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Response of bottlegourd (*Lagenaria Siceraria* Standley) to the application of inorganic fertilizer and spraying with sargassum tea

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Key words: Bottlegourd, Complementary effects, Inorganic fertilizer, Nutrient depleted soil, Sargassum tea

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Abstract

Nowadays, most cultivated farms for crop production are already depleted with soil nutrients due to intensive planting with various crops to sustain the demand of food of the fast-increasing population. It was observed that the depletion of soil nutrients had great effect to the productivity of the farm that resulted to low crop yield and inferior quality of produce. The most intensively planted crop that contributed much to the depletion of the soil nutrients are cereals and vegetables. In vegetable production, one of the most intensively cultivated vegetable is the bottlegourd (*Lagenaria siceraria* Standley). It belongs to the Cucurbitaceae's family that can be planted year-round. To enhance the growth and yield of the bottlegourd, the application of inorganic fertilizer and spraying with Sargassum tea was done. Hence, this study was conducted to evaluate the effects of the application of different rates of inorganic fertilizer and spraying with different concentrations of Sargassum tea on the growth and yield of the bottlegourd. The experiment was laid out in three blocks and the treatments were arranged following the 4 x 5 Factorial Randomized Complete Block Design. Result revealed complementary effects of the application of inorganic fertilizer and spraying with Sargassum tea that the bottlegourd applied with 100% Recommended Rate Inorganic Fertilizer and Sprayed with 1 Part Sargassum Tea: 15 Parts Water (I_3S_3) was the earliest to have harvestable fruits at 54.17 days after transplanting, highest fruit yield (27.47 tha^{-1}) and net income (PhP240,562.36).

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Introduction

Vegetables are considered as one of the major crops grown and source of income of farmers in Northern Philippines. Majority of the people in this countryside are considered vegetarian because much of their diet was a variety of vegetables as compared to other people in different part of the country. Bottlegourd (*Lagenaria siceraria)* is one among the most grown and consumed vegetable. This vegetable belongs to the Cucurbitaceae family under the genus Lagenaria from the word lagena or bottle. Bottlegourd can be grown throughout the year in tropical areas. It can be planted in most kind of soil, preferably in loam soil with high organic matter contents and in warm and humid climate (Minocha *et al.,* 2015).

However, the soil conditions of most farms in the Philippines are already considered at an alarming situation due to nutrient depletion caused by continuous planting with various crops. According to Liu *et al.* (2006) that continuous cultivation was observed as one of the main caused of decreasing soil pH, Ca and Mg in most soils. Likewise, soil degradation due to losses of OM content are also among the prime concerned in most agricultural areas of the world because the amount of nutrients consumed by the plants in every cropping period were not replenished with any organic ameliorant. Moreover, the depletion of soil nutrient was considered as the root cause of the decreasing per capita production of food from crops specially in small farms (Drechsel *et al.,* 2001; Tan *et al.,* 2005), that this declining food production could pose great threat to food supply stability and security.

Therefore, one of the immediate remedies done by most farmers to improve the soil productivity was the application of inorganic fertilizers. However, the application of inorganic fertilizers in the soil is not always the ultimate remedy to increase production because there are always possibilities that it could not be utilized by the plants due to the effects of soil pH, organic matter content, availability of moisture, cation exchange capacity and many more. Further, it is possible that the fertilizers being applied could be fixed or bind with the existing elements in the soil that convert it into unavailable form which could not be absorbed nor utilized by the plants. Likewise, the deficiency of any micronutrients even in minute quantity has great negative effect to the growth and yield of the plants. However, such problem can be corrected by spraying with the necessary nutrients on the leaves of the plants, but commercial foliar fertilizers are very expensive in the market. This problem draws the attention of the government authorities and other concerned groups to find some ways to reciprocate the effects on food sustainability and security.

