ALTERNATIVE APPROACH OF GROWING CUCUMBER USING LOCALLY PRODUCED SEAWEED-BASED ORGANIC FERTILIZER

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ABSTRACT

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This study aimed to determine whether seaweed drippings, as a foliar fertilizer, could act alone or as a supplement to other fertilizers in bringing significant changes to crop growth, yield, and post-harvest qualities of cucumber. This is because there are reports of its fungicidal properties, suggesting it could substitute for the effects of conventional fertilization in other crops. The application of different types of fertilizers and levels of seaweed-based foliar fertilizer (SbFF) does not contribute to the significant improvement of days to flower emergence, sex ratio, number of fruits developed, fruit length, chlorophyll content, plant nutrient status, and post-harvest qualities of cucumber. However, significant improvements were observed in dry matter yield, fruit weight, and yield. A single application of synthetic fertilizer or vermin compost produced longer fruits and heavier dry matter; however, the inclusion of SbFF as a supplement did not further

improve these parameters. In addition, foliar supplementation of SbFF to a basal application of both inorganic and vermicompost did not further improve its yield. However, when SbFF was applied alone, there was a dramatic improvement in yield compared to the unfertilized treatment. Hence, the foliar application of seaweed-based fertilizer is not merely a supplement to fertilizer, but can also bring about significant changes in cucumber yield. This treatment yielded better performance than the control and was comparable to the yield of cucumber plants singly applied with vermicompost and the recommended rate of fertilizer. This increased yield further resulted in higher profit.

INTRODUCTION

Cucumis sativus L. is one of the popular members of the Cucurbitaceae family. It is recognized as the fourth most cultivated vegetable in the world (Adeoye et al., 2016). It contains properties like water (96 g), calcium (12.0 mg), magnesium (15 mg), phosphorus (24.0 mg), vitamin A (45 IU), and vitamin C (12 mg) (Effendy et al., 2010; Narciso et al., 2009). Dalai et al. (2016) reported that cucumber has various medicinal and cosmetic properties.

Despite their various uses and good nutritional value, vegetables, including cucumber, have not been given much importance. Omo (2013) reported that countries in tropical Asia have low vegetable consumption. This was supported by a report from the World Health Organization, which stated that the consumption of vegetables was far below the recommendation of at least 142 kg per capita. On the other hand, the Philippines had a limited and fluctuating supply of vegetables due to low production, attributed to soil depletion of nutrients. Vegetables, especially cucumbers, grown on infertile soils had higher fruit rejects due to small, bitter, and misshapen fruits (Eifediyiet al., 2010). The decline in soil fertility may be attributed to over-cropping and excessive chemical fertilizer application, which can result in soil acidity. Adeoye et al. (2016) stressed that this problem could be addressed through enhancing the fertility status of the land.

One method of growing vegetables sustainably and addressing soil fertility decline is to shift to organic vegetable farming. In the Philippines, organic farming has gained significant attention with the passage of the Organic Agriculture Act of 2010 (RA 10068), a law promoting organic agriculture. This law ensures the use of organic inputs in crop production to "condition and enrich the fertility of the soil, increase farm productivity, reduce pollution and destruction of environment, prevent the depletion of natural resources, further protect the health of the farmers, consumers and general public and save on imported farm inputs."

Several organic inputs have been proven to increase the yield of vegetable crops, such as the utilization of compost, manure, vermicompost, vermitea, plant-fruit extracts, OHN, and seaweed-based organic fertilizers. However, among the above-mentioned organic fertilizers, the use of seaweed-based foliar fertilizer and vermicompost is of interest to the researcher. Vermicompost is the end product of a process called vermicomposting, which utilizes earthworms to accelerate the composting process and produce higher-quality compost. It is a nourishing organic fertilizer having a high amount of humus, macronutrients, micronutrients, more beneficial soil microbes like 'nitrogen-fixing bacteria' and mycorrhizal fungi, and has been scientifically proven as a miracle plant growth enhancer (Chaoui et al., 2003; Guerrero, 2010).

On the other hand, seaweed-based fertilizer produced locally by SPAMAST is actually in the form of collected drippings during the sun drying process of Kappaphycus alvarezii (KD), a locally grown seaweed. Aside from being locally made and inexpensive, it contains nitrogen (0.14%), phosphorus (1.14%), potassium (3.25%), calcium (0.018%), magnesium (0.041%), copper (112.50 ppm), zinc (50 ppm), and iron and manganese (Source). Studies on seaweed extracts revealed that it can enhance and improve the growth, yield, and increase mineral uptake

of crops (Moreira et al., 2016 and Khan et. al, 2012). It was also reported that application of seaweed's dripping increased crop yield of some horticultural crops such as corn, soybean, mungbean, sweet pepper, cauliflower, mango, pechay, and orchid (Caballero et al., 2007 as cited by Agudera et al., 2018).

One interesting point is whether seaweed drippings can act alone or as a supplement with other fertilizers in bringing significant changes to crop growth, despite being very low in concentration of essential nutrients. It could be speculated that there are other growth-promoting substances in the drippings, possibly a hormone that works in concert with the nutrients present, as evidenced by a report that foliarly applied seaweed drippings yielded comparable results to complete fertilizer application in mung beans (Lavison, 2013). Thus, this study aims to investigate whether seaweed drippings can be used as a standalone fertilizer or if they are merely a supplement to existing and known fertilizers, and to determine if there are any effects on the post-harvest quality of cucumber, given reports of its fungicidal properties.

Objectives of the Study

This study aimed to utilize seaweed drippings as a potential organic fertilizer for growing cucumbers. Specifically, the study aimed to:

1. Determine the effects of different types of fertilizer and seaweed's drippings applied singly or in combination on the growth and yield of cucumber;
2. Determine the effects of different types of fertilizer and seaweed drippings applied singly or in combination on the post-harvest qualities of cucumber; and,
3. Determine the profitability of growing cucumber using different types of fertilizer and seaweed's drippings applied singly or in combination.

MATERIALS AND METHODS

Location and Duration of the Study

This study was conducted at Noel Tuburan's Farm in Malalag, Davao del Sur, from April 2019 to June 2019 for the field experiment, while a survey of post-harvest quality was conducted in SPAMAST-Digos Campus starting July 2019 for Post-harvest Quality evaluation.

Choice of Cultivated Variety

The cultivated variety of cucumber used in this study was "Debut". It is a very prolific Asian hybrid type with dark green, striped fruits. Fruits could reach about 18 to 20 cm long.

