**RESPONSE OF WAXY-SWEET WHITE CORN (*Zea mays* L. var. ‘SWEET PEARL F1’) APPLIED WITH DIFFERENT CONCENTRATIONS OF BROWN MACROALGAE (*Sargassum* spp.)-BASED CONCOCTION**

**ABSTRACT**

The study evaluated the response of waxy-sweet white corn (*Zea mays* L. var. 'Sweet Pearl F1') to different concentrations of *Sargassum* spp.-based concoction as a biofertilizer alternative to inorganic fertilizers. This was conducted using a Randomized Complete Block Design (RCBD) with five treatments replicated three times, the study assessed growth parameters, yield components, and economic viability. Results indicated that *Sargassum* spp.-based concoction (SBC) significantly influenced plant height, leaf count, stem diameter, and yield-related parameters, including ear length, ear diameter, and number of kernels per ear. Among the different SBC concentrations, 500 L/ha and 750 L/ha produced results comparable to the recommended rate of inorganic fertilizer (RRIF), particularly in yield and sugar content (brix°). Economic analysis demonstrated that *Sargassum* spp.-based biofertilizer improved net income and return per cost, highlighting its potential as an environmentally sustainable alternative to synthetic fertilizers. These findings suggest that integrating macroalgae-based fertilizers into sweet corn cultivation can enhance production while minimizing chemical inputs, contributing to sustainable agriculture.

**Keywords**: *Sargassum* spp.-based concoction, recommended rate of inorganic fertilizer, growth and yield, ‘Sweet Pearl F1’ waxy-sweet white corn.

1. **INTRODUCTION**

Waxy-sweet white corn (*Zea mays* L. var. 'Sweet Pearl F1') is a hybrid variety recognized for its milky white kernels, high amylose content, exceptional sweetness, early maturity, and adaptability to diverse growing conditions (Alfiler et al., 2022). In the Philippines, corn is a staple crop alongside rice, with white corn primarily consumed by humans. 'Sweet Pearl F1' has gained popularity due to its superior flavor, early harvest, and excellent production potential, contributing to local economic stability and food security (Teñedo, 2024).

Optimal growth and yield of sweet corn require a well-balanced supply of nutrients, including nitrogen, phosphorus, and potassium. Poor soil fertility and inadequate nutrient management can lead to stunted growth, poor cob development, and reduced yields. Traditional synthetic fertilizers, while effective, pose environmental concerns such as soil degradation and water pollution (Canatoy, 2018). Consequently, sustainable agricultural practices are increasingly focusing on biofertilizers, including algae-based formulations, to enhance nutrient uptake and promote plant growth.

Brown macroalgae, particularly *Sargassum* spp., are rich in organic compounds, hormones, and amino acids that improve soil fertility and structure while protecting plants from environmental stresses such as salinity, drought, and low temperatures. Studies have demonstrated that *Sargassum* extracts can enhance seed germination and plant development. For example, Fitriyah et al. (2022) found that different *Sargassum* extracts produced varying phytohormone contents, with *Sargassum polycystum* extract containing the highest levels of gibberellins and kinetin, leading to improved early growth in maize seedlings. Similarly, a study on tomato seedlings under salt stress reported that foliar application of hydroalcoholic extracts of *Sargassum* spp. increased stem diameter and biomass accumulation, indicating enhanced growth and stress tolerance (Sariñana-Aldaco et al., 2022).

Given the potential of *Sargassum* spp. as a biofertilizer, this study aims to evaluate the effectiveness of *Sargassum* spp.-based concoctions at different concentrations as alternatives to inorganic fertilizers on the growth and yield of waxy-sweet white corn ('Sweet Pearl F1'). By exploring sustainable fertilization strategies, this research seeks to contribute to environmentally friendly agricultural practices that maintain or enhance crop productivity.

1. **MATERIALS AND METHODS**
	1. **Location and Duration of the Sudy**

This study was conducted at Purok 4-B1, Barangay Poblacion, Tagbina, Surigao del Sur (8. 452076o N, 126. 168447o E)from June to October 2024.

**2.2 Experimental Design and Treatments**

The study was laid out using a Randomized Complete Block Design (RCBD) with five treatments and replicated three times. The treatments used in the study were as follows:

T1 – Untreated

 T2 – 250 Liters of Concoction / Hectare (L/ha)

 T3 – 500 Liters of Concoction / Hectare (L/ha)

 T4 – 750 Liters of Concoction / Hectare (L/ha)

 T5 – RRIF (Recommended Rate of Inorganic Fertilizer)

**2.3 Field Preparation and Plot Establishment**

The total field area used was 306 square meters. The area was cleaned from plant debris using hand tools. The area consisted of 5 plots and replicated 3 times with a plot size of 3.25 m × 3.25 m representing each treatment, spaced at 1 meter apart per plot. The entire plot with three blocks was separated with one another, measuring 1 meter. The area was plowed and harrowed using tractor, to loosen the soil and remove the weeds before planting.

**2.4 Acquisition of ‘Sweet Pearl F1’ Sweet Corn Seeds**

 One kilogram of hybrid sweet corn (‘Sweet Pearl F1’) seeds was purchased at PMC Agrivet Supply in San Francisco, Agusan del Sur. This sweet corn variety is highly adaptable in any types of environmental conditions.

**2.5 Treatment Preparation and Analysis**

 The brown macroalgae were collected at the shores of Brgy. Dapdap, Barobo, Surigao del Sur (8.53o N, 126. 13o E). The collected brown macroalgae were washed thoroughly with tap water to desalinate, and air-dried for 1 hour to drain the excess water. Molasses was prepared and put into a 60-liter drum container. The collected brown macroalgae were chopped finely and mixed thoroughly into previously prepared molasses with a ratio of 1:1 covered using manila paper and plastic twine and fermented for one week. After fermentation, the concoction was harvested by extracting the juice using a clean cloth. The extracted juice and the seaweed sludge were stored separately and put aside for further use as seaweed-based biofertilizers. One liter of the prepared seaweed concoction was kept in a plastic container and submitted to Regional Soils Laboratory in Brgy. Taguibo, Butuan City, Agusan del Norte (8.4862846 o N,126.1502464 o E) for nutrient analysis such as total N, P, and K content, % organic carbon, % organic matter, and pH.

Table 1. Chemical Properties of *Sargassum* spp.-based concoction (SBC)

|  |  |  |
| --- | --- | --- |
| PROPERTY | VALUES | METHODOLOGY |
| Total Nitrogen (N), % | 0.25 | Kjeldah Method |
| Total Phosphorus (P2O5), % | 0.052 | Vanadomolybdate Method |
| Total Potassium (K2O), % | 1.02 | Aqua-Regia Digestion |
| Organic Matter, % | 9.08 | Walkley-Black Method |
| Organic Carbon, % | 5.28 | Walkley-Black Method |
| pH | 3.85 | Direct Measurement, pH Meter |

Source: Regional Soils Laboratory, Butuan City, Agusan del Norte

**2.6 Soil Sampling and Analysis**

 The collection of soil samples was done on June 8, 2024 using the “Z” pattern. Before digging pits at each of the nine sampling sites, the soil surface was cleaned of liters and vegetation. The nine composited samples of 300 grams of soil per site was collected using a shovel and bolo. A total of 2,700 grams of a soil sample from the area was mixed. Half of the sample was air-dried, pulverized, sieved, and weighed to obtain (1) kilogram of sample, which was submitted to the Regional Soils Laboratory in Brgy. Taguibo, Butuan City, Agusan del Norte (8.4862846 o N,126.1502464 o E), for analysis of chemical properties, namely soil pH, organic matter, extractable phosphorous, and exchangeable potassium.