Hence, the use of locally available organic inputs or other natural liquid extract with enhancing effects aside from the more popular inorganic foliar fertilizer should be given with importance like the seaweed liquid fertilizer. Seaweed has great potential to promote growth and boost yield of any crop due to the presence of macro and micro-nutrients, phytohormones, vitamins and enzymes. At present, products derived from seaweeds are becoming very useful in crop production as organic fertilizer or foliar fertilizer. They enhanced seed germination, improve growth of seedling, increase the tolerance of plants to various unfavorable abiotic conditions (Zhang and Ervin, 2004; Zhang and Ervin, 2008) and boost plant growth, development and yield (Hong *et al.*, 2007; Zodape *et al.,* 2008**;** Khan *et al.*, 2009; Kumari *et al.*, 2011). According to Verkleij (1992) that liquid fertilizer derived from seaweeds extract have macro and micro-nutrients, amino acids and phytohormones. So, in agriculture, the utilization of seaweeds as organic fertilizers had increased recently (Dhargalkar and Pereira, 2005).

Among the endemic seaweeds in the Philippines, *Sargassum* sp. are abundantly found at the shallow seas of the archipelago. Moreover, unlike to other seaweeds with commercial value, Sargassum seaweeds was not yet exploited nor fully utilized for any purposes; therefore, its availability was not yet affected.

Therefore, the aims of this study are; a) to evaluate the effects of the application of different rates of inorganic fertilizer on the development and yield of bottlegourd, b) to assess the effects of spraying different concentrations of Sargassum tea as foliar fertilizer on the development and yield of bottlegourd, c) to evaluate the interaction effects of the application of the different rates of inorganic fertilizer and spraying with different concentrations of Sargassum tea on the development and yield of the bottlegourd, and d) to determine the profitability of producing bottlegourd using inorganic fertilizer and Sargassum tea as foliar fertilizer.

Materials and methods

Location and research design

The study was conducted at the Don Mariano Marcos Memorial State University Research Farm, Casiaman, Bacnotan, La Union, Philippines. The experimental area was laid-out in three blocks and the treatments were arranged following the 4 × 5 Factorial Randomized Complete Block Design (Factorial RCBD). The treatments are as follows;

Factor A (Rates of Inorganic Fertilizer)
I_0–Control (No fertilizer)
I_1–50% Recommended Rate (RR) Inorganic Fertilizer
I_2–5% Recommended Rate (RR) Inorganic Fertilizer
I_3–100% Recommended Rate (RR) Inorganic Fertilizer

Factor B (Concentrations of Sargassum Tea)
S_0–Not Sprayed With Sargassum Tea
S_1–Sprayed With 1 Part Sargassum Tea: 5 Parts Water
S_2–Sprayed With 1 Part Sargassum Tea: 10 Parts Water
S_3–Sprayed With 1 Part Sargassum Tea: 15 Parts Water
S_4–Sprayed With 1 Part Sargassum Tea: 20 Parts Water

Preparation of potting media and sowing

The Tambuli variety of bottlegourd was used in the study. Before sowing, a mixture ratio of 1:1:2 sand, rice hull and garden soil respectively were mixed together as sowing media and then sterilized through heating on old plain G.I. sheet. The sowing media was turned or mixed occasionally throughout the sterilization period (30 minutes pre-heating and another one-hour cooking) and then set aside and let it cool. Then a 3 × 4 inches size polyethylene potting bags were filled with the sowing media.

Prior to sowing, the seeds were soaked in clean water for overnight and then wrapped with cloth for about three days to enhance sprouting. During the three days period, the seeds were washed every day and the cloth was kept moist until the primary roots appeared. Only the seeds with an emerging primary root were sown. One seed was sown per potting bag. Proper cultural management was done uniformly into all the seedlings until they were ready for transplanting.

Land preparation

The experimental area was cleared from any debris of previous crops and weeds. Plowing and harrowing was done twice to pulverize the clods properly. The interval of the 1st and 2nd plowing/harrowing was within a period of one week to expose the soil to direct sunlight to eliminate naturally some of the soil-borne pathogens.