Experimental Design and Treatments

A split-plot design was employed for both the field trial experiment and the postharvest quality assessment (Figures 2 and 3), with types of fertilizer as the main plot and different levels of seaweed-based foliar fertilizer serving as the subplot. The following treatments were as follows:

Factor A. Types of fertilizer	Factor B. Levels of Seaweed-based Foliar Fertilizer
A1- Control (no application)	B1- Control (no application)
A2- Inorganic (RR)	B2- 50% SbFF
A3- Organic (RR)	B3- 100% SbFF

Statistical Analysis

All data were analyzed using Analysis of Variance (ANOVA) through the Statistical Tool for Agriculture (STAR). If a significant difference was observed, it was further tested using Tukey's HSD test to determine the significance of the differences between and among treatment means.

Soil and Plant Tissue Collection and Preparation

Before planting, random soil samples of the experimental site were collected (0-30 cm depth, 2 cm thick and 5 cm wide) from the side of the hole and placed in a clean bucket. Collected soil samples from ten randomly selected sites of the experimental area were thoroughly mixed, sieved with a 2 mm wire mesh, air dried, ground, mixed, and kept in a plastic bag to constitute a composite sample for the analysis. The composite soil sample was submitted and subjected to mechanical and chemical analysis to determine its particle size, organic matter, organic carbon, cation exchange capacity (CEC), pH, phosphorus, and potassium contents specifically at the Regional Soil Laboratory of the Department of Agriculture in Davao City.

Plant tissue analysis, on the other hand, was conducted after the study was terminated during the production phase. Test plants were selected, uprooted, and labeled using clean plastic bags from every treatment plot. This was followed by washing the roots to remove adhering dirt with de-ionized water to prevent contamination. Collected plant samples were cut into pieces and oven-dried. The temperature was set at 100°C for 15 minutes, then reduced to 70°C, and maintained at this temperature for a minimum of three days or until the tissue samples reached a constant weight. Dried plant tissue samples were pulverized using a Wiley mill before plant nutrient determination. The N, P, and K analyses, as received basis (%), were obtained from the Soil Laboratory and Water Management for the determination of plant nutrient status.

Cultural Practices and Management of the Experimental Plants

Land preparation, layout, and seed sowing

The experimental area was cleared by slashing weeds and then thoroughly plowed to pulverize the soil. After plowing, harrowing was done to level the field surface using a carabao-drawn implement. After land preparation, the field layout was completed to accurately measure the plot size for each treatment and replicate within the experimental area. Each plot measures 2 m x 6 m, has a total area of 12 m^2, and can accommodate four rows with a spacing of 0.5 m between hills and 48 plants per plot. An alleyway between plots was provided (1.5 m wide) to facilitate the easy execution of different cultural management practices during the growing period of the experimental plants. A total of 1,296 plants were sown directly into the soil at one (1) seed per hill. Those seeds that were not seeds that were able to germinate were immediately replaced with seeds of the same quality.

Establishment of Fence-type Trellis

Tw-meter-long bamboo poles were provided at the edges of the planting bed. A spacing of about 3 m between posts with twine near the base, in the middle, and near the top end had been established. Then, hang with synthetic straw from the topmost part of the twine to serve as support on vines. Training of vines was conducted by tying synthetic straws every 2 days.

Synthetic and Organic Fertilizer Applications

Split fertilizer application was performed based on the fertilizer application recommendations derived from the soil analysis results. The first fertilizer application of urea (46-0-0) was applied one week after transplanting at a rate of 3.25 g per hill. In contrast, the succeeding application was applied at a rate of 1.62 g per hill during the onset of flowering of the experimental plants. On the other hand, vermicompost was used as a basal at a rate of 150 g per hill before transplanting. At the same time, seaweed dripping was supplemented at rates of 320 ml and 160 ml per 16 L of water, using a knapsack sprayer, foliarly, with a weekly interval until 53 days after sowing (DAS).

Weeding

Weeding was done by hand-pulling to eradicate unwanted plants and to avoid nutrient, light, and water competition with the experimental plants.

Pest Control

Insect pests, such as aphids, whiteflies, leaf folders, and mirid bugs, were controlled by spraying with an insecticide containing systemic thiamethoxam (141 g/L) and the potent pyrethroid lambda-cyhalothrin (106 g/L) at the manufacturer's recommended rate of 10 mL/16 L of water. Spraying was conducted two weeks after planting, and the final application was made at the flowering stage. However, if pest recurrence occurred, immediate spraying of pesticides was done to ensure that test crops were protected from pest infestation.

Water Management

Watering was done as often as necessary using a watering can to ensure that the water requirement of the test crops is sufficiently met.

Harvesting

Harvesting of cucumber fruits was done early in the morning and late in the afternoon by carefully twisting the fruit, with a length range of 15 to 18 cm, and immediately placing it in wooden baskets lined with banana leaves to prevent mechanical damage to the fruits.

Data Gathered

Horticultural characteristics

Dry matter yield (%)

Experimental plants were removed from the field before they reached the senescence stage. The test plants were divided into three parts: roots, stems, and leaves, and were washed with deionized water. The dry matter yield was determined using the method used by Dong et al. (2015). The initial weights of each plant sample were recorded, followed by oven drying at 70°C for a minimum of three days until a constant weight was achieved. The dried samples for each plant part were recorded and summed to determine the total plant biomass. To determine the percentage dry matter yield of each part, the initial weight is divided by the oven-dry weight and then multiplied by 100.

Days to flower emergence

This was done by counting the number of days from transplanting until 80% of the total experimental plants in each treatment had flowered.

Days to first harvest

This was determined by counting the number of days from transplanting to first harvesting.

Physiological parameter

Chlorophyll Content

The method of Turan et al. (2014) was employed for the determination of chlorophyll using a portable chlorophyll meter (CM-B model). This method is non-destructive. Measurements of sample plants were taken at 4 locations on each leaf, two (2) on each side of the midrib on all fully expanded leaves. This was done during the reproductive stage of the test plants.

Yield and yield components

Number of male and female flowers per plant. This was done by counting and recording all male and female flowers at the anthesis stage from ten (10) randomly selected and tagged plants per treatment per replicate.

Sex ratio

Sex ratio was calculated using this formula:

Sex ratio (number of female flowers)/ (number of male flowers)

Number of fruits per plant

This was determined by counting the total number of harvested fruits per plant from the ten sample plants in each treatment and replicate.

Fruit setting (%)

This was determined using the equation given below:

Fruit set (%) = (number of fruits per plant)/ (number of female flowers per plant) x 100

Fruit weight (grams)

This was determined by weighing the harvested fruits of the ten sample plants per treatment.

Fruit length (cm)

This was determined by measuring the length of the harvested fruit samples from plants per treatment plot using a ruler.

