in North Sumatra (Maisarah et al., 2024). According to Lawolo, 2022, in 2022, as many as 2,661,042 households in Indonesia were oil palm farmers, including 314,328 oil palm farmers in North Sumatra (Lawolo et al., 2022). Oil palm farming business actors in Indonesia consist of three schemes: large private plantations, state plantations, and smallholder plantations. However, the distribution of this massive palm oil industry is not free from problems that occur. According to Helviani & Aan Wilhan Juliatmaja, 2023, the palm oil producers who most often experience problems are smallholder plantations due to minimal knowledge of Good Agricultural Practices (GAP) (Helviani & Aan Wilhan Juliatmaja, 2023).

Currently, massive oil palm plantations in the planting area by farmers, both individuals and those in farmer groups, are now facing a problem that must be resolved. The main problem felt

This is an Creative Commons License This work is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License

Journal of Agriculture (JoA)
Volume: 4 | Number 01 | March 2025
E-ISSN: 2829-2421
https://doi.org/10.47709/joa.v4i01.5951

by smallholder oil palm farmers is the long waiting time or grace period needed to produce oil palm plantations (Suharno et al., 2015). In addition, in the process of cultivating oil palm plants, farmers often find trees that suddenly die and fall, causing quite massive losses, leading to economic decline, this can be seen in Figure 1. Smallholder oil palm farmers in Indonesia still face various economic problems and smallholder oil palm farmers are still entangled in many problems (Syafira et al., 2024). This is the main reason for farmers to look for alternative businesses to increase income while waiting for the return of farming capital.



Figure 1. Fallen oil palm trees causing economic losses

On the other hand, the issue of the environmental impact caused by land clearing for oil palm plantations is also very much echoed by environmental observers (Nengsih, 2016). The negative impact that can occur if this negative issue continues to develop, then smallholder oil palm farmers will have fear in rejuvenating oil palms. The issue of the environment becomes more serious because in practice the development of oil palm plantations does not only occur in conversion forest areas, but also conservation areas that have unique ecosystems and have high biodiversity values (Nengsih, 2016). So that solutions are needed to environmental problems that also occur. Cultivating oil palm by combining it with multi-purpose tree species (MPTS) plants, namely multi-purpose plants, can be a solution to these problems (Nengsih, 2016). So that to achieve sustainability in the green economy which is one of the economic systems that focuses on sustainable development, minimizing negative impacts on the environment by maximizing resources efficiently and environmentally friendly, the concept of entrepreneurship intercropping plants can be used. The income of smallholder oil palm farmers is still very low. This is because it only relies on palm oil sales with the long waiting time needed to produce palm oil plantations, which is 3-4 years. Thus, the commercialization potential of the activities of smallholder palm oil farmers is still considered inadequate. Therefore, Intercropping of edamame plants on oil palm plants must be carried out optimally so that the resulting fruit can be produced with good quality. From the selection of seeds, types of fertilizers, the process of planting seeds to maintenance. So in this study, a study was conducted on the growth response of intercropping edamame plants on oil palm plantations with the provision of biosaka. The purpose of this study was to determine the effect of biosaka and NPK fertilizer on the growth and yield of edamame plants.

Edamame plants are one of the potential plants that need to be developed in Indonesia because they have a high protein content equivalent to the protein content in milk and eggs (Sipayung et al., 2025). Edamame has become a popular snack throughout the world, especially because of its high nutritional content and health benefits. Edamame has a relatively high nutritional content, where every 100 grams of seeds contain protein, carbohydrates, fat, vitamin A or carotene, vitamin B1, vitamin B2, vitamin B3, vitamin C, and minerals such as phosphorus, calcium, iron, and potassium (Pambudi, 2013). Edamame is rich in protein, fiber, and various vitamins and minerals. In one cup (160 grams) of cooked edamame, there are about 224 calories,

This is an Creative Commons License This work is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License

Journal of Agriculture (JoA)
Volume: 4 | Number 01 | March 2025
E-ISSN: 2829-2421
https://doi.org/10.47709/joa.v4i01.5951

37% of the daily protein requirement, and various other important nutrients (Pambudi, 2013).

Edamame production in Indonesia has a high level, reaching 3.5 tons to 8 tons/ha, while soybean production is lower, ranging from 1.7 tons to 3.2 tons/ha (Sipayung et al., 2025). Therefore, the development of edamame in Indonesia has very good potential. The demand for edamame exports in Japan is 100,000 tons per year, while the United States needs 7,000 tons per year. Currently, Indonesia is able to meet 3% of the Japanese market demand, while the remaining 97% is supplied by Taiwan and China (Hakim, 2013). The decline in soybean production was caused by a reduction in harvested area of 2.69 thousand ha and productivity of 0.46 quintals/ha (Hakim, 2013).