Preparation and spraying of the bottlegourd with sargassum seaweed tea

The Sargassum seaweeds were gathered along the seashore of the Fisheries Research and Training Center (FRTI)-Don Mariano Marcos Memorial State University (DMMMSU), Paraoir, Balaoan, La Union, Philippines. The seaweeds were washed with fresh water to remove any adsorbed salty substance and foreign objects from the Sargassum seaweeds, then it was air dried for one week. After drying, the seaweeds were chopped finely and then soaked with fresh water within three months until the seaweeds were fully disintegrated or when no solid particles were floating. In every kilogram of dried seaweeds, it was soaked with five liters of unchlorinated water in a container.

Collection of Sagassum seaweeds

Washing of Sargassum seaweeds

Drying of Sargassum seaweeds

Chopping of dried Sargassum seaweeds

Fermenting the Sagassum seaweeds in container

The fermented Sargassum tea

Fig. 1. Preparation of fermented Sargassum tea

The Sargassum seaweeds were stirred inside the container to turn upside and down the seaweeds for faster fermentation. After three months of fermentation, the Sargassum tea was filtered with fine cloth into another container for storage in a few days (Fig. 1). The dilution of the tea concentrates was only done during the day of spraying. The concentration of the diluted tea solution was based on the concentration requirements of the respective treatments as follows: S_1 - 1 part Sargassum tea: 5 parts water; S_2 - 1 part Sargassum tea: 10 parts water; S_3 - 1 part Sargassum tea: 15 parts water; S_4 - 1 part Sargassum tea: 20 parts water. The solution was sprayed on the entire leaves of the plants during their early vegetative stage but not to exceed 400 Lha^{-1} during their late vegetative and fruiting stage. Spraying was done every two weeks from planting and throughout the productive period of the plants.

Transplanting

Prior to transplanting, the seedlings were hardened by gradually exposing to full sunlight within one week, reduce watering and totally stopped at three days before transplanting. Transplanting was done three weeks after sowing. One seedling was planted per hill. There were four rows in a plot with seven hills per row. A total of 28 seedlings were planted per plot at a distance of 1.0 m between hills and 1.5 m between rows.

Fertilizer application

Two weeks after transplanting, the bottlegourd were drenched with one liter of Urea solution per hill (5g Urea per liter of water) and side dressed with 10g Urea per hill every three weeks interval from the vegetative stage until the fruiting period of the plants or until the whole amount of the recommended rate (90-0-0 $kgha^{-1}$ NPK) were applied based on the laboratory analysis of the soil taken from the experimental area. The soil was analyzed by the Regional Soils Laboratory of the Department of Agriculture Regional Field Unit 1, San Fernando, La Union, Philippines.

Irrigation

The bottlegourd was irrigated immediately after transplanting and every 7-10 days thereafter throughout their vegetative and fruiting period. Uniform amount of water was given to all the treatments through furrow irrigation method.

Weeding

Manual weeding by pulling the weeds was done occasionally depending on the growth and density of weeds that emerged especially during the early vegetative stage of the bottlegourd.

Pest control

The bottlegourd were uniformly sprayed with different kind of less toxic insecticides. The different insecticides were alternately sprayed every two weeks interval during their early vegetative stage to flowering stage, but the frequency of spraying during the fruiting period was done at a longer interval or as need arises depending on the prevalent of insect infestation using a less toxic or green label insecticides.

Trellising

Installation of trellis was done after planting or before the vines will begin to climb to minimize damage to the plants using bamboo poles and rope. The vines were guided to the trellis when they start to climb and they were lightly tied to the installed climbing sticks intended for each hill.

Harvesting of fruits

Harvesting of fruits was done when they had already reached the ideal size but still immature stage. Succeeding harvesting was done every three days interval to avoid over maturity.

Data collection

The data gathered are the following; a) the number of days to initial fruit harvesting was counted from transplanting until the plants of the respective treatments have 50% harvestable fruits in a plot. The fruit yield per hectare (tha^{-1}) was computed using the formula: Computed Yield per Hectare = [(Actual Yield per Plot) / (Actual Plot Area)] × (Area / hectare). The net income per hectare (PhP) was computed using the formula: Computed Net Income = (Computed Gross Income per Hectare) – (Computed Cost of Production per Hectare).