Fruit yield (t ha-1)

This was determined by adding the total weights of all harvested marketable and non-marketable fruits per treatment from the first to the last harvest. The formula used in the determination of yield is presented below:

$$\text{Yield (t/ha)} = \frac{\text{Yield (kgs) per 36 sqm}}{\text{1000 kgs}} \times \frac{\text{10,000 sqm}}{\text{ASP}}$$

Where: ASP= area of harvestable sample plot; Kgs= kilograms; t= tons

Number of Marketable Fruits

The harvestable fruits from all plots were counted to determine the number of marketable fruits. A marketable fruit must be intact, fresh in appearance, firm, clean, insect and disease-damage-free, and by PNS/BAFPS 62:2008.

Number of non-marketable fruits

The harvestable fruits from all were harvested by counting the number of non-marketable fruits. A non-marketable fruit based on the PNS/BAFPS 62:2008 had badly curved, constricted, tapered, or badly misshapen features that seriously affect the appearance.

Weight of Marketable and non-marketable fruits

This was done by weighing the marketable and non-marketable fruits after harvesting.

Post-harvest characteristics

Slice-type cucumber fruits from all treatment plots were harvested, selected for uniform size, labeled using plastic bags, and transported in a well-ventilated and roofed vehicle from the field experimental area to a well-ventilated room for post-harvest evaluation. It took an hour to transport the commodity. During the storage period, data were collected from 10 sample fruits of each treatment imposed during production. Some parameters observed in assessing post-harvest characteristics were evaluated using the methods of Bayogan et al. (2021).

Percentage weight loss (%)

This was conducted from day 0 to day 16 with a 2-day interval. This was determined using the formula below:

$$\text{Percentage weight loss (\%)} = \frac{\text{Initial weight (g)} - \text{Final weight (g)}}{\text{Initial weight (g)}} \times 100 \text{ Initial weight (g)}$$

Storage Life (days)

This was recorded by counting the number of days from the day of treatment and storage until the limit of edibility (VQR 3).

Degree of Shriveling

This was observed by counting the number of shriveled fruits every 2 days of interval using a rating scale indicated below:

0- No shriveling
1- Slight (1-25% surface shriveling)
2- Moderate (26-50% surface shriveling)
3- Severe (above 50% surface shriveling)

Disease incidence

This was assessed by counting the number of infected fruits every 2-day interval.

0- no infection
1- slight infection
2- moderate infection
3- severe infection

The equation was used for assessment as shown below:

$$\% Di = \frac{n(0) + n(1) + n(2) \ldots n(3) \times 100}{N \times 3}$$

Where: n number of infected plants classified by scale
N is the total number of samples
3= represents the highest value in the rating scale

Visual Quality Rating

This was determined by counting the number of fruits with defects every 2-day interval.

9-Excellent; field fresh: no defects
7-good; minor defects
5-fair; moderate defects, limit of marketability
3-Poor; serious defects; limit of edibility
1-non-edible

Cost and return analysis

The production cost was determined by recording all expenses incurred throughout the study, from land preparation to harvesting. These include fertilizers, chemicals (such as pesticides), seeds, PE bags, and other materials, as well as labor costs incurred during the study's conduct. Gross income was determined by multiplying the yield of each treatment by the current price of cucumbers on a per-kilogram basis.

All expenses were computed and totaled to determine the most economical treatment. The benefit-cost ratio (BCR) was used to determine the economic feasibility of treatments. This was obtained by dividing the net income by the cost of production to determine the profit per unit of input.

RESULTS AND DISCUSSION

Horticultural characteristics

Dry Matter Yield (%)

The dry matter yield of individual plant parts, such as leaves, stems, and roots, of cucumber plants is reflected in Table 1. The application of inorganic and organic fertilizers, as well as foliar supplementation of SbFF, did not affect the dry matter yield of cucumber, as it exhibited similar weights from all treatments applied. Generally, the development of plant parts from an intact plant provides a greater portion of the stem and leaf development. In contrast, root development has the least proportion compared to the former. In this premise, it appears that the majority of the nutrients absorbed by the plants and accumulated through photosynthesis were allocated to the development of the stem and leaves, regardless of the treatment. This phenomenon, which favors the development of the above-mentioned plant parts, provides further support and nourishment for the growing flowers and fruits. One study specifically supported this finding in broccoli. The application of seaweed extracts at different levels and the recommended rate of synthetic fertilizers proved ineffective in bringing about significant changes to the dry matter yield of broccoli (Manea et al., 2018).

Table 1. *Dry Matter Yield (%) of cucumber influenced by types of fertilizer and varying levels of seaweed-based foliar fertilizer.*

TREATMENTS	Dry Matter Yield (%)		
Type of Fertilizer	Leaves	Stems	Roots
Control	40.23	49.88	9.89
Inorganic (RR)	33.05	58.69	8.26
Vermicompost	35.96	55.79	8.25
Levels of SbFF			
Control	40.94	45.46	7.58
50% RR	32.32	62.67	10.19
100% RR	35.97	53.48	7.70
CVa (%)	24.91	11.79	65.96
CVb (%)	20.87	17.67	55.62

*means in a column within a factor without letters are not significantly different from each other at 5% ANOVA

However, the overall dry matter yield of cucumbers showed interaction effects between types of fertilizers and levels of SbFF (Table 1a). The sole application of vermicompost and synthetic fertilizers produced a heavier dry matter yield. Inclusion of SbFF to the said treatments did not further improve the dry matter yield of cucumber, as reflected by lighter weights compared with those treatments that were applied alone. The same is true for the sole application of SbFF, where the application of 100% SbFF numerically had a heavier dry matter compared to the application of 50% SbFF and the unfertilized treatments, and yielded similar dry matter to those plants grown with a single application of either vermicompost or chemical fertilizers. Prakash et al. (2014)

Claimed that SbFF supplemented with a recommended dose of chemical fertilizer was found to have synergistic effects. Still, the results of this study, specifically regarding dry matter yield, proved to be otherwise, as it acts independently to bring about a significant change in the said parameter. However, result also underscores the importance of nutrients present in both fertilizer types. Shehata et al. (2016) found that celeriac plants increased their leaf dry weight when sprayed with SbFF foliarly. In contrast, Shafeeket et al. (2015) observed the highest stimulation effect of SbFF on the dry weight of onion leaves and other parts across consecutive planting seasons. They attributed this growth-stimulating effect to the presence of macro- and micronutrients, as well as growth-promoting substances, in seaweeds.