Figure 2. (a) Intercropping of Oil Palm and Mucuna (b) Intercropping of Edamame and Potato (Arina et al., 2021)

One of the obstacles often faced by farmers is the condition of the land that is less productive due to the excessive and continuous use of inorganic fertilizers, resulting in soil degradation which can have a negative impact on environmental pollution, both on soil structure, and can leave chemical residues on crop yields. Efforts to increase edamame plant production that do not require a lot of money are by using a new innovation, namely Biosaka. This is a new research value which is an innovation from previous studies. Biosaka is referred to as biological and the abundance of microorganisms in agricultural land, which is a prerequisite for healthy soil. Biosaka is non-toxic, saves the cost of synthetic chemical fertilizers by 50-70% than usual and chemical pesticides, so farmers usually use fertilizer of IDR 3 million / ha / season (save fertilizer 50-70% than usual) by using Biosaka is enough IDR 0.3-1.5 million / ha / season is good (Sianturi, 2024) However, in the use of natural elicitors themselves, not many farmers know about it.

Efforts to increase edamame production also need to pay attention to the nutrients available on the land used and the results of the resulting crop production. The three important nutrients needed by plants are Nitrogen, Phosphorus and Potassium. These are referred to as macronutrients. Nitrogen is a macronutrient that is very important for the vegetative growth of plants, including edamame. Nitrogen plays a role in the formation of proteins, nucleic acids, and chlorophyll. Meanwhile, Phosphorus is also a crucial macronutrient for edamame plants. Phosphorus plays an important role in the process of photosynthesis, respiration, energy formation (ATP), and the development of roots, flowers, and seeds. Phosphorus is needed in large quantities in the formation of plant seeds, especially in the formation of protein and fat in edamame seeds (Iswiyanto et al., 2022). Potassium is a macronutrient that plays a role in various physiological processes of plants, such as regulating turgor pressure, activating enzymes, transporting photosynthesis results, and increasing plant resistance to disease and drought (Dibia & Dana,

This is an Creative Commons License This work is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License

Journal of Agriculture (JoA)
Volume: 4 | Number 01 | March 2025
E-ISSN: 2829-2421
https://doi.org/10.47709/joa.v4i01.5951

2017). The solution that can be done when improving the nutrients available in the soil is to use organic fertilizers that are environmentally friendly and do not damage nature and inorganic fertilizers that are expected to contain the three nutrients are NPK fertilizers that are widely sold on the market. Each type of plant will provide a different growth response to the treatment used. Therefore, this study was conducted to determine how the growth and yield of edamame plants with different treatments.

Literature Review

Research on the practice of planting soybeans between rows of oil palms has actually been widely conducted in Indonesia, but there has been no research that integrates the use of organic fertilizers and edamame soybean plants. The novelty in this study is that this study uses soybean varieties in the form of edamame as intercrops. This was chosen because the need for edamame varieties domestically is approximately 700 tons per year, while exports to Japan have not been fully met, therefore the development of edamame plants still needs to be done. This will also increase the diversification of food commodities that strengthen village development in supporting the achievement of the 6th Asta Cita as additional income for smallholder oil palm farmers. In addition, the novelty of this study is the use of biosaka on edamame plants in addition to NPK chemical fertilizers. This is used because the use of chemical fertilizers in oil palm plantations can indeed cause greenhouse gas emissions, especially nitrous oxide (N_2O), which is a stronger greenhouse gas than carbon dioxide (CO_2). Excessive use of chemical fertilizers can also cause pollution and reduce soil fertility. So the transition from using chemical fertilizers to organic fertilizers, one of which is Biosaka, is very necessary.

Intercropping Concept

Intercropping plants between oil palm plantations is an activity of cultivating food crops, plantations and horticulture as intercrops between oil palms which has great potential to be carried out. However, there are still many smallholder oil palm farmers who do not know about the concept of entrepreneurship of intercropping plants. The pattern of intercropping edamame plants is very profitable for smallholder oil palm farmers as additional income because the community can manage it independently or in collaboration with farmer groups. Considering that smallholder oil palm plantations in the North Sumatra region are the main source of income for farmers, while the waiting time for the oil palm harvest is quite long, reaching 3-4 years after planting. Therefore, knowledge about intercropping plants and its role in the lives of oil palm farmers is very useful for prioritizing the welfare and improving the economy of smallholder farmers. The effort of intercropping edamame beans on oil palm plants is very feasible to do (PPKS, 2023; Saragih et al., 2023).

Other advantages of using intercropping plants include increased efficiency of both labor, land use, and absorption of sunlight. Utilization of space between rows of young oil palm plants can also occur because the technical culture of intercropping under plantation stands is similar to the monoculture planting pattern and does not interfere with the growth and development of plantation crops. In addition, biological stability will be created as an effort to overcome environmental problems so that it can suppress pest and disease attacks and maintain the sustainability of land resources, especially soil fertility.