**2.7 Treatments Application**

Before application, calibration was done to get the volume of water to be mixed with the different treatment recommendations. Treatments used amounted to 264, 528, and 792 mL of Sargassum spp.-based concoction per 10 liters of water for Treatment 2, 3, and 4, respectively. Treatment application was done through drenching method as basal fertilizer one month before planting. Next application was done 7 days after planting with 15-days intervals until maturity. Moreover, the application of the inorganic fertilizer was based on the recommendation from the results of the soil analysis. Specifically, the RRIF was 7-7-45 NPK and 1.98 grams of muriate of potash (0-0-60) and 1.32 grams of complete fertilizer (14-14-14) was applied per plant hill.

**2.8 Sowing of Waxy-Sweet White Corn**

A total of 40 waxy-sweet white corn plants was used as population density per plot. Before sowing, the area was slightly cultivated to allow better plant growth. Three to four seeds were then sowed with a measurement of 25 cm per plant hill and 75 cm per plant row.

**2.9 Water Management**

Watering the plants was done when the need arises and was performed early in the morning or late in the afternoon. This was carried out using a 16-liter knapsack sprayer.

**2.10 Thinning**

Thinning was done by choosing the healthiest corn seedling out of 3-4 seedlings and removed the remaining plants by gently cutting the stems using scissors to provide adequate space for plant development.

**2.11 Fence Establishment**

The area was constructed with fence after planting using bamboo stems, posts and nails to protect the area. The materials were purchased at Barangay Soriano, Tagbina, Surigao del Sur.

**2.12 Pest and Disease Management**

The area was managed by manually uprooting the weeds as they emerge, while those on the ground was removed using bolo. Smudging was done every afternoon in every corner of the area to protect the plants from pests and diseases through gathering the weeds and burning using matches.

**2.13 Harvesting**

The waxy-sweet white corn was harvested 63 days after sowing. This was done by manually harvesting using pruning shears and the harvested sweet corn ears was kept in separate cellophanes prior for data collection.

**2.14 Data Gathered**

1. **Plant height (cm).** Fifteen corn plants were randomly selected as the sample plants per treatment. Plant height was measured at the highest growth point of the plant using a tape measure. This was taken 20 days after sowing with 20-day intervals until harvest. Average plant height was taken per treatment.
2. **Number of leaves.** The number of leaves was collected by manually counting the leaves from the bottom to top of the 15 sample plants per treatment. This was done 20 days after sowing at 20-day intervals until harvest. The average number of leaves was taken from each treatment.
3. **Number of days to tasseling and silking.** The number of days to tasseling and silking was recorded by counting the days starting from sowing until 50% of the 15 sample plants produced tassel and silk. Average number of days was taken per treatment.
4. **Stem diameter (mm).** The stem diameter was recorded by uprooting the 15 sample plants and measuring the diameter of the second internode using a digital caliper. Average stem diameter was taken each treatment.
5. **Ear length with and without husk (mm).** Fifteen corn ears were selected from the sample plants for data collection. The ear length was measured starting from the bottom to tip part of each husked and unhusked corn ears using a tape measure. Average ear length was taken per treatment.
6. **Ear diameter with and without husk (mm).** The ear diameter was recorded by measuring the width of each husked and unhusked corn ears using a digital caliper. Average ear diameter was taken per treatment.
7. **Ear size with and without husk (mm).** The ear size was measured by wrapping the tape measure around the body of each husked and unhusked corn ears to measure to size. Average ear size was taken from each treatment.
8. **Ear weight with and without husk (g).** The ear weight was collected by putting each husked and unhusked corn ears into a digital weighing scale to measure the heaviness. Average ear weight was taken per treatment.
9. **Number of kernels per ear.** The number of kernels was recorded by sticking a toothpick into the kernels and manually counting from the top up to bottom of the 15 corn ears. Average number or kernels was taken per treatment.
10. **Sugar content (brix°).** The sugar content was done by collecting three pieces of kernels from the top, middle and bottom part of each corn ears. The collected kernels were then crushed using a spoon and a plate to squeeze the juice. The juice was extracted using a 3-ml syringe and 1 droplet was put into the digital refractometer to determine the sugar content. The average sugar content was taken from each treatment.
11. **Yield per plot (Kg/plot).** The yield per plot was recorded by weighing all the harvested corn ears from each plot using a digital weighing scale. Average yield per plot was taken per treatment.
12. **Adjusted yield (ton/ha).** This was accomplished by calculating the adjusted yield of the harvested sweet corn ears per plot using the given formula. Average adjusted yield was taken per treatment.



**2.15 Cost and Return Analysis**

 **Return of Production Cost.** Return of production cost was computed using the formula:



*where*; Net income = gross income (Php) – total expenses (Php); and gross income = weight per treatment (kg) – Price (Php/kg).

**2.16 Statistical Tool and Analysis**

All data gathered was recorded and tabulated using Microsoft Excel, and analyzed through the Statistical Tool for Agricultural Research (STAR) using the Analysis of Variance (ANOVA) in Randomized Complete Block Design (RCBD). The Tukey’s Honest Significant Difference (HSD) Test at a 5% level of significance was used to further analyzed the significant differences among treatments.

1. **RESULTS AND DISCUSSION**

**3.1 Plant height (cm)**

The effects of *Sargassum* spp.-based concoction on the growth response of waxy-sweet white corn in terms of plant height at 20, 40, and 60 days after planting (DAS) are presented in Table 2. At 20 DAS, results showed a non-significant difference among all treatments. The highest plant height was observed by T3 (500 L/ha SBC), with a mean of 45.02 cm. It was then followed by T5 (RRIF), T4 (750 L/ha SBC) and T2 (250 L/ha SBC) with a means of 42.91 cm, 42.57 cm, and 35.26 cm, respectively. Meanwhile, T1 (Untreated) was observed with the lowest plant height of 31.14 cm.

Table 2. Plant height of waxy-sweet white corn at 20, 40 and 60 days after sowing (DAS) as applied with different concentrations of *Sargassum* spp.-based concoction

|  |  |
| --- | --- |
| TREATMENTS | PLANT HEIGHT (cm) ***1*** |
| CODE | DESCRIPTION | 20 DAS | 40 DAS | 60 DAS |
| T₁ | Untreated | 31.14 | 54.29c | 92.63c |
| T₂  | 250 L/ha SBC | 35.26 | 73.09bc | 135.46b |
| T₃ | 500 L/ha SBC | 45.02 | 96.45ab | 155.09ab |
| T₄ | 750 L/ha SBC | 42.57 | 101.99a | 169.34a |
| T₅ | RRIF | 42.91 | 108.17a | 174.23a |
| F-test | Replication | ns | ns | ns |
| Treatments | ns | **\*\*** | **\*\*** |
| CV (%) |  | 12.77 | 11.13 | 8.11 |

1\_/15 plants. Means with the same letter in a column are not significantly different at 5% level based on Tukey’s Honest Significant Difference (HSD) Test. SBC (*Sargassum* spp.-based concoction); RRIF (Recommended Rate of Inorganic Fertilizer); ns not significant; **\*\*** highly significant

Moreover, at 40 DAS, statistical analysis showed a highly significant difference among all treatments. The highest plant height was observed in T5 (RRIF), with a mean of 108.17 cm, while the lowest was recorded in T1 (Untreated) with a mean of 54.29 cm. Moreover, at 60 DAS, the highest plant height was observed in T5 (RRIF), with a mean of 174.23 cm, followed by T4 (750 L/ha SBC), T3 (500 L/ha SBC), and T2 (250 L/ha SBC), with a means of 169.34 cm, 155.09 cm, and 135.46 cm, respectively. However, T1 (Untreated) was observed as having the lowest plant height, with a mean of 92.63 cm among all treatments.