Table 1a. *Interaction effects on dry matter yield of leaves of cucumber influenced by types of fertilizer and varying levels of seaweed-based foliar fertilizer.*

Type of Fertilizer	Levels of SbFF		
	Control	50% RR	100% RR
Control	33.93[a]	39.79[a]	46.98[a]
Inorganic (RR)	42.05[a]	31.88[ab]	25.21[b]
Vermicompost	46.85[a]	25.30[b]	35.73[ab]
CVa (%) = 24.91; CVb (%) = 20.87			

*means in a column within a factor without letters are not significantly different from each other at 5% ANOVA

Days to flower emergence

Flower emergence of male and female flowers as affected by types of fertilizer and levels of seaweed-based foliar fertilizer is presented in Table 2. In general, male flowers emerged earlier compared to female flowers. This is supported by the report of AVRDC (2009), which states that cucumber male flowers are the first to open, subsequently followed by female flowers to produce fruits. The presence of male and female flowers in a cucumber plant also suggests that it is self-pollinated, and the timing of flowering between the two may be attributed to the receptivity of female flowers during pollination.

In terms of the effect of treatments, types of fertilizer do not differ from the unfertilized treatment; however, a significant effect was only observed on the levels of seaweed-based foliar fertilizer, especially on the emergence of male flowers. Male flowering occurred earlier in cucumber plants supplemented with 50% SbFF compared to the control and those supplemented with 100% SbFF, respectively. In addition, foliar supplementation of 100% SbFF did not further improve flower emergence, as it exhibited a similar flowering response to that of the unfertilized treatment. The foregoing result indicates that a 50% reduction in foliar supplementation of SbFF promotes earlier flowering, but this improvement cannot be further enhanced by increasing SbFF by 100%. The presence of plant growth-promoting substances in seaweeds may be a reason for early flowering. Seaweed extracts contain phytohormone-like substances such as cytokinin along with IAA, auxins, and gibberellins (Zodape et al., 2010; Abdel-Mawgoud et al.). al., 2010; Kumari et al., 2011), which can aid in early flowering in some plants (Battacharyya et al., 2015).

There was no interaction effect observed between the type of fertilizers and levels of seaweed-based foliar fertilizer on the flower emergence. This result further indicates that basal fertilizer application and foliar supplementation have an independent effect on the days from planting to first flowering of cucumber.

Table 2. *The types of fertilizer and varying levels of seaweed-based foliar fertilizer influence the days to flower emergence of cucumbers.*

TREATMENTS	Days to flower emergence	
Type of Fertilizer	Male	Female
Control	33.57	40.45
Inorganic (RR)	34.42	39.65
Vermicompost	32.71	38.18
Levels of SbFF		
Control	33.96^{a}	40.61
50% RR	32.40^{b}	39.15
100% RR	34.34^{a}	38.51
CVa (%)	4.40	5.15
CVb (%)	3.27	5.06

*means in a column within a factor without letters are not significantly different from each other at 5% ANOVA

Days to first harvest

The duration of the first harvest from planting, as affected by the types of fertilizer and levels of seaweed-based foliar fertilizer, is presented in Table 3. The types of fertilizer showed a significant difference among the treatments imposed. Plants grown with the application of vermicompost were harvested approximately 2 days earlier than those grown with synthetic fertilization and from the unfertilized treatment. The presence of phytohormones and other nutrients may affect the earlier harvesting through their effect on flowering. Earlier flowering occurred in plants treated with vermicompost, resulting in an earlier harvest. Vermicompost has gibberellic acid (tetracyclic diterpenoids) produced by microorganisms during its composting process that has a positive stimulant effect and acts at all stages in the plant cycle (Aremu et al., 2011), particularly in increasing flowering parameters (Abdou et al, 2018). Vermicompost also contains other plant growth regulators (PGRs) in appreciable amounts, such as auxin, gibberellins, cytokinins, ethylene, and abscisic acid (Sha & Islam, 2017), which adhere to humic acid substances in the soil and are eventually taken up by plants. Aranconet et al. (2005) conducted field experiments, demonstrating that PGRs can enhance crop growth and yield even when applied at the lowest rate (2.5 t/ha) of vermicompost.

On the other hand, foliar supplementation of seaweed-based fertilizer did not in any manner improve days to first harvest as reflected in relative days to harvest for those plants grown with SBFF and those plants without foliar fertilizer supplementation. Likewise, there was no interaction effect between the type of fertilizers and levels of seaweed-based foliar fertilizer on the duration of the first harvest. This result further indicates that basal fertilizer application and foliar supplementation have independent effects on the duration from planting to first harvest of cucumbers.

Table 3. *The types of fertilizer and varying levels of seaweed-based foliar fertilizer influence the days to first harvest of cucumbers.*

TREATMENTS	Number of days
Type of Fertilizer	
Control	45.88[a]
Inorganic (RR)	45.15[a]
Vermicompost	43.65[b]
Levels of SbFF	
Control	45.27
50% RR	44.33
100% RR	45.06
CVa (%)	1.60
CVb (%)	4.99

*means in a column within a factor without letters are not significantly different from each other at 5% ANOVA

Plant Nutrient Status (%) and Chlorophyll Count (SPAD)

The nutrient status of cucumber plants as affected by types of fertilizer and levels of seaweed-based foliar fertilizer is presented in Table 4. Neither type of fertilizer nor the levels of SbFF influence the nutrient status of cucumber plants in any manner. The result further shows that N, P and K contents from the plant tissue were found to be very minute and insufficient since report from Uichida et et al. (2009) have shown that cucumber has a sufficiency range of nutrient which ranges between 4.50- 6.00 % for nitrogen, 0.34- 1.25 for phosphorus (%), and 3.90- 5.00% for potassium. There are two possible reasons for the discrepancy in the result. First, it failed to detect a sufficient amount of nutrients in the leaves, possibly due to the dissolution of nutrients within plant parts. Second, fruits from collected plant samples have already been harvested. It means that fruits have not been considered during the collection of plant tissue. This implied that the bulk of these nutrients, coming from the leaf and the soil, had been redirected for use in the developing flowers and fruits, resulting in a minute amount of nutrients present in the sampled tissue. The utilization of these nutrients has helped in plant growth.

In this case, nitrogen has been utilized for the development of structures through the production of amino acids and proteins. At the same time, energy in the form of ATP is required for the development of fruits and flowers, where phosphorus plays a crucial role. Additionally, potassium regulates the entry of carbon dioxide, a key substrate in photosynthesis, and plays a role in sugar transport. According to Uichida et al. (2009) and Lemoine et al. (2016), nitrogen is a constituent of amino acids used in forming protoplasm, a site for cell division, and its deficiency can cause carbon accumulation in leaves and reduction

of cell division. The carbon assimilation in leaves has decreased due to a lack of phosphorus, as it plays a role in energy storage and transfer through ADP and ATP. While potassium (K+) promotes the translocation of photosynthates, root growth is inhibited when a deficiency is detected.