Research (Sipayung et al., 2025) has conducted research with variations in the dose of bioneensis fertilizer on edamame soybean plants (*Glycine max* (L) Merril) which are planted as intercropping in rubber plantation areas. It was found that in rubber plantation areas, the provision of bioneensis fertilizer can increase the growth of edamame soybean plants planted as intercropping. So in this study, research will be conducted to see the growth of edamame plants as intercropping in oil palm plantation areas.

This is an Creative Commons License This work is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License

Journal of Agriculture (JoA)
Volume: 4 | Number 01 | March 2025
E-ISSN: 2829-2421
https://doi.org/10.47709/joa.v4i01.5951

Edamame Plants

Edamame plants (*Glycine max* (L) Merr.) according to researchers at Washington State University, the first written record of edamame came from China, edible beans (Tjahyani et al., 2015). The market potential for edamame soybeans in Indonesia is quite large, both for export and local needs (Wijaya et al., 2020). Edamame is an agricultural product whose marketing is starting to grow rapidly in Indonesia (Fariha Amsa et al., 2021). Indonesians call it vegetable soybeans or more easily called Japanese soybeans. Edamame has a high protein content which is equivalent to the protein content in milk and eggs (Endang Kantikowati, Karya, Dian Murti Minangsih, Joko Santoso, 2024). Edamame also contains anti-cholesterol substances so it is very good for consumption and edamame also does not contain cholesterol and little saturated fat, is rich in fiber, vitamins C and B, calcium, iron, and folic acid (Endang Kantikowati, Karya, Dian Murti Minangsih, Joko Santoso, 2024).

North Sumatra is the right place for the development of Edamame plants, where edamame has good opportunities to be cultivated, the market prospects are still wide open. The price of edamame is also relatively good, the price per kg ranges from IDR 23,000 to IDR 46,900 depending on the brand and type. The varieties that are widely cultivated include Ryoko, Taiso, Surumidori and Surunoko (Tjahyani et al., 2015). Ryoko is the most widely cultivated variety because the pods are larger, the taste is sweeter and the fine hairs on the pods are less. Domestic edamame demand is approximately 700 tons per year, while exports to Japan have not been fully met, therefore edamame plant development still needs to be carried out.

Biosaka

Biosaka is a material from plant or grass solutions that are known to be able to protect plants from pests and diseases and can reduce fertilizer use by 50-90 percent (Shofwan Kusnendi et al., 2023). Several types of plants that are commonly used as raw materials for making biosaka include: Babadotan (*Ageratum conyzoides* L), Tutup bumi (Elephantopus mollis kunth), Kitolod (*Hippobroma longiflora*), Maman ungu (*Cleome rutidosperma*), Patikan kebo (*Euphorbia hirta* L), Meniran (*Phyllanthus niruri* L), Anting-anting (Acalypha australis L.) Jelantir (*Erigeron sumatrensis* Retz), Sembung (*Baccharis balsamifera* L.), Sembung rambat (*Eupatorium denticulatum* Vahl) and so on (Shofwan Kusnendi et al., 2023). These plants contain phytochemical compounds such as alkaloids, flavonoids, terpenoids, steroids, saponins, tannins, phenolics, and quinones. The content of phytochemical compounds in biosaka was confirmed from biosaka samples (Shofwan Kusnendi et al., 2023). The increasing price of inorganic fertilizers has forced farmers to look for other alternatives to supply nutrients for their plants (Reflis et al., 2023). Biosaka is one option to support the reduction of the use of inorganic fertilizers for plants (Reflis et al., 2023). Biosaka is a new innovation in the application of organic fertilizers made from grass to reduce the use of chemical fertilizers (Reflis et al., 2023). Biosaka is a biological elicitor whose function is to increase plant resistance to diseases and pests (Reflis et al., 2023).

Research Method

This research was conducted on May 2024 at the LLDIKTI Growth Center Region I, Medan. The materials used in this study included edamame soybean seeds, organic compost, NPK fertilizer, and botanical pesticides. The tools used in this study were a digger, sprayer, scale, bucket, hoe, plastic hose, meter, sack, paper bag, plastic, and. The design used was a randomized block design (RAK) with 3 replications. There were two factors in the treatment, namely. The first factor, the administration of NPK fertilizer was given in different doses, namely P0 = Without NPK fertilizer, P1, = 10 g NPK / polybag, P2 = 20 g NPK / polybag P3 = 30 g NPK / polybag. Meanwhile, Biosaka administration was carried out with 4 concentration levels, namely Bo = 10

This is an Creative Commons License This work is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License

Journal of Agriculture (JoA)
Volume: 4 | Number 01 | March 2025
E-ISSN: 2829-2421
https://doi.org/10.47709/joa.v4i01.5951

ml/L/polybag, B1 = 20 ml/L/polybag, B2 = 30 ml/L/polybag and B4 = 40 ml/L/polybag. Thus, there were a total of sixteen types of treatments tested, each treatment would be repeated three times. Data from observations and measurements would be analyzed statistically using analysis of variance (ANOVA). If there is a treatment that has a significant effect, it will be continued with the BNT Test with a significance level of 5%.