The study’s findings revealed that applying different concentrations of *Sargassum* spp.-based concoction has a significant impact on the growth response of waxy-sweet white corn plants. At 20 DAS, there was no observable differences in plant height among the treatments. However, at 40 and 60 DAS, there was a highly significant variation in plant height among all treatments. Untreated (T1) showed the lowest plant height at all stages of growth, while the RRIF (T5) had the highest plant height at 40 and 60 DAS.

Several studies have shown that the implementation of NPK fertilizers in the soil are essential for plants, allowing for increased production of chlorophyll to capture more light energy, which improved photosynthesis and developed the plant height of sweet corn plants (Sofyan et al., 2019; Abdullah & Al-Obaidy, 2023). Results from the study of Canatoy (2018) also concluded that sweet corn plants treated with the RRIF absorbed nitrogen considerably more than those plants that received no fertilizer, resulting to higher nitrogen absorption and nutrient metabolization by plants. Yakaka & Alkali (2021) also stated that inorganic fertilizer led to the growth of taller sweet corn plants when compared to the absence of fertilizer application.

However, the application of SBC yielded similar results in the growth response of waxy-sweet white corn comparable to RRIF. Based on the results of the chemical test report of the *Sargassum* extract, the homemade concoction was revealed to contain high potassium levels (Table 1), which can affect various growth parameters in sweet corn, such as plant height (Atmaja et al., 2022; Nurliawati & Faqih, 2024). Similarly, Jumadi et al. (2023) concluded that *Sargassum* spp.-based concoction can increase germination of sweet corn seeds and contains cytokinins, gibberellins, and auxin that is responsible for tissue elongation, apical dominance, and cell division. A study by Basmal (2010) also stated that *Sargassum* spp.-based biofertilizer can be mixed with fish waste to create growth hormones as well as liquid organic fertilizers full of macro and micronutrients to initiate cell growth and plant elongation. These findings suggest that SBC contains various essential nutrients necessary for sweet corn growth, especially plant height.

**3.2 Number of leaves**

The number of waxy-sweet white corn leaves applied with different concentrations of *Sargassum* spp.-based concoction is presented in Table 3. At 20 DAS, results revealed a highly significant difference among all treatments. The highest number of leaves was observed in both T3 (500 L/ha SBC) and T4 (750 L/ha SBC) with a mean of 7.53, followed by T5 (RRIF) with a mean of 7.07 and T2 (250 L/ha SBC) with a mean of 6.13. The lowest number of leaves was recorded in T1 (Untreated) with a mean of 5.73.

However, at 40 DAS, statistical analysis showed no significant difference between the treatments. T4 (500 L/ha SBC) was recorded as the highest number of leaves with a mean of 12.27 while the lowest number of leaves was observed in T1 (Untreated) with a mean of 10.40. Moreover, at 60 DAS, results revealed a highly significant difference among the treatments. The highest number of leaves was observed in T4 (750 L/ha SBC) with a mean of 16.27. It was followed by T5 (RRIF), T3 (500 L/ha SBC), and T2 (250 L/ha SBC) with a mean of 16.00, 15.00, and 14.33, respectively. The lowest number of leaves was recorded in T1 (Untreated) with a mean of 13.67.

Table 3. Number of leaves of waxy-sweet white corn at 20, 40 and 60 days after sowing (DAS) as applied with different concentrations of *Sargassum* spp.-based concoction

|  |  |
| --- | --- |
| TREATMENTS | NUMBER OF LEAVES***1*** |
| CODE | DESCRIPTION | 20 DAS | 40 DAS | 60 DAS |
| T₁ | Untreated | 5.73b | 10.40 | 13.67c |
| T₂  | 250 L/ha SBC | 6.13b | 10.93 | 14.33bc |
| T₃ | 500 L/ha SBC | 7.53a | 11.27 | 15.00abc |
| T₄ | 750 L/ha SBC | 7.53a | 12.27 | 16.27a |
| T₅ | RRIF | 7.07ab | 11.80 | 16.00ab |
| F-test | Replication | ns | ns | ns |
| Treatments | **\*\*** | ns | **\*\*** |
| CV (%) |  | 7.21 | 7.79 | 4.25 |

1\_/15 plants. Means with the same letter in a column are not significantly different at 5% level based on Tukey’s Honest Significant Difference (HSD) Test. SBC (*Sargassum* spp.-based concoction); RRIF (Recommended Rate of Inorganic Fertilizer); ns not significant; **\*\*** highly significant

The findings revealed that the application of different concentrations of SBC significantly affected the number of leaves at 20 and 60 DAS, but not at 40 DAS. These results correspond with earlier studies that showed the positive benefits of SBC on plant growth and development. For instance, Ansyarif et al. (2020) reported that a 10-ppm concentration of *Sargassum* spp.-based biofertilizer resulted in the highest number of shoots and leaves of orchid plants. In addition, Lin et al. (2020) stated that *Sargassum* spp. derived lactic acid indicates higher photosynthetic efficiency than that of terrestrial biomass, leading to high carbon fixation and leaf productivity. Chbani et al. (2015) also stated that *Sargassum* spp.-based biofertilizerreduces the risk of biotic and abiotic stress and encourages growth of plant leaves. These studies suggest that *Sargassum* spp.-based biofertilizer, such as SBC,can be effective bio-stimulants for sweet corn and various crops, potentially improving plant growth and productivity.

**3.3 Number of days to tasseling and silking**

The number of days to tasseling and silking of waxy-sweet white corn are presented in Table 4. Statistical analysis showed a highly significant difference among all treatments. The earliest days from planting to tasseling was observed in T5 (RRIF) with a mean of 37.00 days. It was then followed by T3 (500 L/ha SBC) with a mean of 37.60 days, T4 (750 L/ha SBC) with a mean of 37.80 days and T2 (250 L/ha SBC) with a mean of 39.33 days. Meanwhile, the most extended number of days from planting to tasseling was recorded in T1 (Untreated) with a mean of 42.80 days.

On the other hand, results showed a highly significant difference across all treatments in terms of number of days to silking. T5 (RRIF) was observed as the most accelerated number of days from planting to silking with a mean of 42.40 days. It was then followed by T4 (750 L/ha SBC), T3 (500 L/ha SBC) and T2 (250 L/ha SBC) with a mean of 42.60, 44.40, and 48.53 days, respectively. On the other hand, the most extended number of days from planting to silking was recorded in T1 (Untreated) with a mean of 51.67 days.