On the other hand, chlorophyll content measures the leaf greenness, which determines the photosynthetic activity in the leaves (Ghosh et al., 2004). The higher the chlorophyll content in the leaves, the more sugars are generated that are needed for the developing plant parts. Halpern et al. (2015) reported that SbFF could increase the nutrients in soybean grain. Application of SbFF resulted in about 36% nitrogen, 61% phosphorus, and 49%

Potassium in soybean grain under rainfed conditions. Likewise, Ghosh et al.

(2004) and Khan et al. (2019) noted that the enhancement of chlorophyll content in soybeans was attributed to higher light intensity, supplemented with organic fertilizer. Battacharyya et al. (2015) suggested, on the other hand, that the chlorophyll content of a plant may depend on environmental factors such as temperature and light intensity. However, the results of the chlorophyll content suggest otherwise, as all treatments have a similar quantity of chlorophyll. In addition, the high light intensity observed during the study could not be equated with the higher chlorophyll content. What has been reported by these authors may not always be the sole reason to link fertilization and light intensity to increased chlorophyll pigments in the leaves. There might be other factors that should be considered, such as temperature. In addition, cucumber, as a C3 plant, requires only 1/3 full sunlight to be fully operational for active photosynthesis, and beyond that, a high-energy-driven process, known as photorespiration, would take place.

Table 4. *Chlorophyll count (SPAD) and Nutrient status (%) of cucumber were influenced by types of fertilizer and varying levels of seaweed-based foliar fertilizer at the reproductive stage.*

TREATMENTS	SPAD	Nitrogen	Phosphorus	Potassium
Type of Fertilizer				
Control	44.59	1.01	0.05	0.75
Inorganic (RR)	46.60	0.58	0.07	0.52
Vermicompost	42.19	0.82	0.07	0.49
Levels of SbFF				
Control	44.88	0.82	0.07	0.65
50% RR	45.23	0.80	0.04	0.57
100% RR	43.27	0.78	0.07	0.55
CVa (%)	7.97	31.82	36.35	43.40
CVb (%)	9.57	31.41	69.29	31.24

*means in a column within a factor without letters are not significantly different from each other at 5% ANOVA

Yield and yield components

Number of male and female flowers per plant

The application of the type of fertilizer and SbFF supplementation did not influence the number of flowers (male and female flowers) produced per plant (Table 5). Even though the results gave no significance, it indicates that control had the least number of male flowers compared to those cucumber plants grown with vermicompost and inorganic fertilizer applications. Additionally, there are more male flowers developed than females. This could be attributed to the sex ratio of the cucumber.

The sex expression of cucumber can be controlled through genetic, environmental, and chemical factors. The latter are involved in the development of floral organs. There is an interplay between nutrients and plant hormones. Auxin, for example, has an important role to play in floral initiation, while gibberellin plays an important role in the development of petals and stamens, and cytokinin is involved in anther and pollen grain production (Da Costa et al., 2013; Sawhney & Shukla, 1994).

Table 5. *The types of fertilizer and varying levels of seaweed-based foliar fertilizer influence the number of flowers of cucumber.*

TREATMENTS	Number of flowers	
Type of Fertilizer	Male	Female
Control	31.93	7.27
Inorganic (RR)	34.82	8.25
Vermicompost	32.01	7.74
Levels of SbFF		
Control	30.41	7.91
50% RR	33.41	7.21
100% RR	34.94	8.15
CVa (%)	19.19	15.40
CVb (%)	14.98	13.36

*means in a column within a factor without letters are not significantly different from each other at 5% ANOVA

Sex ratio and Fruit setting (%)

The type of fertilizers and varying levels of SbFF did not affect the sex ratio of flowers (ratio of females to males). Test plants treated with standard NPK and vermicompost fertilizers were comparable to the unfertilized plants. The same result was also obtained from supplementation with SbFF. This result suggests that the application of fertilizers, either basal or foliar, did not contribute to improving the sex ratio. One possible reason for the non-improvement of the sex ratio could be the inherent characteristics of the test crop. However, Ahmed et al. (2007) noted that light intensity plays a crucial role in the development of flowers. He further reported that light intensity promotes the higher production of male flowers than female flowers.

Generally, in every female flower, there are five male flowers developed, which contribute to a successful pollination and the development of fruits in cucumber. Gajc-Wolska et al. (2010) reported from

Their study, which was conducted for consecutive years, had disclosed that cucumber lines loaded flowers of one (1) male flower and five (5) female

flowers per plant. However, the majority of the treatments show a 1:4 ratio except 50% SbFF, which achieved a higher male-to-female ratio of 1:5, coinciding with the literature cited above.

Table 6. *Types of fertilizers and varying levels of seaweed-based foliar fertilizers influence the sex ratio and fruit set of cucumbers.*

TREATMENTS	Female: Male	Fruit Set (%)
Type of Fertilizer		
Control	1: 4	85.50
Inorganic (RR)	1: 4	92.09
Vermicompost	1 : 4	85.22
Levels of SbFF		
Control	1: 4	86.29
50% RR	1: 5	86.35
100% RR	1: 4	90.19
CVa (%)	20.26	7.96
CVb (%)	20.49	10.50

*means in a column within a factor without letters are not significantly different from each other at 5% ANOVA

On the other hand, fruit setting, as influenced by types of fertilizer and levels of SbFF, showed no significant difference among treatments. Generally, both fertilization through the soil and foliar fertilizer supplementation resulted in a fruit set of more than 80%.

Fruit weight (g) and length (cm)

Both types of fertilizer and levels of seaweed-based foliar fertilizer failed to improve fruit length and weight of cucumber, as reflected in similar fruit sizes from the unfertilized treatment (Table 7). On the other hand, an interaction effect was observed in the fruit weight of cucumbers as affected by the application of different types of fertilizers and levels of SbFF (Table 7a). Fruits from a single application of synthetic fertilizer are heavier compared to those fruits coming from the unfertilized treatment, and the inclusion of SBFF did not further improve fruit weight. However, it is interesting to note that the unfertilized cucumber and vermicompost-treated plants, supplemented with a seaweed-based foliar fertilizer, produced heavier fruits compared to those unfertilized and unsupplemented plants, as well as those treated with a single application of vermicompost. This result suggests that foliar fertilizer application of seaweed-based fertilizer has the same magnitude of fruit growth as those experimental plants fertilized with the recommended rate of synthetic fertilizer. Santos et al. (2010) attributed higher fruit weight to SbFF due to the enhancement of physiological responses in plants, such as greater nutrient mobilization from the soil, resulting from a more extensive root system supplemented with SbFF. The same result was observed in tomato plants foliarly sprayed with K. Alvarezii extracts (Kurepin et al., 2014).