Results and Discussion

The Influence and Provision of Biosaka on the Growth and Production of Edamame

Height of Edamame Plants

Based on the results of the research that has been done, it was found that the provision of NPK and Biosaka fertilizers can affect the height of edamame plants. Various doses of fertilizers gave significantly different results based on statistical tests. Table 1 shows that there is an effect on the treatment in the observation of the use of NPK fertilizers, Biosaka and the Interaction of Both. In the provision of NPK Fertilizer, it can be seen that the treatment of NPK dose 30gr/polybag (P3) gave the highest plant height of 66.68 cm at 8 MST. While in the provision of Biosaka B1 with the treatment of biosaka dose 20 ml/L/polybag (B1) gave the highest plant yield of 66.11 cm at 8 MST. Furthermore, the Interaction of NPK Fertilizer and Biosaka, namely at a dose of NPK 30 gr/polybag and Biosaka 10ml/L/polybag (P3B0) showed the highest plant yield at 59.11 cm at 8 MST. This observation shows that the best use of fertilizer for plant height is shown in the use of NPK fertilizer. This is in line with the research of Yuniarti et al., 2019 in (Ramli et al., 2024) which shows that the use of NPK fertilizer affects the assimilation capacity of organic C, C/N, N, and plant height (Ramli et al., 2024). Plant height growth is related to the presence of essential nutrients such as N, P, and K, where the role of nitrogen (N) is the main ingredient in the formation of chlorophyll, amino acids, proteins and protoplasm which stimulate plant height growth (Putri & Putri, 2023).

Table 1. Plant Height with Biosaka and NPK Fertilizer Treatment at Ages 2, 4, 6 and 8 Weeks After Planting (WAP)

Treatment	2 WAP (cm)	4 WAP (cm)	6 WAP (cm)	8 WAP (cm)
NPK				
P0	17,70 b	42,97	48,44	61,11
P1	17,77 ab	46,21	53,42	66,08
P2	19,74 ab	44,89	51,94	64,68
P3	20,28 a	46,36	53,82	66,68
Biosaka				
B0	17,83 b	45,24	52,36	65,14
B1	18,57 ab	47,54	53,38	66,11
B2	19,06 ab	44,81	52,22	65,00
B3	20,02 a	42,85	49,67	62,31
Interaction (PxB)				
P0B0	15,46	38,83	43,61	43,61
P0B1	17,59	46,50	51,39	51,39
P0B2	17,49	46,44	51,72	51,72
P0B3	20,27	40,11	47,06	47,06
P1B0	16,86	47,11	54,94	54,94
P1B1	16,60	50,33	55,44	55,44
P1B2	18,57	45,89	54,28	54,28
P1B3	19,06	41,50	49,00	49,00
P2B0	19,23	46,39	51,78	51,78

This is an Creative Commons License This work is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License

Journal of Agriculture (JoA)
Volume: 4 | Number 01 | March 2025
E-ISSN: 2829-2421
https://doi.org/10.47709/joa.v4i01.5951

Treatment	2 WAP (cm)	4 WAP (cm)	6 WAP (cm)	8 WAP (cm)
P2B1	19,58	45,94	52,39	52,39
P2B2	19,60	40,06	49,61	49,61
P2B3	20,54	47,17	54,00	54,00
P3B0	19,79	48,61	59,11	59,11
P3B1	20,51	47,39	54,28	54,28
P3B2	20,60	46,83	53,28	53,28
P3B3	20,20	42,61	48,61	48,61

Description: Numbers followed by different letters in the same column are significantly different according to the 5% DMRT test.

The results of the study showed that the interaction between Biosaka and NPK fertilizer had no significant effect on the variable of plant height. This is in line with the study (Sinurat, 2023), which conducted a study on the effect of NPK fertilizer and biosaka on the growth and production of lowland rice. The single factor Biosaka with a concentration of 20 ml/L/polybag (B1) is a provision that is considered quite effective on the variable of plant height at the ages of 2 MST, 4 MST and 8 MST. Biosaka elicitors with compounds derived from natural ingredients are suspected of being able to stimulate plant growth because biosaka containing elicitor compounds minimizes pest and disease attacks and the presence of ZPT (Plant Growth Regulator) content in biosaka is suspected of being able to stimulate the growth of roots, stems, leaves and fruit (Ayu Kartika et al., 2024). The use of Biosaka on plant height variables that are not much different from the use of NPK fertilizers can be considered. This is because the long-term use of chemical fertilizers and pesticides can cause physical degradation of soil structure and environmental pollution (Putrantri et al., 2024). According to Soekamto and Fahrizal (2019) in (Putrantri et al., 2024), the accumulation of residues from chemical fertilizers can complicate the soil decomposition process, thereby decreasing land productivity. Economically, farmers' expenditures on purchasing fertilizers also tend to have quite high costs (Putrantri et al., 2024). So based on the plant height variable, the use of Biosaka compared to the use of NPK can be a good choice for the environment and the economy.

