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Effect of Organic Fertilizer and Different Rates of Fish Amino Acid (FAA) on Growth and Yield of Okra (*Abelmoschus esculentus*) in University College of Agroscience Malaysia, Melaka

Hidayatul Shamilah Ismauddin[1]*, Nur Farahiyah Mohd Fuzi[1] and Noraidah Nordin[1]

[1]University College of Agroscience Malaysia, Malaysia.

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ABSTRACT

This study investigates the effects of varying concentrations of Fish Amino Acid (FAA) combined with organic vermicompost fertilizer on the growth and yield performance of okra (Abelmoschus esculentus). FAA, derived from sardine fish residues through fermentation with brown sugar, was applied in four different concentrations (10 ml, 15 ml, 20 ml, and 25 ml per liter of water), with vermicompost serving as the growth medium. The experiment was conducted using a Completely Randomized Block Design (CRBD) and evaluated parameters including plant height, number of leaves, number of fruits, fruit weight, and fruit length.

Keywords: Fish Amino Acid (FAA), Vermicompost, Organic Fertilizer, Okra (*Abelmoschus esculentus*), Sustainable Agriculture, Organic Farming.

1. INTRODUCTION

1.1 Background of the Study

Vermicomposting is a sustainable method for converting organic waste into nutrient-rich compost, improving soil fertility and physicochemical properties, and enhancing microbial activity [1]. Vermicomposting is considered the most effective technique for managing diverse organic waste. It offers an environmentally sustainable, economically practical, and socially acceptable approach, whereby organic refuse is converted into a nutrient-rich product commonly referred to as 'black gold' or vermi-fertilizer [2]. Similarly, fish amino acids (FAA), derived from fermented fish by-products with brown sugar, are recognized for promoting vegetative growth by supplying readily available nitrogen and bioactive compounds. Marine fish species, particularly those with dark or bluish backbones, provide high-quality proteins and amino acids essential for FAA production [1].

Despite evidence of vermicompost and FAA benefits individually, the combined effects of these treatments, particularly on okra (Abelmoschus esculentus) growth and yield, remain insufficiently studied. Existing literature has not fully explored how the FAA application, when integrated with vermicompost, influences soil properties, plant physiology, and productivity outcomes in okra cultivation.

Therefore, this study aims to evaluate the effects of varying FAA application rates in conjunction with vermicompost on the growth performance and yield of okra. Findings are expected to provide insights into optimizing organic fertilization strategies for sustainable crop production [3].

*Corresponding author: cikmilly88@gmail.com

1.2 Problem Statement

While commercial fertilizers offer an economical solution for supplying nitrogen (N) to boost plant growth and yield, their overuse or improper application can lead to nitrate pollution in soil and water sources [4]. Excessive use of chemical fertilizers in agriculture negatively impacts the environment, human health, and the sustainability of farming practices. Therefore, various strategies are being implemented to reduce the harmful effects of chemical farming [5].

Organic agriculture has gained global attention as a method to safeguard ecosystems and enhance human well-being. The growing demand for organic produce reflects a shift in consumer preferences toward safer, more environmentally friendly food. Organic vegetable farming is part of a holistic approach that supports biodiversity and natural biological processes.

1.3 Research Objectives

1) To examine the effects of varying rates of Fish Amino Acid (FAA) on the growth and yield of okra.
2) To determine the FAA rate that yields the best growth performance and highest fruit production.

1.4 Research Questions

1) Which FAA application rates are most effective in enhancing the growth and yield of okra?
2) Does the application of Fish Amino Acid (FAA) influence okra growth and yield in comparison to using only organic fertilizer?

1.5 Significance of the Study

Fish waste has potential as an organic fertilizer due to its high levels of essential nutrients, including nitrogen (N), phosphorus (P), and potassium (K), which are vital for plant development. Amino acids and mineral nutrients in the growing medium help stimulate rhizosphere activity and promote plant growth [6]. Fish amino acids promote nutrient uptake and minimize nutrient loss, especially nitrogen, which is necessary for chlorophyll formation and plant vigor [7].