Statistical analysis

The data were subjected to analysis of variance (ANOVA) to determine any significant differences among the treatments following the 4 × 5 Factorial Randomized Complete Block Design (Factorial RCBD). The Tukey's Honest Significant Difference (HSD) Test was also used to test the significant differences between the treatment means in every variables with significant differences among the treatments as per ANOVA test results.

Results and discussion

Number of days to initial fruit harvesting

Effects of the application of inorganic fertilizer to the number of days to initial fruit harvesting of bottlegourd

In Table 1, it showed the number of days to the initial fruit harvesting of bottlegourd as affected by the application of different rates of inorganic fertilizer. The result revealed that there was a significant difference among the treatments wherein the plants applied with 100% RR inorganic fertilizer (I_3) were significantly the earliest (52.40 days) to have harvestable fruits while the plants without inorganic fertilizer (I_0) were the latest at 59.07 days. This could be attributed to the immediate effects of the applied inorganic fertilizer which conformed to the statement of Lenahan (2014) that inorganic fertilizers contain a high percentage of readily available nutrients and had quick effect than organic fertilizers. Baghel *et al.* (2018) mentioned that modern agriculture frequently uses synthetic inorganic fertilizers to increase the yield in a given unit area because it has sufficient nutrient contents and quick effects to the plant.

Effects of spraying sargassum tea solution to the number of days to initial fruit harvesting of bottlegourd

The number of days to initial fruit harvesting as affected by spraying with different concentrations of Sargassum tea is shown in Table 1 with significant differences among the treatments.

Table 1. Number of days to initial fruit harvesting of bottlegourd as affected by the application of different rates of inorganic fertilizer and spraying with different concentrations of Sargassum tea

Treatment	Number of days					
	Sargassum tea concentrations					
Rate of inorganic fertilizer	S_0	S_1	S_2	S_3	S_4	Mean, Inorganic Fertilizer
I_0	61.33^{a}	60.67^{a}	57.00^{bc}	57.67^{bc}	58.67^{b}	59.07^{a}
I_1	57.67^{bc}	56.67^{cd}	55.00^{def}	56.00^{cde}	57.00^{bc}	56.47^{b}
I_2	54.67^{efg}	54.33^{efgh}	53.00^{ghi}	52.67^{hi}	53.00^{ghi}	53.53^{c}
I_3	53.67^{fghi}	53.00^{ghi}	52.67^{hi}	50.33^{j}	52.33^{i}	52.40^{d}
Mean, Sargassum tea	56.83^{a}	56.17^{ab}	54.42^{cd}	54.17^{d}	55.25^{bc}	

*Means in a column followed by the same letter are not significantly different at 0.05 level of Tukey's Honest Significant Difference (HSD) Test.

Inorganic Fertilizer: I_0 – Control (No Fertilizer), I_1 – 50% RR Inorganic Fertilizer, I_2 – 75% RR Inorganic Fertilizer, I_3 – 100% RR Inorganic Fertilizer Sargassum Tea: S_0 – Control (No Sargassum Tea), S_1 – 1 Part Sargassum Tea: 5 Parts Water, S_2 –1 Part Sargassum Tea: 10 Parts Water, S_3 – 1 Part Sargassum Tea: 15 Parts Water, S_4 – 1 Part Sargassum Tea: 20 Parts Water

Table 2. Fruit yield of bottlegourd as affected by the application of different rates of inorganic fertilizer and spraying with different concentrations of Sargassum tea

Treatment	Fruit Yield (tha^{-1})					
	Sargassum Tea Concentrations					
Rate of Inorganic Fertilizer	S_0	S_1	S_2	S_3	S_4	Mean, Inorganic Fertilizer
I_0	11.72^{l}	12.86^{kl}	14.01^{k}	13.63^{k}	13.03^{kl}	13.05^{d}
I_1	17.33^{j}	18.70^{ij}	19.23^{i}	21.19^{gh}	20.01^{hi}	19.29^{c}
I_2	18.85^{ij}	21.84^{fg}	23.29^{ef}	25.02^{cd}	23.41^{def}	22.48^{b}
I_3	23.12^{ef}	24.69^{cde}	25.37^{bc}	27.47^{a}	26.89^{ab}	25.51^{a}
Mean, Sargassum Tea	17.76^{d}	19.52^{c}	20.48^{b}	21.83^{a}	20.84^{b}	

*Means in a column followed by the same letter are not significantly different at 0.05 level of Tukey's Honest Significant Difference (HSD) Test.