Table 7. *The types of fertilizer and varying levels of seaweed-based foliar fertilizer influenced the weight (g) and length (cm) of cucumbers.*

TREATMENTS	Fruit Weight (g)	Fruit Length (cm)
Type of Fertilizer		
Control	191.74	17.58
Inorganic (RR)	200.07	18.20
Vermicompost	190.10	17.64
Levels of SbFF		
Control	192.74	17.48
50% RR	194.66	17.85
100% RR	194.49	18.09
CVa (%)	6.29	2.29
CVb (%)	6.76	5.09

*means in a column within a factor without letters are not significantly different from each other at 5% ANOVA

Table 7.1a. *Interaction effects on weight (g) per fruit of cucumber influenced by types of fertilizer and varying levels of seaweed-based foliar fertilizer.*

Types of Fertilizer	Levels of SbFF		
	Control	50% RR	100%RR
Control	176.19^{b}	201.18^{a}	197.85^{a}
Inorganic (RR)	217.88^{a}	192.81^{a}	189.50^{a}
Vermicompost	184.15^{b}	190.00^{a}	196.14^{a}
CVa (%)= 6.29; CVb (%)= 6.76			

*means in a column within a factor without letters are not significantly different from each other at 5% ANOVA

Number of fruits per plant

Several fruits, categorized as marketable and non-marketable, are presented in Table 8. Results showed that there were no significant differences among treatments observed. The marketable fruits were numerically higher in plants treated with inorganic fertilizer than in those treated with vermicompost, compared to the control treatment. In addition, application of 100% SbFF gave a higher number of marketable fruits compared to 50% SbFF and the control. In general, plants without fertilizer application had a lower number of non-marketable fruits than the fertilized treatments. However, between plants with 100% SbFF and those with 50% SbFF, the 100% dosage of SbFF yielded a higher numerical value in terms of the number of fruits developed per plant.

In general, the application of synthetic fertilizers yields a higher number of fruits per plant compared to organically applied plants and unfertilized plants. The varying levels of SbFF did not exhibit any improvement in fruit production. The higher development of fruits, regardless of the treatments, could be reflective of the cucumber plant's higher efficiency in setting fruits. This is also supported by a higher sex ratio, where in every one female flower developed; there are five competing male flowers to pollinate

One male flower (Gajc-Wolska et al., 2018), which may result in higher development of fruit.

Table 8. *The types of fertilizer and varying levels of seaweed-based foliar fertilizer influence the number of cucumber fruits per plant.*

Types of Fertilizer	Levels of SbFF		
	Control	50% RR	100%RR
Control	176.19[b]	201.18[a]	197.85[a]
Inorganic (RR)	217.88[a]	192.81[a]	189.50[a]
Vermicompost	184.15[b]	190.00[a]	196.14[a]
CVa (%)= 6.29; CVb (%)= 6.76			

*means in a column within a factor without letters are not significantly different from each other at 5% ANOVA

Fruit yield

Yield improvement resulting from the applied treatments is evident in the table presented below (Table 9). Generally, plants fertilized with both organic and inorganic fertilizers, as well as foliar application of SbFF, yield better results compared to the unfertilized treatment. The increased yield from these treatments ranges from 40% to 70% above the control. It appears that the inclusion of SbFF in the basal application of both organic and vermicompost did not further improve its yield. However, when SbFF was applied alone, there was a dramatic improvement in yield compared to the unfertilized treatment. This result suggests that the foliar application of seaweed-based fertilizer is not merely a supplement to fertilizer, but can also stand alone in bringing significant changes to the yield of cucumber, as evidenced by better yield performance compared to the control and comparable to those of cucumber plants treated with vermicompost and the recommended rate of fertilizer. The presence of mineral elements, humic acid, and PGR-like substances can stimulate plant growth, leading to an increase in yield (Aremu et al., 2014;

Devanathan et al., 2018). This occurrence can be traced back to the process of vermicomposting, where microbial diversity and activity, particularly by plant-friendly microorganisms and earthworms, increase dramatically, resulting in the production of nutrients and PGR compounds in the soil (Chaulagain et al., 2017).

Arancon et al. (2005) reported that vermicompost alone applied to grape plants exhibits a positive effect in terms of yield for about 5 5-year duration of the experimental study. They added that vermicompost, when combined with inorganic fertilizer, had increased the yield of okra. This result aligns with the findings of several studies on the impact of seaweed-based foliar fertilizers on crop yields. For example, de Jesús Carballo-Méndez et al. (2018) claim that SbFF, like KD, has improved the yield of mungbean while increasing the yield of tomato.

Table 9. *Interaction effects on yield (t ha-1) of cucumber influenced by types of fertilizer and varying levels of seaweed-based foliar fertilizer.*

Type of Fertilizer	Levels of SbFF		
	Control	50% RR	100% RR
Control	28.40b	41.28b	41.44a
Inorganic (RR)	45.66a	40.43b	45.52a
Vermicompost	39.59b	53.60a	43.46a

CVa% =19.52; CVb(%) =13.24%

*means in a column within a factor without letters are not significantly different from each other at 5% ANOVA

There is different literature reported on the optimum yield of cucumber under field and glasshouse conditions. Abu Zurayk (2019) cited that the world average yield of cucumbers is 15 tons per hectare (t ha-1) under field conditions, whereas greenhouses or glasshouses can produce yields exceeding 60 t ha-1.

1. However, FDA-WIFSS (Undated) revealed that the yield of cucumber depends on the length of harvesting. Based on its report, the 12-week period of cucumber fruit harvesting reached up to 11.03 t ha-1. In the Philippines, cucumber fruits with marketable yield only could be attained from 15 to 20 t ha-1 (PCAARRD, 2009) while in the average yield regardless of variety selected under different seasons such as UPL Cu- 6 and UPL Cu- 11 is ranging from 25 to 35 t ha-1 (DARFU, 2015). From the result, the yield of cucumber surpassed the yield indicated above. Possibly because of the variety used, the number of people per hectare, and the length of harvesting.