Additionally, fish-based fertilizers stimulate soil microbial activity. These beneficial microbes, including nitrogen-fixing bacteria, help convert nitrogen into forms easily absorbed by plants, enriching the soil and promoting healthy crop growth. A soil ecosystem supported by fish-based fertilizers can yield high-quality produce. Solid fish residues have also been known to reduce plant-parasitic nematodes [8].

Amino acids in FAA also act as facilitators for micronutrient decomposition and uptake. They aid in nutrient absorption and transport within plants due to their ability to regulate membrane activity. L-Glycine and L-glutamate, in particular, serve as effective chelating agents for nutrient uptake.

By enhancing soil health and nutrient availability, fish fertilizers contribute to increased fertility, plant resistance to diseases, and overall improved fruit quality and yield [9]. Therefore, the FAA is a valuable component in optimizing plant productivity. Organic fertilizers enhance natural soil processes, which have long-term effects on soil fertility [10].

This research focuses on assessing four specific FAA application rates. FAA will be diluted accordingly and sprayed on 16 okra plants, with each treatment applied to four polybag-grown plants. Vermicompost will be used as the primary growing medium. The control group will receive only vermicompost without FAA and will include four replications. The trial will be conducted over a period of two months to assess effectiveness.

Possible limitations include pest infestations from species such as the shoot and fruit borer (*Earias vittella*), fruit borer (*Helicoverpa armigera*), leafroller (*Sylepta derogata*), leafhopper (*Amrasca biguttula biguttula*), whitefly (*Bemisia tabaci*), aphid (*Aphis gossypii*), solenopsis mealybug (*Phenacoccus solenopsis*), dusky cotton bug (*Oxycarenus hyalinipennis*), red cotton bug (*Dysdercus koenigii*), red spider mite (*Tetranychus urticae*), and root-knot nematode (*Meloidogyne incognita*), which could potentially damage okra crops.

2. EXPERIMENTAL DETAIL

2.1 Experimental Design

The experiment will be conducted at University College Agroscience Malaysia (UCAM). The study area is divided into four equal blocks, where each block consists of polybag-grown plants arranged with a 0.5-meter spacing between blocks. Each block is further subdivided into five equal plots. The experimental treatments will be assigned using a Completely Randomized Block Design (CRBD) following a randomization process.

CRBD is selected to evaluate treatment effects at an experimental site with non-uniform conditions. This design helps manage site variability by applying the blocking principle. The main advantage of CRBD is that it minimizes experimental error by organizing treatments into blocks, thereby enhancing the accuracy and reliability of treatment comparisons by reducing variability caused by environmental factors.

2.2 Experimental Treatments

The use of organic fertilizer with different rates of fish amino acid served as experimental treatments of the study as follows:

T1 - Control (Vermicompost)
T2 - Vermicompost + 10 ml of FAA + 1 liters of water
T3 - Vermicompost + 15 ml of FAA + 1 liters of water
T4 - Vermicompost + 20 ml of FAA + 1 liters of water
T5 - Vermicompost + 25 ml of FAA + 1 liters of water

2.3 Experimental Layout

Table 1 summarizes the complete randomized block design used in this study.

Table 1: Complete Randomized Block Design.

	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5
Block 1	T2R1	T4R1	T3R1	T5R1	T1R1
Block 2	T1R2	T3R2	T4R2	T2R2	T5R2
Block 3	T3R3	T1R3	T5R3	T4R3	T2R3
Block 4	T2R4	T4R4	T3R4	T1R4	T5R4

2.4 Methodology

2.4.1 Preparation of Fish Amino Acid

Fish amino acids (FAA) are prepared by collecting fish waste, such as heads, bones, skin, fins, and viscera. In cases where fish waste is unavailable, whole fish from the local market may be used. The collected material is weighed and mixed with brown sugar at a 1:1 ratio. During the mixing process, layers of fish residues and brown sugar are alternately placed in a container, ending with a final layer of brown sugar until the container is nearly full.

Suitable fermentation containers include clay jars, plastic coolers, or any airtight containers. Once the layering is complete, the mixture is covered to ensure the fish is not exposed, and the container is sealed with a breathable cloth that allows airflow while preventing insect entry. The container should be stored in a cool, shaded, and well-ventilated area away from direct sunlight and animals.