Inorganic Fertilizer: I_0 – Control (No Fertilizer), I_1 – 50% RR Inorganic Fertilizer, I_2 – 75% RR Inorganic Fertilizer, I_3 – 100% RR Inorganic Fertilizer Sargassum Tea: S_0 – Control (No Sargassum Tea), S_1 – 1 Part Sargassum Tea: 5 Parts Water, S_2 –1 Part Sargassum Tea: 10 Parts Water, S_3 – 1 Part Sargassum Tea: 15 Parts Water, S_4 – 1 Part Sargassum Tea: 20 Parts Water

The bottlegourd sprayed with 1 part Sargassum tea: 15 Parts Water (S_3) were the earliest (54.17 days) to have harvestable fruits but comparable to S_2 (sprayed with 1 Part Sargassum Tea: 10 Parts Water), while the latest was attained by those not sprayed with Sargassum tea (S_0) at 56.83 days after planting but comparable to S_1 (1 Part Sargassum Tea: 5 Parts Water) with 56.17 days.

This implies that the spraying of the bottlegourd with Sargassum tea solution has great effects to its fruiting because Sargassum tea as foliar fertilizer is water soluble that produces immediate results and enhances the efficacy of the inorganic fertilizer applied in the soil. Moreover, there was no soil fixation, leaching and runoff because they were applied on the leaf and remain there until fully absorbed and no watering is required after the application. The significance of foliar spraying of water-soluble fertilizers is to augment the micro and macronutrient deficiencies from the soil (Garhwal *et al.*, 2007). A minute amount of micronutrient given to the plants has great favorable effects to their growth and yield.

It was reported in previous studies that organic products like the seaweed extracts as foliar fertilizers for a variety

of plants are now gaining significant role in agriculture (Karthikeyan and Shanmugam, 2016; Khan *et al.,* 2009). The seaweed extract is considered as biostimulant because it's effects that when sprayed on the leaves, it will enhance the growth rate (Khan *et al.*, 2009; Hernadez *et al.*, 2014), and improved the chemical composition of the plants (Spinelli *et al.*, 2009). It was found out through the chemical analysis of the extracts the presence of phytohormones such as auxins and cytokines in considerable amount (Panda *et al.*, 2012.)

Interaction effects of the application of inorganic fertilizer and spraying with sargassum tea solution to the number of days to initial fruit harvesting of the bottlegourd

The application of inorganic fertilizer and spraying with Sargassum tea have significant interaction effects to the early fruiting of the bottlegourd. The plants applied with 100% RR of inorganic fertilizer and sprayed with 1 part Sargassum: 15 parts water (I_3S_3) were the earliest to have harvestable fruits but comparable to all the treatments applied with inorganic fertilizer and sprayed with Sargassum tea with days ranging from 54.42–56.83 days after transplanting. They were comparable too with those applied with 75% RR inorganic fertilizer and sprayed with lower concentration of Sargassum tea with days ranging from 52.67–53 days after planting. The result implies that there were synergistic effects of the inorganic fertilizer applied and Sargassum tea sprayed to the earlier fruiting of the bottlegourd when applied with the right amount of inorganic fertilizer and simultaneously supplemented with the right concentration of Sargassum tea. It was proven in previous studies that seaweed extracts have biostimulating effects to horticultural crops, particularly when they are in stressful conditions (Alam *et al.*, 2013; Colla and Rouphael, 2020; Goñi *et al.*, 2018).