Table 4. Number of days to tasseling and silking of waxy-sweet white corn applied with different concentrations of *Sargassum* spp.-based concoction

|  |  |  |
| --- | --- | --- |
| TREATMENTS | NUMBER OF DAYS TO TASSELING***1*** | NUMBER OF DAYS TO SILKING***1*** |
| CODE | DESCRIPTION |
| T₁ | Untreated | 42.80ab | 51.67ab |
| T₂  | 250 L/ha SBC | 39.33ab | 48.53ab |
| T₃ | 500 L/ha SBC | 37.60a | 44.40a |
| T₄ | 750 L/ha SBC | 37.80a | 42.60a |
| T₅ | RRIF | 37.00a | 42.40a |
| F-test | Replication | ns | ns  |
| Treatments | **\*\*** | **\*\*** |
| CV (%) |  | 3.19 | 3.10 |

1\_/15 plants. Means with the same letter in a column are not significantly different at 5% level based on Tukey’s Honest Significant Difference (HSD) Test. SBC (*Sargassum* spp.-based concoction); RRIF (Recommended Rate of Inorganic Fertilizer); ns not significant; **\*\*** highly significant

The findings demonstrated that both the application of RRIF and the application of SBC caused a significant impact on the growth of waxy-sweet white corn than untreated. This is in line with the studies of Jobouri & Anwer (2010) stating that increasing the nitrogen fertilizer levels can significantly affect the growth characteristics of corn plants, reducing the number of days to 75% tasseling while increasing all other growth characteristics. Meanwhile, Maurya et al. (2023) concluded that using 100% inorganic nitrogen sources improves the performance of sweet corn plants, resulting to shortest time to 50% tasseling. Application of inorganic fertilizers at higher rates can result to faster tasseling and silking of sweet corn plants (Faisal et al., 2025).

Although inorganic fertilizer produced desirable results, the application of SBC resulted to comparable outcomes in terms of growth response of waxy-sweet white corn. Research from Ali et al. (2021) reported that *Sargassum* spp. extract can promote positive growth and development to major crops such as increased flowering in tomato plants, enhanced growth parameters of soybean and other growth development. *Sargassum* extract at 1% concentration enhanced flowering ability of the plant *Tagetes erecta* (Sridhar & Rengasamy, 2010). Jaikumar et al. (2024) also stated that *Sargassum* extract act as a bio-stimulant promoter for crop health and flowering capacity. These studies suggest that SBC have potential as bio-stimulants for improving plant growth and development.

**3.4 Stem diameter (mm)**

The stem diameter of waxy-sweet white corn plants is presented in Table 5. Statistical analysis revealed a highly significant difference among all treatments. The highest stem diameter was observed in T5 (RRIF), with a mean of 10.51 mm. It was then followed by T4 (750 L/ha SBC), with a mean of 10.00 mm, T3 (500 L/ha SBC) with a mean of 8.53 mm and T2 (250 L/ha SBC) with a means of 6.94 m. Meanwhile, T1 (Untreated) was observed as the lowest stem diameter with a mean of 4.40 mm among all treatments.

The findings demonstrated that either of the application of the RRIF and the different concentrations of SBC resulted to significant difference in the growth of waxy-sweet white corn plants in contrast to untreated. This result aligns to several studies conducted by Diananda et al. (2020), Raksun et al. (2021), Fauziah et al. (2022) and Mutmainnah et al. (2024) where inorganic fertilizers can positively affect the growth of sweet corn plants, including the stem diameter. In addition, Yukui et al. (2012) also concluded that recommended levels of nitrogen fertilizer result in greater increases in stem perimeter and plant height of sweet corn compared to excessive fertilizer application.

Table 5. Stem diameter of waxy-sweet white corn as applied with different concentrations of *Sargassum* spp.-based concoction

|  |  |
| --- | --- |
| TREATMENTS | STEM DIAMETER (mm) ***1*** |
| CODE | DESCRIPTION |
| T₁ | Untreated | 4.40c |
| T₂  | 250 L/ha SBC | 6.94b |
| T₃ | 500 L/ha SBC | 8.53ab |
| T₄ | 750 L/ha SBC | 10.00a |
| T₅ | RRIF | 10.51a |
| F-test | Replication | ns |
| Treatments | **\*\*** |
| CV (%) |  | 10.75 |

1\_/15 plants. Means with the same letter in a column are not significantly different at 5% level based on Tukey’s Honest Significant Difference (HSD) Test. SBC (*Sargassum* spp.-based concoction); RRIF (Recommended Rate of Inorganic Fertilizer); ns not significant; **\*\*** highly significant

On the other hand, the application of SBC showed significant growth to waxy-sweet white corn plants similar to that of the RRIF. For example, a study conducted by Nurjannah et al. (2021) concluded that the application of *Sargassum* spp.-based concoction improves the quantity of stem growth in sweet corn compared to chemical fertilizer control. Kumari et al. (2024) also stated that there is a highly significant difference in the growth perimeters, including stem diameter of sweet corn plants when applied with *Sargassum* spp.-based biofertilizer at 10%concentration. Similarly, Sariñana-Aldaco et al. (2022) concluded that applying *Sargassum* spp. extract increased the stem diameter of tomato seedlings, especially under saline conditions. Aside from that, the usage of *Sargassum* spp. extract as bio-stimulants can enhance eggplant growth including stem diameter (Aydi-Ben-Abdallah et al., 2021). These findings suggest that the application of SBC can be an effective fertilizer in increasing stem of sweet corn and other crop cultivation.

**3.5 Ear length with and without husk (mm)**

Table 6 shows the yield response of waxy-sweet white corn in terms of ear length with and without husk as affected by the application of different concentrations of SBC. Results revealed a highly significant difference among all treatments. In the ear length with husk, T4 (750 L/ha SBC) was recorded as the longest ear length with a mean of 248.80 mm, while the shortest ear length with husk was observed in T1 (Untreated) with a mean of 183.80 mm. On the other hand, in the ear length without husk, T5 (RRIF) was observed as the longest length with a mean of 147.52 mm, followed by T4 (750 L/ha SBC) with a mean of 140.59 mm, T3 (500 L/ha SBC) with a mean of 135.61 mm, and T2 (250 L/ha SBC) with a mean of 119.75 mm. The shortest ear length without husk was recorded in T1 (Untreated) with a mean of 84.34 mm.

Table 6. Ear length of waxy-sweet white corn with husk and without husk as applied with different concentrations of *Sargassum* spp.-based concoction

|  |  |
| --- | --- |
| TREATMENTS | EAR LENGTH (mm) ***1*** |
| CODE | DESCRIPTION | UNHUSKED | HUSKED |
| T₁ | Untreated | 183.80b | 84.34b |
| T₂  | 250 L/ha SBC | 218.47ab | 119.75ab |
| T₃ | 500 L/ha SBC | 238.13a | 135.61a |
| T₄ | 750 L/ha SBC | 248.80a | 140.59a |
| T₅ | RRIF | 238.20a | 147.52a |
| F-test | Replication | ns | ns |
| Treatments | **\*\*** | **\*\*** |
| CV (%) |  | 7.44 | 10.06 |

1\_/15 ears. Means with the same letter in a column are not significantly different at 5% level based on Tukey’s Honest Significant Difference (HSD) Test. SBC (*Sargassum* spp.-based concoction); RRIF (Recommended Rate of Inorganic Fertilizer); ns not significant; **\*\***highly significant



Figure 7. Ears of sample plants with husk



Figure 8. Ears of sample plants without husk

The study’s findings indicated that the usage of RRIF and SBC as organic fertilizer showed a significant benefit in the yield of waxy-sweet white corn plants compared to plants with untreated. This aligns to the studies of Sugiono et al. (2023) which stated that the application of inorganic fertilizer significantly increases the yield of sweet corn on clay soil, particularly cob length. Speede et al. (2024) also conducted a study revealing a 23% increase in fruit length of tomatoes and cucumbers when compared to commercial standard goods. Similarly, a study by Rumhungwe et al. (2016) concluded that applying inorganic fertilizer as a basal and top dressing increases the fruit yield and quality of Irish potatoes grown in bags.