Within 3 to 5 days, fermentation begins, aided by the osmotic pressure of the brown sugar, which causes the fish waste to liquefy. The full fermentation process takes approximately 30 days. Once completed, the FAA will emit a slightly sweet and mildly fishy aroma. The liquid extract is filtered, then diluted with chlorine-free water to the specified application rate.

2.4.2 Seedling Production

Peat moss is used as the growing medium for seedling production. Seedling trays are filled with peat moss and moistened before sowing. Open-pollinated okra seeds are sown at the rate of three seeds per hole.

The trays are placed in a partially shaded area and watered regularly with a watering can over a period of 2 weeks. Five days before transplanting, seedlings undergo a hardening process to strengthen their tissues and reduce transplant shock.

2.4.3 Transplanting and Management

Transplanting is done after 2 weeks, once the seedlings reach 5-10 cm in height and have developed 3-4 leaves. The planting medium is prepared in a 3:2:1 ratio and partially filled into polybags before the seedlings are placed. Two seedlings are planted in each polybag and then covered with soil.

A total of 20 polybags are used in the study, with each treatment replicated 4 times. The base of the seedlings is gently pressed to ensure proper root anchorage. Watering is done immediately after transplanting. Application of Fish Amino Acid (FAA) begins 1 week after transplanting and is repeated every 7 days for 40 days.

2.4.4 Care and Management

Regular cultivation and weeding are carried out to reduce competition for nutrients and to ensure good air circulation for the plants. Watering is done twice daily or as needed. Although okra tolerates dry conditions, sufficient and regular watering improves overall vigor and yield.

2.4.5 Pest and Disease Management

As the study employs organic practices, no chemical pesticides are used. Instead, pest control is managed using yellow sticky traps, which are effective for monitoring and reducing pest populations. These traps, made of 10 × 25 cm plastic sheets coated with sticky glue, are attached to bottles and placed near the plants.

Monitoring and control measures are conducted biweekly after transplanting to ensure pests and diseases are managed effectively.

2.4.6 Harvesting

The first harvest is expected around one month after transplanting. Okra pods should be harvested when they are 10–12 cm in length, glossy, and tender. Harvesting is best done when pods are young and still immature, typically right after the flowers wilt.

Harvests can be conducted every few days using pruning shears or a sharp knife. If pods exceed 5 inches in length, they may become fibrous, although some varieties remain tender even when longer. Due to the presence of tiny spines on many okra varieties, gloves and long sleeves are recommended during harvesting to prevent skin irritation.

3. RESULTS AND DISCUSSION

3.1 GROWTH PARAMETER

3.1.1 Growth Increment (Height)

Plant height is a crucial growth indicator that reflects a crop's overall vigor and development rate. It is often positively associated with the plant's productive potential, including the yield of food, grain, or fruit. An optimal plant height generally indicates healthy growth and better performance.

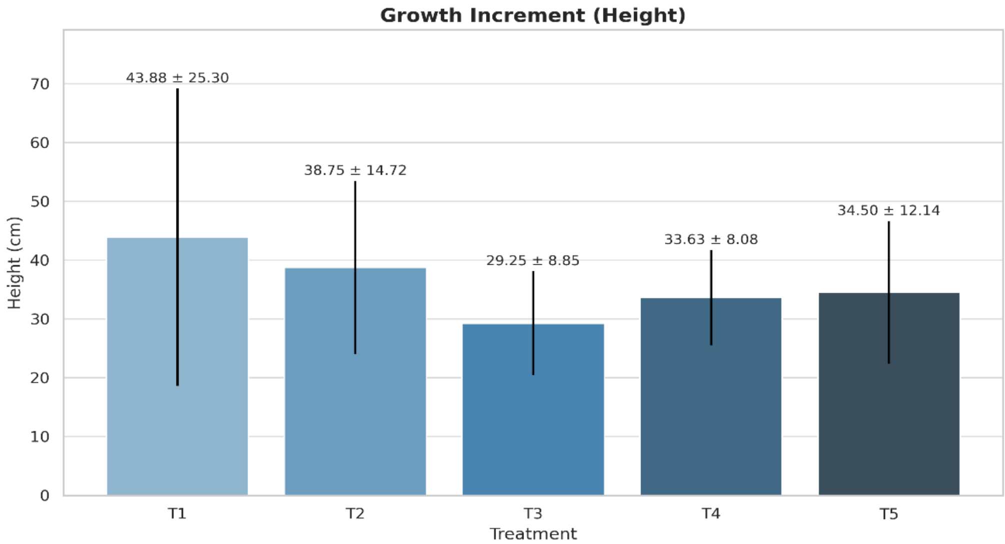
Table 2: Initial Height, Final Height, and Growth Increment on Plant Height of Okra.