Fruit yield

Effects of the application of inorganic fertilizer on the fruit yield of the bottlegourd

In Table 2, it shows the yield of bottlegourd applied with different rates of inorganic fertilizer. The highest yield was produced by the bottlegourd applied with 100% RR inorganic fertilizer (I_3) with 25.51 tha^{-1}. This is possibly due to the adequate amount of nutrient and immediate effect of the inorganic fertilizer applied that sustained the growth and yield, while those not applied with inorganic fertilizer was the lowest with 13.05 tha^{-1}. The result proved that inorganic fertilizers have rapid effects on the plant's development because all the nutrients present are water soluble and readily available in form. Likewise, it has also high nutrient content, therefore just a small amount is needed. The application of the right dosage of inorganic fertilizer enhanced the development of higher root mass that absorbed more nutrients from the soil which are necessary to the growth and yield, then later leave more biomass residues in the soil (Han *et al.*, 2016).

Effects of spraying sargassum tea on the fruit yield of the bottlegourd

Table 2 shows the fruit yield of the bottlegourd as affected by spraying with Sargassum tea. The bottlegourd sprayed with 1 Part Sargassum Tea: 15 Parts Water Group (S_3) had the highest fruit yield with 21.83 t ha^{-1} which could be attributed to the presence of phytohormones and nutrients that enhanced and sustained the fruiting of the bottlegourd throughout their productive period, while those not sprayed with Sargassum tea (S_0) had the lowest with 17.76 t ha^{-1}.

As reported by previous studies that when seaweed extract will be applied as foliar or sprayed in the leaves of the plants, it positively affected the root growth then the plants could absorb more water including nutrients present in the soil that increased yield (Mancuso *et al.*, 2006; Alam *et al.*, 2013). Moreover, it was reported that the seaweed extracts have phytohormones that stimulate the plants thus it improved the quality and boost the yields (Wierzbowska *et al.,* 2015).

Interaction effects of the application of different rates of inorganic fertilizer and spraying with different concentrations of sargassum tea on the fruit yield of the bottlegourd

Analysis of variance revealed significant interaction effects of the application of different rates of inorganic fertilizer and spraying with different concentrations of Sargassum tea on the fruit yield of the bottlegourd (Table 2).

Table 3. Net income of the bottlegourd as affected by the application of inorganic fertilizer and spraying with Sargassum tea

Treatment	Net income (PhP)					
	Sargassum tea concentrations					
Rate of inorganic fertilizer	S_0	S_1	S_2	S_3	S_4	Mean, Inorganic Fertilizer
I_0	20,912	26,183	40,060	35,784	30,317	30,651
I_1	102,837	106,158	117,772	148,496	131,379	121,328
I_2	124,575	152,096	177,610	204,934	181,218	168,087
I_3	182,102	193,874	207,844	240,562	232,345	311,346
Mean, Sargassum tea	107,606	81,554	135,822	157,444	143,815	

*Means in a column followed by the same letter are not significantly different at 0.05 level of Tukey's Honest Significant Difference (HSD) Test.

Inorganic Fertilizer: I_0 – Control (No Fertilizer), I_1 – 50% RR Inorganic Fertilizer, I_2 – 75% RR Inorganic Fertilizer, I_3 – 100% RR Inorganic Fertilizer Sargassum Tea: S_0 – Control (No Sargassum Tea), S_1 – 1 Part Sargassum Tea: 5 Parts Water, S_2 –1 Part Sargassum Tea: 10 Parts Water, S_3 – 1 Part Sargassum Tea: 15 Parts Water, S_4 – 1 Part Sargassum Tea: 20 Parts Water

The bottlegourd applied with 100% RR Inorganic Fertilizer and sprayed with 1 Part Sargassum Tea: 15 Parts Water was the highest with 27.47 tha^{-1} fruit yield. The result implies great effects by the synchronized application of inorganic fertilizer and spraying with Sargassum tea to the yield of the bottlegourd. According to Arancon *et al.* (2008) that the simultaneous use of inorganic and organic fertilizers had positive effects to the crop productivity as well as on the soil condition. Likewise, Baghel *et al.* (2018) stated that the combined plant nutrient application is very efficient methods of supplying the required nutrients needed by the plants. Another objective of the integrated application is to provide the required inorganic and organic fertilizers at lesser amount without affecting the crop yield. Another thing is that foliar fertilizer spraying after fertilizer application in the soil is an effective method to provide the trace elements needed by the crops to increase yield, and to improve soil conditions (Niu *et al.*, 2021).