Based on the description of the Biomax-1 variety of edamame plants, the height of the edamame plants ranges from 37.61 - 40.33 cm antara 37,61 – 40,33 cm (Putri & Putri, 2023). Meanwhile, in this study, edamame plants had an average plant height of 40 cm - 60 cm. This shows that the plant height obtained in this study is still in accordance with the description of the plant. To obtain optimal plant height in edamame plants, it is necessary to adjust the planting distance and fertilizer dosage according to the soil conditions and environment where the edamame plants are cultivated, as well as choosing edamame plant varieties that have good genetic properties to produce optimal plant height (Putri & Putri, 2023). There are several factors that affect plant height growth such as: lighting for plants to photosynthesize, water, temperature stress, air, humidity, soil pH, genetic factors originating from the plant itself, competition with other plants, plant care itself by humans and nutrient stress or nutrients (Putri & Putri, 2023).

Flowering Age of Edamame Plants

Table 2 shows that the administration of Biosaka concentration and NPK dose resulted in an average flowering age of around 39-41 days after planting.

Table 2. Flowering Age with Biosaka and NPK Fertilizer Treatments

Treatment	NPK				Average
	P0	P1	P2	P3	
Biosaka	….....(Days)….....				

This is an Creative Commons License This work is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License

Journal of Agriculture (JoA)
Volume: 4 | Number 01 | March 2025
E-ISSN: 2829-2421
https://doi.org/10.47709/joa.v4i01.5951

B0	41,78	41,89	41,67	39,89	41,31 a
B1	41,78	41,56	41,11	40,78	41,31 ab
B2	39,44	40,11	41,67	41,44	40,66 ab
B3	41,00	41,11	40,44	39,66	40,55 b
Average	41,00 a	41,17 ab	41,22 ab	40,44 b	

Description: Numbers followed by different letters in the same column are significantly different according to the 5% DMRT test.

Based on observations of the age of edamame flowers with various doses of NPK and Biosaka fertilizers, the results were not significantly different based on statistical tests. This is because the nutrients given in each treatment are sufficient for edamame growth. The average age of flower emergence was fastest in treatment B3, which was 40.55 days, and the slowest in treatment B0, which was 41.31 days. However, in this study, edamame plants experienced slower flowering than the plant description. The plant description explains that flowering occurs at the age of 30-35 dap (days after planting), while in this study edamame plants began to flower at 39-41 dap (Putri & Putri, 2023). This is due to the genetic nature of the plant and environmental factors where edamame plants are cultivated. Several environmental factors that affect the flowering of edamame plants include altitude above sea level, temperature, humidity, and light. The altitude above sea level greatly determines the flowering of plants, such as in North Sumatra which is a lowland area with an altitude of ± 13 meters above sea level, while the main producer of edamame plants is located in Jember Regency, East Java which has an altitude of 3,330 meters above sea level (Putri & Putri, 2023). The appropriate air temperature for edamame plants is 23-30 ° C, while the appropriate humidity is 60-70% (Putri & Putri, 2023).). So that edamame plants have not been able to adapt well to higher temperatures. Light also affects the growth and production of edamame plants. In addition, the genetic characteristics of plants also affect the flowering of edamame plants. Environmental factors will affect the physiological processes of plants, the speed of flowering plants is influenced by genetic characteristics and their environment (Putri & Putri, 2023). The genetic characteristics of edamame plants play a greater role in determining the age of flowering (Putri & Putri, 2023). So that the biosaka and fertilizers given play a role in edamame plants, helping the plants grow faster and healthier because they are able to provide nutrients for plant growth.

Number of Pods per Plant and Per Edamame Plot

Based on the results of the study, the provision of NPK fertilizer and biosaca significantly affected the number of pods per edamame plant. The interaction between biosaca and NPK with edamame plants gave significantly different results based on statistical tests. The highest number of pods in the P3B0 treatment reached 28.56 pods per plant and 113.60 pods per plot, while the lowest number of pods in the P0B0 treatment only reached 11.20 pods per plant and 48.00 pods per plot. The low numbers obtained from the average plant description which explains that the number of pods per plant ranges from 20-28 pods due to several internal and external factors, so that it can cause low pod formation (Putri & Putri, 2023). High temperatures can affect damage to soybean seeds in the field. In addition, the optimal air temperature for soybean plants ranges from 20-30°C during the plant growth period to the pod filling stage. Pod formation is influenced by nutrients, water and sunlight, so that pod formation and filling can affect edamame plant yields. Apart from external factors, pod formation is determined by the genetics of the plant. Because each variety used must be different in terms of growth and yield.