Treatment	Initial Height (cm)	Final Height (cm)	Growth Increment (cm)
T1 (Control)	12.63	56.50	43.88
T2 (10 ml FAA)	14.63	53.38	38.75
T3 (15 ml FAA)	14.38	43.63	29.25
T4 (20 ml FAA)	14.25	47.88	33.63
T5 (25 ml FAA)	13.38	47.88	34.50

As shown in Table 2, plant height was measured at two stages: the beginning of the experiment (initial height) and the end (final height), with the growth increment calculated as the difference between the two. Interestingly, T1 (Control) recorded the lowest initial height at 12.63 cm but showed the highest final height at 56.50 cm, resulting in the greatest growth increment of 43.88 cm. In contrast, T3 (15 ml FAA) initially showed a higher plant height of 14.38 cm than T1, T4, and T5. However, it registered the lowest final height at 43.63 cm, resulting in the smallest overall growth increment (29.25 cm). This suggests that the control group outperformed all FAA treatments in terms of height increment under the given conditions, and this is consistent with [11], which states that Okra can reach up to 3 meters high, though it always measures simply over 1 meter.

A two-way ANOVA was carried out to examine the effect of different application rates of Fish Amino Acid (FAA) and the control treatment on plant height growth increment. The analysis revealed no statistically significant interaction between the FAA rates and the control ($p > 0.05$). This means that the variation in plant height growth among the different treatments was not significant. It suggests that all plants, regardless of treatment, received sufficient nutrients from the vermicompost medium, which may have contributed to similar growth patterns across treatments. This finding is consistent with a study conducted by [12], which also reported no significant differences in plant growth among treatments.

From the data as shown in Figure 1, it can be observed that the control treatment (T1) resulted in the highest mean growth increment, with an average of 43.88 cm ± 25.30. This was followed by T2 (10 ml FAA) at 38.75 cm ± 14.72, T5 (25 ml FAA) at 34.50 cm ± 12.14, and T4 (20 ml FAA) at 33.63 cm ± 8.08. The treatment with the lowest average growth was T3 (15 ml FAA), which recorded a mean increment of 29.25 cm ± 8.85.



* T1 = Control (Vermicompost), T2 = 10ml FAA / 1L water + Vermicompost, T3 = 15ml FAA / 1L water + Vermicompost, T4 = 20ml FAA / 1L water + Vermicompost AND T5 = 25ml FAA / 1L water + Vermicompost. The values indicate the Mean ± SD of 4 replications.

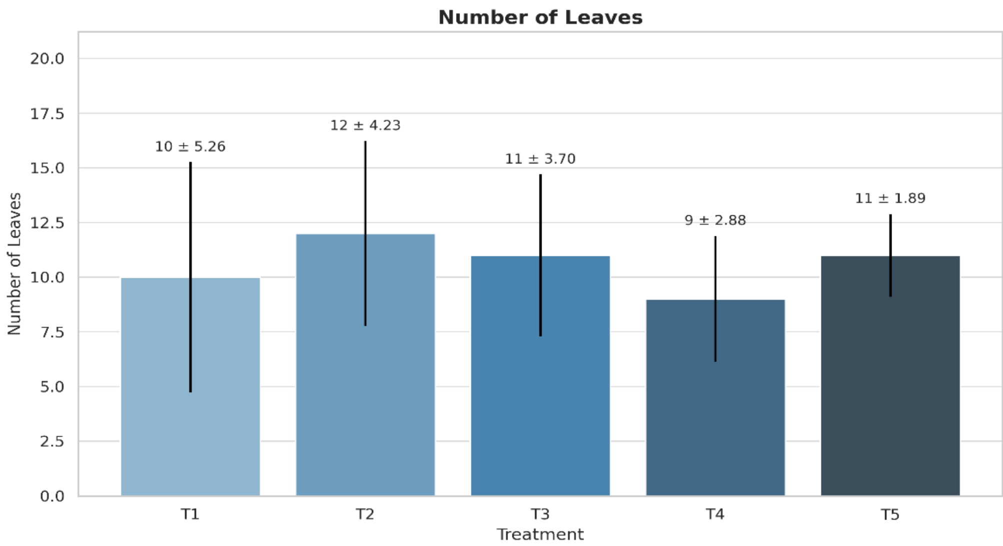
Figure 1: Growth Increment of Plant Height.