Post-harvest characteristics

Weight loss (%)

Weight loss of cucumber fruits (from day 2 to day 16) as affected by types of fertilizer and levels of seaweed-based fertilizer is presented in Table 10. There was no apparent difference in weight loss between plots with applied fertilizers and those with SbFF applied. Regardless of the treatments, weight loss from fruits increased over time. It also shows that the weight loss of cucumber fruit is minimal during the early days of storage, as reflected in fruits stored 2 days after harvesting. However, a doubling of weight loss has been observed after 2 days of storage, and this increase is dramatic by Day 16. This result further indicates that the weight loss of cucumber is not dependent on the treatments applied. However, it can be noted that unfertilized plants and those treated with inorganic fertilization had the highest weight loss compared to plants grown with vermicompost fertilizer application. On the other hand, reduction of 50% levels of SbFF had a more significant influence on weight loss compared to unsupplemented plants and those with a higher rate of SbFF. In addition, all cucumber fruits lasted for 16 days, with the lowest weight loss occurring in fruits treated with 50% SbFF foliar fertilizer and grown with vermicompost.

Generally, pre-harvest factors, such as fertilization, influence post-harvest life due to high nutrient accumulation that has been assimilated, which significantly helps plant growth and development. Nutrient assimilation coupled with good sunshine and optimum moisture may result in the accumulation of more food reserves, which are an important factor in prolonging the post-harvest life of the commodity since it is the sole source of food to the respiring fruit. Diriba-Shiferaw et al. (2013) reported that the application of balanced fertilizers during production could enhance storage life and reduce weight loss of garlic bulbs. In the study by Hailu et al. (2008), the optimal amount of fertilizer application at pre-harvest could affect the weight loss and post-harvest life of carrots under both controlled and ambient temperatures. Although the controlled temperature-treated carrots have superior results, it could also be attributed to the fertilizers applied in the optimum amount to the soil, which resulted in an increase in the shelf life of the carrots even at ambient temperature. It further indicates that an excessive amount of fertilizer applied may lead to early deterioration of post-harvest produce, particularly under ambient conditions.

However, the result of this study is in contrast with the above-mentioned finding. During the duration of this study, the area experienced limited rainfall with high light intensity. Hence, the similar weight loss, even in cucumber plants that have been fertilized and supplemented with foliar fertilizer, could be attributed to climatic factors such as high light intensity and limited moisture absorption, which causes stress to the growing plants.

Table 10. *The cumulative weight loss (%) of cucumber during storage was influenced by the types of fertilizer and varying levels of seaweed-based foliar fertilizer applied during production.*

TREATMENTS	Day 2	Day 4	Day 6	Day 8	Day 10	Day 12	Day 14	Day 16
Type of Fertilizer								
Control	3.32	8.47	12.80	13.93	15.95	17.30	19.34	21.91
Inorganic (RR)	2.42	6.72	10.97	12.09	14.15	15.56	17.12	23.84
Vermicompost	2.48	6.56	11.14	12.33	14.55	16.03	18.20	19.65
Levels of SbFF								
Control	2.27	6.55	10.91	12.06	14.18	15.63	17.29	23.19
50% RR	2.86	7.01	11.48	12.65	14.76	16.17	18.17	18.88
100% RR	3.09	8.19	12.52	13.65	15.70	17.10	19.20	23.34
CVa (%)	42.01	36.11	18.40	16.40	13.37	12.64	13.14	32.42
CVb (%)	38.07	39.26	24.55	22.43	19.57	18.06	18.63	28.28

*means in a column within a factor without letters are not significantly different from each other at 5% ANOVA

Storage life (days)

The type of fertilizer and varying levels of SbFF fertilizer did not influence the storage life of cucumber (Table 11). Storage life was determined at the time when the fruits reached the limit of edibility or at VQR of 3.

Fruits from plants applied with vermicompost during production have numerically longer storage life (15.22 days) compared to those from plants fertilized with inorganic fertilizer and unfertilized plants. On the other hand, weekly application of SbFF at the rate of 100% during the production period numerically resulted in having a more extended storage period than plants grown with 50% SbFF and the control.

Table 11. *The storage life (days) of cucumber is influenced by the types of fertilizer and varying levels of seaweed-based foliar fertilizer during production.*

TREATMENTS	STORAGE LIFE (days)
Type of Fertilizer	
Control	14.67
Inorganic (RR)	14.89
Vermicompost	15.22
Levels of SbFF	
Control	14.67
50% RR	14.78
100% RR	15.33
CVa (%)	9.95
CVb (%)	8.26

*means in a column within a factor without letters are not significantly different from each other at 5% ANOVA

There was no interaction effect between types of fertilizer and levels of seaweed-based foliar fertilizer. The application of basal fertilizer with varying levels of SbFF did not further improve the post-harvest life of cucumber. This result implied that a cultural practice such as fertilization is not a single factor that determines the storage life of cucumber. Other possible factors would likely affect the storage life of cucumber but were not included in the study.

Degree of shriveling

Based on the analysis results, both types of fertilizers and levels of SbFF have an impact on the preservation of cucumber quality. Fertilized and unfertilized fruits had the same response, as they started to shrivel on day 4. Significant results can be observed on fruits with SbFF supplementation on day 4 wherein SbFF at a rate of 100%, along with unsupplemented SbFF, had a better physical appearance than a dosage of 50% SbFF. Fruits were generally shriveled over time; however, the results indicated that cucumber fruits had shriveled slightly (1-25% surface shriveling) during storage. The outward expression of the cucumber storage quality can be dictated by its genetic characteristics.

It further shows that the interaction effect of fertilizer application with SbFF supplementation was observed on Day 8. Those fruits with pre-harvest application of both organic and inorganic fertilizers, with and without foliar supplementation of SbFF, had the least degree of shriveling compared to the control. However, it appears that the degree of shriveling is relative, as the shriveling of cucumbers is between 1% and 25%.

Table 12. The degree of shriveling of cucumber during storage is influenced by the types of fertilizer and varying levels of seaweed-based foliar fertilizer applied during production.

TREATMENTS	Day 0	Day 2	Day 4	Day 6	Day 8	Day 10	Day 12	Day 14	Day 16
Type of Fertilizer									
Control	0.00	0.11	0.47	0.64	0.64	0.71	0.71	0.71	0.82
Inorganic (RR)	0.00	0.09	0.38	0.64	0.71	0.6	0.64	0.73	0.78
Vermicompost	0.00	0.07	0.44	0.58	0.69	0.67	0.69	0.6	0.73
Levels of SbFF									
0	0.00	0.04	0.33[b]	0.6	0.67	0.62	0.69	0.67	0.87
50% RR	0.00	0.09	0.57[a]	0.67	0.71	0.73	0.76	0.76	0.78
100% RR	0.00	0.13	0.37[b]	0.6	0.67	0.62	0.6	0.62	0.69
CVa (%)	-	-	14.17	16.04	29.89	23.35	29.34	47.25	38.31
CVb (%)	-	-	40.07	29.90	26.79	21.05	31.24	34.36	28.52

*means in a column within a factor without letters are not significantly different from each other at 5% ANOVA

Paliyath and Murr (2008) reported that one of the problems encountered in the post-harvest life of cucumber was water loss, which leads to fruit shriveling even at controlled temperature. This result contrasts with the present study, which yielded the lowest degree of shriveling (rated lower than 1) across all types of fertilizer and varying levels of SbFF supplementation.