Table 3. Number of Pods per Plant with Biosaka and NPK Fertilizer Treatments

Treatment	**NPK**				**Average**
	P0	**P1**	**P2**	**P3**	

This is an Creative Commons License This work is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License

Journal of Agriculture (JoA)
Volume: 4 | Number 01 | March 2025
E-ISSN: 2829-2421
https://doi.org/10.47709/joa.v4i01.5951

Biosaka			(pods)		
B0	11,20	17,81	22,11	28,56	19,92
B1	19,33	17,11	18,22	27,33	20,50
B2	16,44	15,67	14,67	22,33	17,28
B3	16,11	16,33	15,56	21,78	17,44
Average	15,78 c	16,81 bc	17,89 b	25,50 a	

Description: Numbers followed by different letters in the same column are significantly different according to the 5% DMRT test.

Table 4. Number of Pods per Plot with Biosaka and NPK Fertilizer Treatments

Treatment	NPK				Average
	P0	P1	P2	P3	
Biosaka			(pods)		
B0	48,00	71,60	87,60	113,60	80,20
B1	71,00	70,67	70,67	94,33	76,67
B2	66,80	64,08	69,00	82,67	70,64
B3	64,67	63,67	64,67	77,00	66,50
Average	62,62 c	67,51 bc	72,99 b	91,90 a	

Description: Numbers followed by different letters in the same column are significantly different according to the 5% DMRT test.

The use of Biosaka and NPK showed higher results on the variables of the Number of Pods per Plant and Per Plant Plot compared to the study (Putri & Putri, 2023), which showed that the interaction between the dose of banana peel compost fertilizer and edamame plants gave the highest number of pods in the treatment reaching 20.6 pods. So that the use of Biosaka on the variable number of plant pods with the use of NPK fertilizer can be considered.

Pod Weight per Plant and Per Plot of Edamame

Based on observations of edamame pod weight with various doses of NPK and biosaka fertilizers, the results were significantly different based on statistical tests. This is because the nutrients given in each treatment were sufficient for edamame growth. The results showed that the pod weight of edamame plants in the P2B2 treatment had the highest weight of 130.68 g, while the lowest was in the P0B3 treatment, which was 68.43 g. The pod weight of edamame plants per plot in the P2B2 treatment had the highest weight of 283.68 g, while the lowest was in the P0B0 treatment, which was 204.12 g. Meanwhile, the description of the edamame plant explains that the pod weight ranges from 58.31 - 82.67 g/plant. This shows that the pod weight in this study is higher than the plant description. Several factors that affect the pod weight of edamame plants include planting distance, fertilizer dose, and number of seeds per planting hole.

Table 5. Weight of Pods per Plant with Biosaka and Fertilizer Treatments

Treatment	NPK				Average
	P0	P1	P2	P3	
Biosaka			(g)		
B0	71,40	91,00	100,60	110,76	93,44
B1	100,61	92,71	96,06	100,97	97,59
B2	75,14	117,73	130,68	90,23	103,44
B3	68,43	110,91	107,20	99,01	96,39
Average	78,90 c	103,09 ab	108,64 a	100,24 b	

Description: Numbers followed by different letters in the same column are significantly different according to the 5% DMRT test.

This is an Creative Commons License This work is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License

Journal of Agriculture (JoA)
Volume: 4 | Number 01 | March 2025
E-ISSN: 2829-2421
https://doi.org/10.47709/joa.v4i01.5951

Table 6. Weight of Pods per Plot with Biosaka and NPK Fertilizer

Treatment	NPK				Average
	P0	P1	P2	P3	
Biosaka			(g)		
B0	204,12	210,36	253,67	256,56	231,78
B1	237,94	229,24	239,06	240,27	237,19
B2	210,24	259,23	283,68	220,23	243,35
B3	212,43	249,21	247,24	252,81	240,43,
Average	216,181 b	237,04 ab	255,91 a	242,87 ab	

Description: Numbers followed by different letters in the same column are significantly different according to the 5% DMRT test.

In addition, environmental factors such as temperature, humidity, and light can also affect the growth and yield of edamame plants, including pod weight. The seed filling period is the most critical period in the growth period of edamame. If there is a disturbance in this period, it will reduce the yield. An environmental temperature of 30 ℃ during flowering will cause the flowers to fall off so that the pods formed will be reduced. If the availability of N and P is in a balanced condition, it will result in increased formation of amino acids and proteins in seed formation so that the pods are fully filled. Phosphorus for plants can also improve generative growth, especially in the formation of flowers, fruits and seeds. If vegetative growth is good, the photosynthesis produced is high, this causes the plant's ability to form generative organs to increase (Putri & Putri, 2023).

Conclusion

Based on the research that has been done, it can be concluded that Biosaka has the potential to increase the productivity of edamame plants. The best dose for edamame plant production is in the P3B1 treatment (NPK 30gr/polybag + 20 ml/L/Polybag) as much as 100.97 g/plant which can increase the weight of pods/plant, pod weight and number of pods/plant. The fastest flower emergence age is in the B3 treatment, which is 40.55 days. The results of the study showed that the interaction between Biosaka and NPK fertilizer had no significant effect on the variable of plant height. So that the use of Biosaka on edamame plant variables which is not much different from the use of NPK fertilizer can be considered as a result of the use of chemical fertilizers in the long term which can cause physical degradation of soil structure and environmental pollution.