Since there was no significant difference among treatments, it is likely that okra plant height was primarily influenced by genetic factors. According to [13], plant height in okra is often more genetically controlled than influenced by environmental conditions. In this study, all the okra plants used were of the same variety, an F1 hybrid derived from GW-304, which may explain the similarity in growth height due to their shared genetic makeup. Okra grows best in soil with a near-neutral pH of 6.5-7.0, though it'll do fine at pH 7.6 [14].

3.1.2 Number of Leaves

Leaves play a crucial role in plant development, primarily by converting sunlight into energy through photosynthesis. The glucose produced fuels overall growth, flowering, and fruit formation. A two-way ANOVA was performed to assess the effects of different FAA application rates and the control treatment on leaf number. The analysis revealed no statistically significant interaction between treatments ($p > 0.05$), indicating that leaf number did not differ significantly among treatments.

As shown in Figure 2, T2 (10 ml FAA) recorded the highest leaf count with 12 leaves, while T4 (20 ml FAA) had the lowest at 9 leaves. Both T3 (15 ml FAA) and T5 (25 ml FAA) had the same number of leaves, each with 11, and T1 (control) produced 10 leaves. According to [1], FAA is an effective fertilizer for both soil and foliage, promoting growth during the vegetative stage of crops.



* T1 = Control (Vermicompost), T2 = 10ml FAA / 1L water + Vermicompost, T3 = 15ml FAA / 1L water + Vermicompost, T4 = 20ml FAA / 1L water + Vermicompost AND T5 = 25ml FAA / 1L water + Vermicompost. The values indicate the Mean ± SD of 4 replications.

Figure 2: Number of Leaves.

3.2 YIELD PARAMETER

3.2.1 Number of Fruits

The number of fruits per plant is a key yield component, reflecting a plant's ability to produce harvestable pods. While a higher fruit count is often linked to better productivity, fruit size and weight also play important roles.

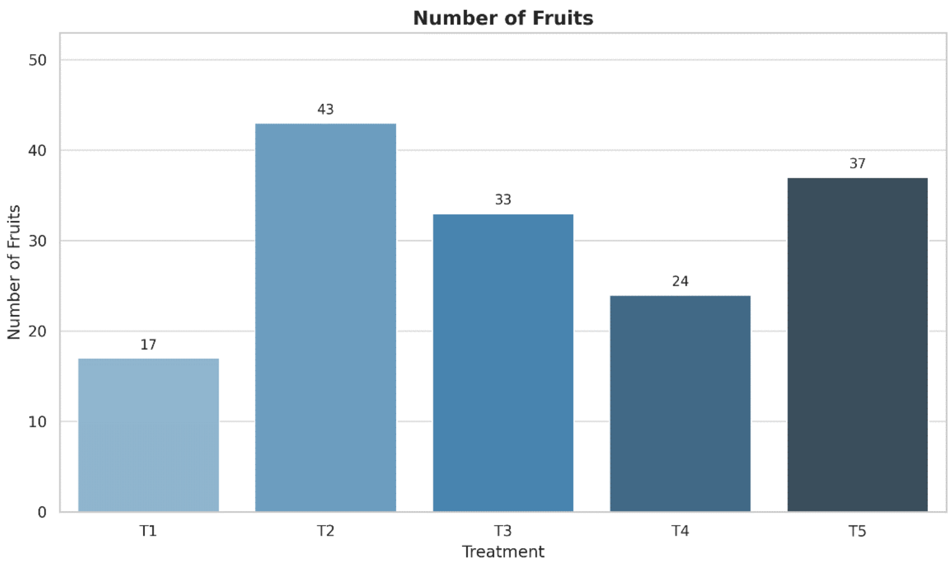


Figure 3: Number of Okra Fruit.