Meanwhile, several studies also supported the application of SBC that resulted to an essential yield development on the waxy-sweet white corn plants in comparison to the RRIF. For instance, the use of *Sargassum* concoction greatly enhances growth attributes like cob length, and total yield in sweet corn (Fatriana et al., 2020; Kumari, 2024). Similarly, Indika et al. (2021) concluded that *Sargassum* spp. applied as a foliar fertilizer increased the pod length of the *Vigna* *radiata* plant. Yao et al. (2020) also reported that *Sargassum* spp. As seaweed-based extract can improve the photosynthetic ability of tomato leaves, resulting to an increase in tomato fruit length and quality. These studies suggest that *Sargassum* spp.-based biofertilizer, such as SBC, can be effective metabolic enhancers for various crops, potentially improving plant growth and productivity.

**3.6 Ear diameter with and without husk (mm)**

Table 7 indicates the ear diameter of waxy-sweet white corn with and without husk as affected by the applying different concentrations of *Sargassum* spp.-based concoction. Results proved a highly significant difference between all treatments. In the ear diameter with husk, the highest number of ear diameter is noted in T5 (RRIF) with a mean of 48.58 mm, followed by T4 (750 L/ha SBC), T3 (500 L/ha SBC), and T2 (250 L/ha SBC) with a mean of 46.90, 45.71, and 40.43 mm, respectively. T1 (Untreated) was observed as the lowest ear diameter with husk with a mean of 29.86 mm. Meanwhile, in the ear diameter without husk, T5 (RRIF) was recorded as the highest ear diameter with a mean of 41.61 mm, while the lowest ear diameter without husk was observed in T1 (Untreated) with a mean of 25.69 mm.

Table 7. Ear diameter of waxy-sweet white corn with husk and without husk as applied with different concentrations of *Sargassum* spp.-based concoction

|  |  |
| --- | --- |
| TREATMENTS | EAR DIAMETER (mm) ***1*** |
| CODE | DESCRIPTION | UNHUSKED | HUSKED |
| T₁ | Untreated | 29.86b | 25.69b |
| T₂  | 250 L/ha SBC | 40.43a | 35.64a |
| T₃ | 500 L/ha SBC | 45.71a | 39.15a |
| T₄ | 750 L/ha SBC | 46.90a | 40.76a |
| T₅ | RRIF | 48.58a | 41.61a |
| F-test | Replication | ns | ns |
| Treatments | **\*\*** | **\*\*** |
| CV (%) |  | 8.41 | 9.56 |

1\_/15 ears. Means with the same letter in a column are not significantly different at 5% level based on Tukey’s Honest Significant Difference (HSD) Test. SBC (*Sargassum* spp.-based concoction); RRIF (Recommended Rate of Inorganic Fertilizer); ns not significant; **\*\*** highly significant



Figure 9. Ears of selected sample plants with husk



Figure 10. Ears of selected sample plants without husk

The results of the study indicated that the application of RRIF and different concentrations of *Sargassum* spp.-based concoction showed a significant effect in the yield of waxy-sweet white corn in terms of ear diameter compared to untreated. This corresponds to a study of Canatoy (2018) which stated that the full RRIF significantly affected the soil pH and gave significantly higher ear diameter in sweet corn. Similarly, research of Purnomo & Subiksa (2021) and Türk & Alagöz (2018) concluded that the application of inorganic fertilizer had a substantial impact on plant growth, fresh ear yield, biomass, ear length, and ear diameter of sweet corn plants grown in peatland. In addition, increasing inorganic fertilizer dosages to 100% may increase ear diameter, and speed up the growth of pistillate and staminate of sweet corn plants (Rahayu et al., 2018).

However, the significant yield of waxy-sweet white corn plants can be attributed to the elements found in the *Sargassum* spp.-based concoction similar to that of the RRIF. For instance, Fatriana (2020) reported that the application of *Sargassum* spp. extract significantly improved the cob diameter of corn plants. Sariñana-Aldaco et al. (2022) also concluded the use of SBC is a good alternative as a biofertilizer that helps improve the quality yield of tomato plants, including fruit diameter. In addition, several studies stated that the usage of *Sargassum* spp. as bio-stimulants increased cucumber fruit diameter and quality (Shabani et al., 2023) and stimulate higher fruit diameter of cucumber plants (Prasedya et al., 2019). These studies demonstrate that SBC concoction can enhance various crop yield parameters.

**3.7 Ear size with and without husk (mm)**

The ear size of waxy-sweet white corn with and without husk is presented in Table 8. Results proved that there is a highly significant difference between all treatments. In the ear size with husk, the largest size was observed in T5 (RRIF) with a mean of 163.53 mm, followed by T4 (750 L/ha SBC), T3 (500 L/ha SBC), and T2 (250 L/ha SBC) with a mean of 161.67, 153.53, and 136.53 mm, respectively. The smallest ear size with husk was observed in T1 (Untreated) with a mean of 102.53 mm. On the other hand, in the ear size without husk, T5 (RRIF) was listed as the largest ear size with a mean of 145.33 mm. It was then followed by T4 (750 L/ha SBC), T3 (500 L/ha SBC), and T2 (250 L/ha SBC) with a mean of 141.60, 135.67, and 125.47 mm, respectively. The smallest ear size without husk was observed in T1 (Untreated) with a mean of 89.13 mm.

Table 8. Ear size of waxy-sweet white corn with husk and without husk as applied with different concentrations of *Sargassum* spp.-based concoction

|  |  |
| --- | --- |
| TREATMENTS | EAR SIZE (mm) ***1*** |
| CODE | DESCRIPTION | UNHUSKED | HUSKED |
| T₁ | Untreated | 102.53b | 89.13b |
| T₂  | 250 L/ha SBC | 136.13a | 125.47ab |
| T₃ | 500 L/ha SBC | 153.53a | 135.67a |
| T₄ | 750 L/ha SBC | 161.67a | 141.60a |
| T₅ | RRIF | 163.53a | 145.33a |
| F-test | Replication | ns | ns |
| Treatments | **\*\*** | **\*\*** |
| CV (%) |  | 8.16 | 10.70 |

1\_/15 ears. Means with the same letter in a column are not significantly different at 5% level based on Tukey’s Honest Significant Difference (HSD) Test. SBC (*Sargassum* spp.-based concoction); RRIF (Recommended Rate of Inorganic Fertilizer); ns not significant; **\*\*** highly significant

The findings resulting to the significant impact on the yield of waxy-sweet white corn can be due to the nutrients found in the RRIF and the different concentration of SBC than that of untreated. This aligns with the research of Rahayu et al. (2018) stating that inorganic fertilizer tends to increase soil pH and cation exchange capacity of growth medium, increasing sweet corn ear size and quality. Omidire et al. (2015) also concluded that inorganic fertilizer showed higher fruit sizes of squash, cucumber, and okra plants. In addition, Gill et al. (2015) reported the usage of inorganic fertilizer was shown to be the most effective treatment, producing the largest fruit size and weight of plants. Similarly, the findings from the study of Hassan (2015) indicate that the majority of strawberry plant yield characteristics, including fruit size were significantly impacted by applying 100% of the recommended dose of N, P, and K.