Further, more recently emerged studies confirmed that combined application of inorganic fertilizers and organic fertilizers from various sources have synergistic effects (Amujoyegbe *et al.,* 2007; Mahmood *et al.*, 2017) and enhanced the productive capability of many crops such as cereals, fruits and vegetables (Moe *et al.*, 2017; Islam *et al.*, 2017; Zhao *et al.*, 2014).

Net income

Effects of the application of inorganic fertilizer on the net income of the bottlegourd

The bottlegourd applied with 100% RR inorganic fertilizer (I_3) had the highest net income with PhP311,346, while those not applied with inorganic fertilizer (I_0) had the lowest with PhP30,651. This could be attributed to the higher or lower yield of the bottlegourd as affected by the rate of the applied inorganic fertilizer (Table 3).

Effects of spraying sargassum tea on the net income of the bottlegourd

The bottlegourd sprayed with 1 part Sargassum Tea: 15 parts Water (S_3) had the highest net income (PhP157,444), while those sprayed with 1 part Sargassum Tea: 5 parts Water (S_1) had the lowest net income with PhP81,554. This could be attributed to the yield of the bottlegourd as affected by spraying with different concentrations of Sargassum tea (Table 3).

Interaction effects of the application of inorganic fertilizer and spraying with sargassum tea solution to the net income of bottlegourd

The plants applied with 100% RR inorganic fertilizer and sprayed with 1 Part Sargassum Tea: 15 Water (I_3S_3) registered the highest net income (PhP240,562) and followed by the those applied with 100% RR inorganic fertilizer and sprayed with 1 Part Sargassum Tea: 20 Water (I_3S_4) with PhP232,345 net income.

The lowest income was attained by those not applied with inorganic fertilizer and not sprayed with Sargassum tea (I_0S_0) with PhP20,912 (Table 3).

The result could be attributed to the higher yield of the plants due to the application with the right amount of inorganic fertilizers and the spraying with Sargassum tea because it has a quick plant response even in small quantities that increased yield and quality. Further, the cost of spraying with Sargassum tea (S_4) was lesser due to lower concentration. Baghel *et al.* (2018) stated that the main purpose of the combined application of nutrient is to lessen the use of inorganic fertilizers but maintained high crop yield. The integrated application of nutrients is the right method for obtaining optimum crop yield with lesser cost of production. Moreover, combined use of organic and inorganic fertilizers plays a significant role in sustaining soil fertility for better crop yield (Elkholy *et al.,* 2010; Vanlauwe *et al.,* 2010) and improves the use efficiency of the recommended inorganic fertilizer and reduces its cost (Ali *et al.,* 2009; Abedi *et al.*, 2010).

Conclusion

Most cultivated farms were already depleted with soil nutrients, so the application of nutrients from inorganic and organic sources are necessary to boost the growth and yield of the crops. It was observed in the study that the application of 100% RR inorganic fertilizer had enhanced the early fruiting and boost the yield of the bottlegourd due to the presence of sufficient amount of nutrients which has immediate effect to the growth and development of the bottlegourd. Likewise, the spraying with 1 part Sargassum tea: 15 parts water (S_3) had augmented the lacking amount of micronutrients and phytohormones needed by the vegetables which has a great effect even in minute quantity as it boost the early fruiting and yield of the bottlegourd. Likewise, there was a complementary effects observed in the simultaneous application of inorganic fertilizer and spraying with Sargassum tea, because the plants applied with 100% RR inorganic fertilizer and sprayed with 1 part Sargassum tea: 15 parts water (I_3S_3) were the earliest to have harvestable fruits, highest fruit yield and net income due to the availability of the required amount of macronutrients and micronutrients from the inorganic fertilizer and Sargassum tea which sustained the growth and boost the yield of the bottlegourd at lower cost.

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