Figure 3 shows the effect of different FAA rates on okra fruit production. Although statistical analysis ($p > 0.05$) indicates no significant differences among treatments, T2 (10 ml FAA) produced the highest number of fruits (43), while the control treatment T1 recorded the lowest (17). Treatments T3, T4, and T5 produced 33, 24, and 37 fruits, respectively.

Further analysis using the LSD test showed a significant difference ($p < 0.05$) between T2 and the control. The 26-fruit difference suggests that FAA enhances yield potential. This aligns with [9], who reported similar results, and with [12], who emphasized that weekly FAA application can improve yield, taste, and aroma in vegetables. The use of vermicompost (VC) supports plant development during both early and later growth stages, but applying the correct concentration is essential to achieve optimal growth and yield [15].

3.2.2 Weight of Fruit (Pod Weight)

Figure 4 shows the effect of different FAA application rates on okra pod weight. A two-way ANOVA showed no statistically significant differences ($p > 0.05$) between treatments, indicating that FAA rates did not significantly affect fruit weight. T2 (10 ml FAA) recorded the highest fruit weight at 451 grams, followed by T5 (409 g), T3 (398 g), and T1 (control) with 266 g. T4 (20 ml FAA) produced the lowest fruit weight at 231 grams.

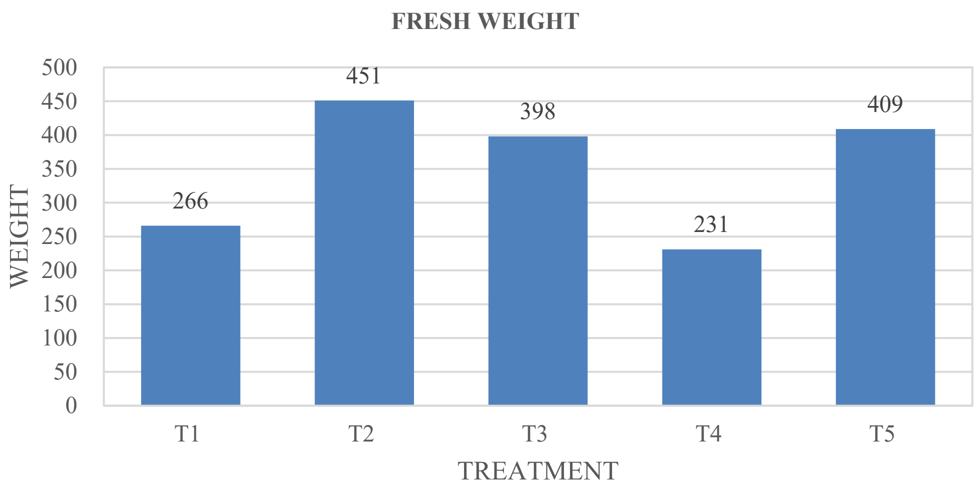
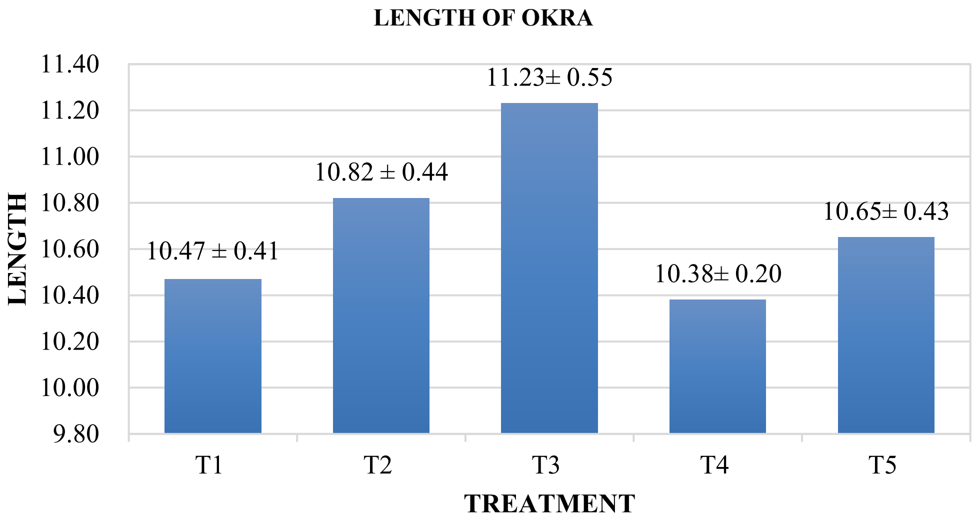


Figure 4: Fresh Weight of Okra.