Research on intercropping system in oil palm is very useful for science because it can improve understanding of the effects of interactions between the two crops, optimization of land use, and the potential for increasing farmer income. In addition, this research can also provide information on sustainable and environmentally friendly cultivation practices, as well as provide alternatives for farmers to diversify crops so as to reduce the risk of loss if problems occur in oil palm plants, and provide opportunities for farmers to utilize land optimally.

Acknowledgements

We would like to express our deepest gratitude to LLDIKTI Region 1, North Sumatra Province, for their support in implementing this program. We would also like to express our gratitude to the Institut Teknologi Sawit Indonesia. This research activity was funded in the 2024 budget year through the Collaboration Program of the Institut Teknologi Sawit Indonesia and LLDIKTI Region 1. We are very grateful to the related parties who have facilitated the implementation of this research program.

References

This is an Creative Commons License This work is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License

Arina, I. N., Martini, M. Y., Surdiana, S., Fauzi, R. M., & Zulkefly, S. (2021). Radiation Dynamics on Crop Productivity in Different Cropping Systems. *International Journal of Agronomy*, *2021*.

Ayu Kartika, M., Nurhidayati, & Basit, A. (2024). Pengaruh Aplikasi Biosaka Dan Pupuk Anorganik Terhadap Pertumbuhan Dan Serapan Hara N, P, Dan K Pada Padi Gogo Varietas Inpago 13 Fortiz the Influence of Biosaka Application and Inorganic Fertilizer on the Growth and N, P, and K Nutrients Uptakes in Gogo. *Agronisma*, *11*(2), 391–406.

Dibia, I. N., & Dana, A. I. W. (2017). Peranan bahan organik dalam peningkatan efisiensi pupuk anorganik dan produksi kedelai edamame (Glycine max L. Merill) pada tanah subgroup vertic epiaquepts Pegok Denpasar. *Jurnal Agrotrop*, *7*(2), 167–179.

Endang Kantikowati, Karya, Dian Murti Minangsih, Joko Santoso, R. M. (2024). Pertumbuhan Dan Hasil Edamame (Glycine Max L.) Varietas Ryokko Akibat Perlakuan Pupuk Kandang Ayam Dan Nitrogen. *Agro Tatanen*, *6*, 21–29.

Fariha Amsa, Dewi, R. K., & Dewi, I. A. L. (2021). Analisis Strategi Pemasaran Edamame (Studi Kasus di UD.Lanusa, Denpasar). *Jurnal Agribisnis Dan Agrowisata*, *10*(2), 454.

Hakim, N. A. (2013). Perbedaan Kualitas dan Pertumbuhan Benih Edamame Varietas Ryoko yang Diproduksi di Ketinggian Tempat yang Berbeda di Lampung. *Jurnal Penelitian Pertanian Terapan*, *13*(1), 8–12.

Helviani, H., & Aan Wilhan Juliatmaja. (2023). Penyuluhan Terhadap Petani Swadaya Kelapa Sawit Guna Peningkatan Ekonomi Masyarakat Desa Anaiwoi Kecamatan Tanggetada Kabupaten Kolaka. *PaKMas: Jurnal Pengabdian Kepada Masyarakat*, *3*(1), 32–37. https://doi.org/10.54259/pakmas.v3i1.1604

Iswiyanto, A., Radian, R., & Abdurrahman, T. (2022). Pengaruh Nitrogen Dan Fosfor Terhadap Pertumbuhan Dan Hasil Kedelai Edamame Pada Tanah Gambut. *Jurnal Sains Pertanian Equator*, *12*(1), 95. https://doi.org/10.26418/jspe.v12i1.60354

Lawolo, O., Pinem, L. D., Nainggolan, E. W., Sitopu, Y. D., & Nainggolan, H. L. (2022). Analisis Pendapatan Usahatani Kelapa Sawit Rakyat Dan Kontribusinyaterhadap Pendapatan Keluarga Petani Di Kabupaten Tapanuli Selatan. *Prosiding Seminar Nasional Universitas Pgri Palangka Raya*, *1*, 54–62. https://doi.org/10.54683/puppr.v1i0.8

Maisarah, Dian, R., Ginting, M. S., Siregar, R. M., Barus, F. A., & Aznur, T. Z. (2024). Sosialisasi Teknis Dan Peningkatan Pemeliharaan Kelapa Sawit Pada Wilayah Petani Sawit Rakyat Kelurahan Namu Ukur Selatan. *Jurnal Pengabdian Masyarakat: Pemberdayaan, Inovasi Dan Perubahan*, *4*(4). https://doi.org/10.59818/jpm.v4i4.762

Nengsih, Y. (2016). Tumpangsari Tanaman Kelapa Sawit (Elaeis Guineensis Jacq.) Dengan Tanaman Karet (Hevea Brassiliensis L.). *Jurnal Media Pertanian*, *1*(2), 69. https://doi.org/10.33087/jagro.v1i2.18

Pambudi, S. (2013). *Budidaya & khasiat kedelai edamame : camilan sehat dan multi manfaat*. Yogyakarta : Pustaka Baru Press.