On the other hand, applying different concentrations of SBC contributed to significant yield benefits of waxy-sweet white corn plants similar to that of the RRIF. For instance, a study of Villaver (2022) concluded that sweet corn treated with *Sargassum* spp.-based concoction produced higher corn cob sizes than those treated with conventional organic fertilizers. Moreover, *Sargassum* spp.-based biofertilizer increases the amount of nutrients in the soil, especially phosphorus and nitrogen, which are essential for fruit development and plant growth, resulting to greater fruit sizes due to nutrient boost (Adderley et al., 2023). Additionally, Sridhar (2020) reported the usage of *Sargassum* spp. extract resulting to highly significant impact on the yield parameters of peanuts, including sizes of pods. Results from the study of Baliah et al. (2017) revealed that fruit size and length were among the yield characteristics of okra plants that improved dramatically with increasing the concentration of seaweed liquid fertilizer. These findings suggest that *Sargassum* spp.-based biofertilizer, such as SBC, can potentially enhance crop growth and yield when applied to crops at appropriate concentrations.

**3.8 Ear weight with and without husk (g)**

The ear weight of waxy-sweet white corn with and without husk is presented in Table 9. Statistical analysis showed a highly significant difference between all treatments. In the ear weight with husk, T5 (RRIF) was recorded as the heaviest ear weight with a mean of 171.73 grams, followed by T4 (750 L/ha SBC), T3 (500 L/ha SBC), and T2 (250 L/ha SBC) with a mean of 154.53, 137.73, and 95.47 grams, respectively. T1 (Untreated) remained as the lowest ear weight with husk with a mean of 44.13 grams. Meanwhile, in the ear weight without husk, T5 (RRIF) was observed as the heaviest ear weight with a mean of 119.07 grams, while the lowest ear weight was recorded in T1 (Untreated) with a mean of 24.13 grams.

Table 9. Ear weight of waxy-sweet white corn with husk and without husk as applied with different concentrations of *Sargassum* spp.-based concoction

|  |  |
| --- | --- |
| TREATMENTS | EAR WEIGHT (g) ***1*** |
| CODE | DESCRIPTION | UNHUSKED | HUSKED |
| T₁ | Untreated | 44.13c | 24.13c |
| T₂  | 250 L/ha SBC | 95.47b | 68.93b |
| T₃ | 500 L/ha SBC | 137.73ab | 101.20ab |
| T₄ | 750 L/ha SBC | 154.53a | 111.20ab |
| T₅ | RRIF | 171.73a | 119.07a |
| F-test | Replication | ns | ns |
| Treatments | **\*\*** | **\*\*** |
| CV (%) |  | 14.38 | 17.77 |

1\_/15 ears. Means with the same letter in a column are not significantly different at 5% level based on Tukey’s Honest Significant Difference (HSD) Test. SBC (*Sargassum* spp.-based concoction); RRIF (Recommended Rate of Inorganic Fertilizer); ns not significant; **\*\*** highly significant

The result’s findings stated that the application of the RRIF and different concentrations of SBC produced highly significant benefit on the yield of waxy-sweet white corn, particularly the ear weight, compared to that of control. El-Gizawy (2019) concluded that sweet corn treated with inorganic fertilizer significantly exhibit larger yield components, including ear weight. Similarly, research of El-Gawad and Morsy (2017) reported that sweet corn receiving inorganic fertilizers consistently showed higher ear weights than untreated controls. Moreover, studies reported a significant increase in the fruit weight of tomato by 19%, while cucumber fruit weight saw an increase of 24% when treated with inorganic fertilizers due to improved nutrient availability and uptake, particularly nitrogen, which is crucial for fruit development.

 Meanwhile, different concentrations of SBC produced significant effects to the yield of waxy-sweet white corn comparable to that of RRIF. This aligns with the research of Possinger (2013) revealing that *Sargassum* spp. as soil amendments is recommended as a partial replacement for nitrogen fertilizer that can improve soil quality and sweet corn ear weight. Another study of Fatimah & Daud (2018) revealed that *Sargassum* spp.-based extract as fertilizer positively influence the growth of tomato and chili peppers, leading to increased fruit weight compared to control groups. In addition, Junaidi & Wulandari (2017) indicated that using *Sargassum* spp.-based biofertilizer could lead to improved fruit weight of melons. These studies suggest that SBC can serve as an effective bio-stimulant for various crops, increasing growth and yield performance.

**3.9 Number of kernels per ear**

The number of kernels of waxy-sweet white corn ears as applied with the different concentrations of SBC is shown in Table 10. Statistical analysis indicated that there is a highly significant difference among all treatments. The highest number of kernels per ear was recorded in T5 (RRIF) with a mean of 290.20, followed by T4 (750 L/ha SBC) with a mean of 278.40, T3 (500 L/ha SBC) with a mean of 247.73, and T2 (250 L/ha SBC) with a mean of 206.60. The lowest number of kernels was listed in T1 (Untreated) with a mean of 73.53, among all treatments.

Table 10. Number of kernels of waxy-sweet white corn ears as applied with different concentrations of *Sargassum* spp.-based concoction

|  |  |
| --- | --- |
| TREATMENTS | NUMBER OF KERNELS***1*** |
| CODE | DESCRIPTION |
| T₁ | Untreated | 73.53b |
| T₂  | 250 L/ha SBC | 206.60a |
| T₃ | 500 L/ha SBC | 247.73a |
| T₄ | 750 L/ha SBC | 278.40a |
| T₅ | RRIF | 290.20a |
| F-test | Replication | ns |
| Treatments | **\*\*** |
| CV (%) |  | 16.76 |

1\_/15 ears. Means with the same letter in a column are not significantly different at 5% level based on Tukey’s Honest Significant Difference (HSD) Test. SBC (*Sargassum* spp.-based concoction); RRIF (Recommended Rate of Inorganic Fertilizer); ns not significant; **\*\*** highly significant

The findings of the study revealed that the application of the RRIF and the different concentrations of SBC resulted to a highly significant impact on the yield of waxy-sweet white corn. This is in line with the findings of Shahin et al. (2022) revealing that the application of inorganic fertilizers resulted in significantly higher number of cobs plant, number of rows cob, and number of kernels row. Similarly, studies of Eshghizadehb (2011) stated that further increase in inorganic fertilizer doubled the number of kernel ear and grain yield of sweet corn. Kurane (2014) also concluded that inorganic fertilizer application significantly resulted to number of cobs per hectare, number of grains and grain yield per cob. In addition, the findings of Almaz et al. (2017) revealed that 100% application of inorganic fertilizer resulted to highest yield parameters, including number of kernels per cob, and 1000-kernel weight.

On the other hand, the application of SBC revealed comparable results similar to that of inorganic fertilizer. This is supported in one of the studies of Villaver (2019) concluding that applying *Sargassum* spp. as organic fertilizer gave the highest number of kernels per ear. Meanwhile, Gopi & Munisamy (2024) presented the effects of *Sargassum* spp.-based bio-stimulants in sweet corn crop, improving the grain yield, grain rows, and number of grains per cob. Yield attributes like pod yield and seed yield were all observed through foliar application of *Sargassum* spp. nano powder in pigeon peas (Sujatha, 2016). These studies suggest that *Sargassum* spp.-based biofertilizer, such as SBC, can positively influence sweet corn and other crops’ growth and yield.