According to [1], FAA enhances nitrogen availability in the soil, improving crop yield while maintaining water quality. However, in this study, the absence of significant differences may be attributed to FAA promoting vegetative growth more than reproductive yield [3]. Nutrients may have been diverted to plant growth because sufficient nutrients were already present in the vermicompost and soil. According to [6], plant tissue requires a specific amount of sufficient amino acids, with each or a combination of amino acids performing certain functions. In general, fruit weight is often influenced by the number of fruits produced; more fruits typically contribute to a higher total weight.

3.2.3 Length of Fruit (Pod Length)

A two-way ANOVA was used to assess the effect of different FAA rates and the control on okra pod length. The analysis revealed no statistically significant interaction between treatments ($p > 0.05$), indicating that FAA application had minimal influence on fruit length. As shown in Figure 5, T3 (15 ml FAA) produced the longest fruits with a mean length of 11.23 cm. T4 (20 ml FAA) recorded the shortest fruits at 10.38 cm. The other treatments recorded mean lengths of 10.43 cm (T1 – control), 10.82 cm (T2 – 10 ml FAA), and 10.65 cm (T5 – 25 ml FAA). However, multiple comparisons using the LSD test revealed a significant difference ($p < 0.05$) between T3 and both T1 (control) and T4, indicating that the 15 ml FAA application produced significantly longer fruits. This is consistent with findings by [16], who reported wide genetic variation in fruit length, and with [12], who observed that combining FAA with vermicompost increased okra pod length compared to the control.



* T1 = Control (Vermicompost), T2 = 10ml FAA / 1L water + Vermicompost, T3 = 15ml FAA / 1L water + Vermicompost, T4 = 20ml FAA / 1L water + Vermicompost AND T5 = 25ml FAA / 1L water + Vermicompost. The values indicate the Mean ± SD of 4 replications.

Figure 5 Length of okra.

4. CONCLUSION

This study aimed to evaluate the effects of various application rates of Fish Amino Acid (FAA) combined with vermicompost, compared with a control without FAA, on five key agronomic parameters: plant height increment, number of leaves, number of fruits, fruit weight, and fruit length. Statistical analysis revealed no significant differences ($p > 0.05$) across all treatments, suggesting that variation in FAA rates did not result in a superior overall treatment.

Descriptive results indicated that applying 10 ml FAA per liter of water (T2) with vermicompost produced the most favorable trends in yield-related parameters, including number of leaves, number of fruits, and fruit weight. T2 yielded an average of 43 pods, compared with 17 pods in the control (T1). Although statistical significance was not observed, the 10 ml FAA rate appears to offer potential agronomic benefits under certain growing conditions. Organic waste residues can be converted into valuable compost through vermicomposting, reducing pollution and providing substitutes for chemical fertilizers [17].

The findings suggest that FAA, when integrated with an organic medium such as vermicompost, has the potential to enhance plant performance and yield quality. FAA is known to supply bioavailable nitrogen and essential amino acids, which support vegetative growth and fruit development [1]. Moreover, this organic approach may offer a viable and sustainable alternative to synthetic foliar fertilizers, which are often costly and environmentally taxing. Using cyanobacteria-based biofertilizers offers a promising alternative for agricultural production [18].

Soils under organic farming systems generally contain higher levels of organic matter. It also indicates that organic farming has a positive impact on both agro-biodiversity (the diversity of breeds used by farmers) and natural biodiversity (wildlife) [19].

It is recommended that future studies expand upon this research by incorporating larger sample sizes, different crop types, and varied agroecological conditions to better evaluate the synergistic effects of FAA and organic fertilizers. Long-term assessments would also help in determining their effectiveness in promoting soil health and sustainable vegetable production.

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