PPKS. (2023). *Tanaman Sela Pada Peremajaan Kelapa Sawit Rakyat* (Issue 51). Pusat Penelitian Kelapa Sawit.

Putrantri, D. A., Hidayat, I. H., Sari, H. P., & Azalia, A. (2024). *Penerapan Pertanian Berkelanjutan Melalui Aplikasi Biosaka Untuk Meningkatkan Produktivitas Tanaman*

This is an Creative Commons License This work is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License

Sayuran Di Gapoktan Lestari Makmur Kabupaten Tulang Bawang Barat Sustainable agriculture implementation through the BIOSAKA application to improve vegetabl. *1*(2), 91–98.

Putri, R. R., & Putri, S. D. (2023). Potensi Penggunaan Kompos dari Limbah Kulit Pisang untuk meningkatkan Produktivitas Tanaman Edamame (Glicyne max (L .) Merril). *Jurnal Liefdeagro*, *2*.

Ramli, Ramli, A., Adrianto, B., & Rachmat, R. (2024). Aplikasi Pupuk Organik Biosaka dan NPK Terhadap Peningkatan Pertumbuhan Tanaman Padi (Oryza sativa L.). *Jurnal Agrisistem*, *20*(1), 24–30. https://doi.org/10.52625/j-agr.v20i1.318

Reflis, Sumartono, E., Nyayu Neti Arianti, & Ketut Sukiyono. (2023). Biosaka pengembangan pertanian organik. *Community Development Journal*, *4*(2), 2939–2945.

Saragih, D. A., Pulungan, D. R., & Ningsih, T. (2023). *Prospektus Kacang Edamame Dalam Peningkatan Pendapatan Perusahaan Perkebunan Kelapa Sawit*.

Shofwan Kusnendi, F., Muttaqi, K., Ravi Wibowo, A., & Muaratama Sibarani, E. (2023). Respon Pertumbuhan Bibit Kelapa Sawit (Elaeis guineensis Jacq.) terhadap Pemberian POC Kulit Pisang Kepok dan Biosaka. *Jurnal Citra Widya Edukasi*, *15*(3), 231–252.

Sianturi, J. I. (2024). *Pengaruh Kombinasi Pemberian Ekstrak Biosaka Dan Pupuk Organik Notayam Terhadap Pertumbuhan Dan Hasil Bawang Merah*. Universitas Medan Area.

Sinurat, W. L. (2023). *Pengaruh Pupuk NPK dan Biosaka terhadap Pertumbuhan dan Produksi Padi Sawah (Orzya sativa L .)*. Universitas Sumatera Utara.

Sipayung, H. H., Sukariawan, A., & Rahutomo, S. (2025). Variasi Dosis Pupuk Bioneensis pada Tanaman Kedelai Edamame (Glycine max (L) Merril) yang Ditanam Secara Tumpang Sari di Areal Tanaman Karet. *Tabela Jurnal Pertanian Berkelanjutan*, *3*(1), 4–9.

Suharno, A.D., Y., & Barbara, B. (2015). Analisis Kinerja Usahatani Perkebunan Kelapa Sawit Rakyat Melalui Pola Kemitraan Di Provinsi. *Jurnal Agribisnis Indonesia*, *3*(2), 135–144.

Syafira, R., Nasution, Z., & Charloq, C. (2024). Analisis Kendala Program Peremajaan Sawit Rakyat (PSR) terhadap Potensi Pertumbuhan Ekonomi Petani Sawit Rakyat. *Jurnal Ilmiah Global Education*, *5*(1), 431–441. https://doi.org/10.55681/jige.v5i1.2469

Tjahyani, R. W. T., Herlina, N., & Suminarti, N. E. (2015). Kedelai Edamame (Glycine max (L.) Merr.) Pada Berbagai Macam Dan Waktu Aplikasi Pestisida. *Jurnal Produksi Tanaman*, *3*(6), 511–517.

Wijaya, R., Yudiastuti, S. O. N., & Handayani, A. M. (2020). Diversivikasi Produk Edamame Sebagai Makanan Sehat Pada Pandemik Covid-19 Dengan Teknologi Pengeringan Tipe Food Dehydrator Di Upt Pengolahan Dan Pengemasan Produk Pangan Polije. *NaCosVi : Polije Proceedings Series*, *2017*(5), 196–201.

This is an Creative Commons License This work is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License