**3.10 Sugar content (brix°)**

Table 11 shows the number of sugar content of waxy-sweet white corn ears as applied with different levels of SBC. Results stated that there is a highly significant difference among the treatments. T3 (500 L/ha SBC) was listed as the highest number of sugar content with a mean of 11.07 brix°. It was then followed by T4 (750 L/ha SBC), followed by T5 (RRIF) and T2 (250 L/ha SBC) with a mean of 10.13, 9.63, and 8.53 brix°, respectively. The lowest sugar content was recorded in T1 (Untreated) with a mean of 7.40 brix°.

Table 11. Sugar content (brix°) of waxy-sweet white corn ears as applied with different concentrations of *Sargassum* spp.-based concoction

|  |  |
| --- | --- |
| TREATMENTS | SUGAR CONTENT (brix°)***1*** |
| CODE | DESCRIPTION |
| T₁ | Untreated | 7.40b |
| T₂  | 250 L/ha SBC | 8.53ab |
| T₃ | 500 L/ha SBC | 11.07a |
| T₄ | 750 L/ha SBC | 10.13a |
| T₅ | RRIF | 9.63ab |
| F-test | Replication | ns |
| Treatments | **\*\*** |
| CV (%) |  | 9.65 |

1\_/15 ears. Means with the same letter in a column are not significantly different at 5% level based on Tukey’s Honest Significant Difference (HSD) Test. SBC (*Sargassum* spp.-based concoction); RRIF (Recommended Rate of Inorganic Fertilizer); ns not significant; **\*\*** highly significant

The study’s findings demonstrated that both of the application of the RRIF and the different concentrations of SBC brought a significant difference in the yield of waxy-sweet white corn plants compared to untreated. This aligns with the research of Baroud et al. (2019) stating that applying *Sargassum* spp.-based concoctionto pepper plants resulted in a significant increase in the overall sugar content of pepper plants. Moreover, the increase in sugar content brought on by SBC caused the right cellular responses and influences certain gene expressions and metabolic functions in broad beans and sunflower plants (Mohammed et al., 2023). Similarly, Chen et al. (2021) reported that applying *Sargassum* spp.-based concoction could increase cane yield and promote sucrose accumulation in sugarcane. Alasvandyari et al. (2024) also concluded that the application of *Sargassum* spp.-based concoction at 1.5% LESb increased the proline and soluble sugar content of sweet corn plants.

Meanwhile, the application of SBC was proportional to the RRIF, resulting to a significant impact in the sugar content of waxy-sweet white corn. This is supported by several studies of Ajibola et al. (2020) and Mohammadi (2024 revealing that the application of inorganic fertilizer significantly increased the yield parameters, including sugar content of agricultural crops such as sweet corn and banana.  Overall, these studies suggest that SBCcan improve sweet corn yield and quality, making it a valuable addition to sustainable agricultural practices.

**3.11 Yield per plot (Kg/plot) and adjusted yield (tons/ha)**

The yield per plot and adjusted yield of waxy-sweet white corn as applied with different concentrations of *Sargassum* spp.-based concoction is presented in Table 12. Statistical analysis demonstrated that there is a highly significant difference between all treatments. T5 (RRIF) was listed as the highest yield per plot having a mean of 6.77 Kg/plot. It was followed by T4 (750 L/ha SBC), T3 (500 L/ha SBC), and T2 (250 L/ha SBC) with a mean of 6.33, 5.62, and 3.13 Kg/plot, respectively. T1 (Untreated) was recorded as the lowest yield per plot with a mean of 1.43 Kg/plot.

Meanwhile, results from adjusted yield stated a highly significant difference between the treatments. The highest adjusted yield was observed in T5 (RRIF) with a mean of 6.42 ton/ha, followed by T4 (750 L/ha SBC), T3 (500 L/ha SBC), and T2 (250 L/ha SBC) with a mean of 5.99, 5.33, and 2.96 ton/ha. The lowest adjusted yield was recorded in T1 (Untreated) with a mean of 1.35 ton/ha among all treatments.

Table 12. Yield per plot and adjusted yield of waxy-sweet white corn as applied with different concentrations of *Sargassum* spp.-based concoction

|  |  |  |
| --- | --- | --- |
| TREATMENTS | YIELD PER PLOT (Kg/plot) | ADJUSTED YIELD(tons/ha) |
| CODE | DESCRIPTION |
| T₁ | Untreated | 1.43c | 1.35c |
| T₂  | 250 L/ha SBC | 3.13bc | 2.96bc |
| T₃ | 500 L/ha SBC | 5.62ab | 5.33ab |
| T₄ | 750 L/ha SBC | 6.33a | 5.99a |
| T₅ | RRIF | 6.77a | 6.42a |
| F-test | Replication | ns | ns |
| Treatments | **\*\*** | **\*\*** |
| CV (%) |  | 19.23 | 19.23 |

Means with the same letter in a column are not significantly different at 5% level based on Tukey’s Honest Significant Difference (HSD) Test. SBC (*Sargassum* spp.-based concoction); RRIF (Recommended Rate of Inorganic Fertilizer); ns not significant; **\*\*** highly significant

The results revealed that both the application of RRIF and the application of SBC produced significant effect on the yield of waxy-sweet white corn compared to untreated. For instance, Akintoye & Olaniyan (2012) presented sweet corn applied inorganic fertilizer showed an increase in yield and its components. Meanwhile, research of Kara & Uygur (2020), and Akpan & Udoh (2017) positively concluded that the highest growth and yield characteristics of sweet corn was found in inorganic fertilizer treatment. These studies suggest the benefits of inorganic fertilizer in increasing the yield of sweet corn plant.

Although inorganic fertilizer yielded beneficial results, the application of SBC resulted to comparable outcomes in the yield response of waxy-sweet white corn. This is supported by the study of Pal et al. (2015) concluding that foliar application of seaweed saps of *Sargassum* spp. resulted to an increase growth and yield of sweet corn. Additionally, Jupri et al. (2019) stating the results that 10% concentration of *Sargassum* spp.-based concoction increased the yield of rice plants. Similarly, the findings of Pei et al. (2024) demonstrated that, in comparison to control treatments, the application *Sargassum* spp.-based extracts resulted in a significantly average increase in crop output of 15.17%. These results indicate that *Sargassum* spp.-based biofertilizer, such as SBC, may be beneficial in raising the yield of sweet corn and other crops.

**3.12 Cost and Return Analysis**

Table 13 presents contradicting outcomes between the untreated plots and those with treatment application, with the treated plots demonstrating greater yields and gross incomes. The control group (T1) yielded a low net income, suggesting that the absence of treatments leads to minimal income generation. This is supported by the study of Nsabimana (2021) concluding that agricultural inputs are essential for increasing productivity and earnings in agriculture. Meanwhile, 250 L/ha SBC (T2) resulted to a fair net income, indicating that *Sargassum* spp.-based concoction can improve yield and return on investment. This aligns with the study of N'Yeurt & Iese (2014) revealing that *Sargassum* spp. as agro-fertilizer can increase farm income and at the same time, can reduce environmental damage.