Table 12a. *Interaction effects of types of fertilizer and levels of seaweed-based foliar fertilizer on the degree of shriveling of cucumber during the eighth day of storage.*

Type of Fertilizer	Levels of SbFF		
	No Application	50% RR	100% RR
Control	0.40[b]	0.66[a]	0.86[a]
Inorganic (RR)	0.80[a]	0.66[a]	0.66[ab]
Vermicompost	0.80[a]	0.80[a]	0.46[b]
CVa (%)=29.89; CVb (%)=26.79			

*means in a column within a factor without letters are not significantly different from each other at 5% ANOVA

Table 12b. I*nteraction effects of types of fertilizer and levels of seaweed-based foliar fertilizer on the degree of shriveling of cucumber during the 10th day of storage.*

Type of Fertilizer	Levels of SbFF		
	No Application	50% RR	100% RR
Control	0.53^{b}	0.80^{a}	0.80^{a}
Inorganic (RR)	0.53^{b}	0.66^{a}	0.60^{ab}
Vermicompost	0.80^{a}	0.73^{a}	0.46^{b}
CVa (%)=23.35; CVb (%)=21.05			

*means in a column within a factor without letters are not significantly different from each other at 5% ANOVA

Visual quality rating

The application of different types of fertilizer had a significant effect on visual quality, and levels of seaweed-based foliar fertilizer generally did not influence the visual quality of cucumbers during storage. Fruits are in excellent condition during the first four days of storage. However, the visual quality of fruit deteriorates over time. Minor defects were observed after Day 6 and started to reach marketability on Day 12, with the limit of edibility reached on Day 14.

Table 13. *The visual quality rating of cucumbers during storage is influenced by the types of fertilizer and varying levels of seaweed-based foliar fertilizer applied during production.*

TREATMENTS	Day 0	Day 2	Day 4	Day 6	Day 8	Day 10	Day 12	Day 14	Day 16
Type of Fertilizer									
Control	9.00	9.00	8.87	7.44	6.64	5.53^{b}	4.93	3.76	3.84
Inorganic (RR)	9.00	9.00	8.87	7.71	6.73	5.49^{b}	5.31	3.67	3.71
Vermicompost	9.00	9.00	8.82	7.76	6.6	6.07^{a}	5.22	4.07	3.93
Levels of SbFF									
0	9.00	9.00	8.82	7.71	6.64	5.71	4.8	3.67	3.89
50% RR	9.00	9.00	8.87	7.49	6.69	5.67	5.22	3.89	3.76
100% RR	9.00	9.00	8.87	7.71	6.64	5.71	5.44	3.93	3.84
CVa (%)	-	-	3.94	10.45	11.9	2.14	23.98	11.19	15.31
CVb (%)	-	-	2.75	8.55	7.84	9.46	19.25	14.7	11.10

*means in a column within a factor without letters are not significantly different from each other at 5% ANOVA

Disease incidence

No disease incidence was observed during the observation under storage of cucumber fruits. However, it had observed that the deterioration process brought about rotten fruits during storage. It implied that the application of organic and inorganic fertilizers with SbFF supplementation has the same responses in terms of disease incidence, but this could be due to the plant's genetic characteristics.

Cost and Return Analysis

The cost and return analysis is reflected in Table 14. This was undertaken from the 1st week until the 18th week of harvesting. The highest yield was attained by the vermicompost-applied plants with a 50% inclusion of SbFF. This was followed by a comparison of plants that received inorganic fertilizers with those that did not. Although the organic one yields the highest amount, it does not necessarily mean it has the highest benefit-cost ratio. The latter had been attained through the inorganic treatment. However, it was noticed that singly applied SbFF had a higher BCR compared to the unsupplemented SbFF.

Further, it indicates that the inclusion of SbFF could be an alternative source of fertilizer as it stands alone in producing better yields compared to unfertilized plants, as it resulted in a positive profit relative to the different types of fertilizers imposed.

Table 14. *The types of fertilizer and different levels of seaweed-based foliar fertilizer per hectare influence the cost and return of cucumber production.*

Type of Fertilizer Levels of SbFF	Total** Yield (kgs)	Production Cost	Gross Income	Net Income	Benefit Cost Ratio (BCR)
Control					
0	13,225.00	290,956.79	330,625.00	39,668.21	0.14
50% SbFF	22,008.33	329,756.79	550,208.33	220,451.54	0.67
100% SbFF	19,441.67	348,556.79	486,041.67	137,484.88	0.39
Inorganic					
Without SbFF	23,402.78	307,356.79	585,069.44	277,712.65	0.90
50% SbFF	18,055.56	346,156.79	451,388.89	105,232.10	0.30
100% SbFF	22,622.22	364,956.79	565,555.56	200,598.77	0.55
Vermicompost					
Without Vermicompost	20,069.44	355,356.79	501,736.11	146,379.32	0.41
50%	23,983.33	394,156.79	599,583.33	205,426.54	0.52
100%	22,091.67	412,956.79	552,291.67	139,334.88	0.34

**Marketable yield- Php 25.00 at farm gate price

CONCLUSION AND RECOMMENDATIONS

Conclusion

This present study draws the following conclusions:

1. Singly and in combinations of different types of fertilizer and levels of SbFF have generally contributed to the improvement of growth, yield components, and post-harvest qualities of cucumber, but insignificance was also found in those parameters, with relative results to be proved as otherwise.
2. Foliar spray application of seaweed-based fertilizer is not only a supplement but can also bring significant changes in cucumber yield. This treatment exhibits better yield performance than the control
Moreover, at par in yield with those cucumber plants singly applied with vermicompost and the recommended rate of fertilizer.

Recommendations

1. Apply the 50% SbFF singly and in combinations of vermicompost with 50% SbFF for cucumber plants and other family-related plants;
2. Validate and evaluate the same crop as a test plant under rainy or wet season, and,
3. Test other vegetable crops to be applied with seaweed-based foliar fertilizers containing bio-stimulants that are emerging and available in the market.

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