Table 13. Cost and return analysis of waxy-sweet white corn as applied with different concentrations of *Sargassum* spp.-based concoction

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| TREATMENTS | YIELD (Kg) | GROSS1 INCOME | TOTAL EXPENSES | NET2INCOME | RPC3(%) |
| T1 - Untreated | 1,224.69 | 67,357.95 | 9,915 | 57,442.98 | 579.36 |
| T2 - 250 L/ha SBC | 2,685.28 | 147,690.4 | 10,572 | 137,118.4 | 1,297.01 |
| T3 - 500 L/ha SBC | 4,835.30 | 265,951.5 | 10,589 | 255,362.5 | 2,411.52 |
| T4 - 750 L/ha SBC | 5,434.08 | 298,874.4 | 10,606 | 288,268.4 | 2,718.00 |
| T5 - RRIF | 5,824.13 | 320,327.15 | 10,255 | 310,072.15 | 3,023.67 |

1Gross Income (Php) = Yield (kg) x Price (Php)

2Net Income (Php)= Gross Income (Php) – Total Expenses (Php)

3$RPC=\frac{Net Income}{Cost of Production} ×100$

Moreover, 750 L/ha SBC (T4) led to the highest net income out of all the *Sargassum* treatment concentrations, revealing the fermentation of SBC can promotes plant growth, therefore increasing farm yield and net returns (Wang et al., 2016). However, out of all the treatments, RRIF (T5) garnered the highest net income and return per cost (RPC), suggesting that it was the most efficient treatment in terms of investment returns.

The study’s findings are supported by several research, which stated that waxy-sweet white corn farming has shown potential for increasing farm income across various regions, indicating favorable returns on investment (Patmawati et al., 2021; Agustyari et al., 2013). Additionally, a study of Sunarpi et al. (2021) concluded that *Sargassum* spp. contains phytohormones which can increase growth and yield of plants, suggesting its potential as a raw material for the development of organic fertilizers, which are adaptive to the environment for a sustainable agriculture.

High returns in sweet corn production costs translate to increased profitability for farmers, allowing for reinvestment in farm improvements, technological upgrades and business expansion. This enhanced financial stability strengthens the overall industry, making it more attractive to investors and fostering economic growth in agricultural communities. Furthermore, higher returns can improve the competitiveness of domestic sweet corn producers in the marketplace, ensuring a reliable supply for consumers and potentially leading to greater market share.

1. **CONCLUSION**

The application of *Sargassum* spp.-based concoction (SBC) demonstrated significant improvements in the growth and yield of waxy-sweet white corn. Higher concentrations (500 L/ha and 750 L/ha) yielded results comparable to inorganic fertilizers, supporting the use of macroalgae-based biofertilizers as an effective alternative for sustainable sweet corn production. Additionally, the study revealed the economic advantages of using *Sargassum* spp., improving net income and return per cost, making it a viable option for farmers seeking cost-effective and eco-friendly fertilization strategies. Future research should explore the long-term effects of macroalgae-based biofertilizers such as the SBC on soil health and productivity across multiple cropping seasons to further validate their efficacy in sustainable agricultural systems.

**DISCLAIMER (ARTIFICIAL INTELLIGENCE)**

Authors hereby declares that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

**COMPETING INTERESTS**

Authors have declared that no competing interests exist

**REFERENCES**

Abdullah, H. O., & Al-Obaidy, K. S. (2023, December). Response of Sweet Corn (*Zea mays* Saccharata L.) to Different Levels of Organic and Inorganic Fertilizer. In *IOP Conference Series: Earth and Environmental Science* (Vol. 1252, No. 1, p. 012065). IOP Publishing.

Adderley, A., Wallace, S., Stubbs, D., Bowen-O’Connor, C., Ferguson, J., Watson, C., & Gustave, W. (2023). *Sargassum spp.* as a biofertilizer: is it really a key towards sustainable agriculture for The Bahamas?. *Bulletin of the National Research Centre*, *47*(1), 112.

Agustyari, N.K., Antara, I.M., & Anggreni, I.L. (2013). Perbandingan Pendapatan Usahatani Jagung Manis dan Padi di Subak Delod Sema Padanggalak Desa Kesiman Petilan Kecamatan Denpasar Timur. *Journal of Agribusiness and Agritourism, 2*, 44959.

Ajibola, O. V., Ogunmola, O. N., & Amujoyegbe, J. B. (2020). Efficacy of soil amendments on agronomic traits, yield and nutritional quality of Sweet Corn (*Zea mays* L. var. saccharata). *Horticult Int J*, *4*(4), 96-106.

Akintoye, H. A., & Olaniyan, A. B. (2012). Yield of sweet corn in response to fertilizer sources. *Global Advanced Research Journal of Agricultural Science*, *1*(5), 110-116.

Akpan, E. A., & Udoh, V. S. (2017). Effects of fertilizer levels on growth and yield attributes of three dwarf sweet corn varieties (*Zea mays* L. Saccharata Strut) in Itu Flood Plain, Akwa Ibom State, Nigeria. *Canadian Journal of Agriculture and Crops*, *2*(1), 60-67.

Alasvandyari, F., Mahdavi, B., & Rahimi, A. (2024). Alleviating the water deficit stress effect on *Zea mays* L. using an extract of the seaweed *Sargassum boveanum*. *Journal of Applied Phycology*, 1-10.

Alfiler, C. T., Natividad, C. B., & Ferrer, C. F. R. (2022). Formulation of Ice Cream from Sweet Pearl F1 as Affected by Three Levels of Corn Starch and Its Corresponding Nutritional Analysis. *Int J Cur Res Rev,*Vol, 14(03), 24.

Ali O, Ramsubhag A, & Jayaraman J. (2021 March 12). Biostimulant Properties of Seaweed Extracts in Plants: Implications towards Sustainable Crop Production. *Plants (Basel)*. 10(3):531. doi: 10.3390/plants10030531. PMID: 33808954; PMCID: PMC8000310.

Almaz, M. G., Halim, R. A., Yusoff, M. M., & Wahid, S. A. (2017). Effect of incorporation of crop residue and inorganic fertilizer on yield and grain quality of maize. *Indian Journal of Agricultural Research*, *51*(6), 574-579.

Ansyarif, F., Ghazali, M., Muspiah, A., & Kurnianingsih, R. (2020). Pengaruh ekstrak *Sargassum cristaefolium* pada Multiplikasi *Dendrobium antennatum* Rchb. f secara In Vitro. *Bioscientist: Jurnal Ilmiah Biologi*, *8*(1), 18-24.

Atmaja, I., Nurmanah, D., Faqih, A., & Jaenudin, A. (2022). Improving Vegetative Growth of Sweet Corn Through Filter Cake and Potassium Application. *KnE Life Sciences*. <https://doi.org/10.18502/kls.v7i5.12539>.

Aydi-Ben-Abdallah, R., Ammar, N. A. W. A. I. M., Ayed, F., Jabnoun-Khiareddine, H., & Daami-Remadi, M. E. J. D. A. (2021). Single and combined effects of *Bacillus* spp. and brown seaweed (*Sargassum vulgare*) extracts as bio-stimulants of eggplant (*Solanum melongena* L.) growth. *Advances in Horticultural Science*, *35*(2), 151-164.

Baliah, N., Priyatharsini, S., Celestin Sheeba, P., & Raja, V. (2017). Effect of Seaweed Liquid Fertilizer of *Sargassum wightii* on the Yield Characters of *Abelmoschus esculentus* (L.) Moench). *International Journal of Advanced Research in Science, Engineering and Technology*, *4*(9).

Baroud, S., Tahrouch, S., Hatimi, A., Sadqi, I., & Hammou, R. A. (2019). Effect of Brown Algae on Germination, Growth and Biochemical Composition of Pepper Leaves (*Capsicum. annuum*). *Atlas Journal of Biology*, 611-618.

Basmal, J. (2010). Liquid organic fertilizer from seaweed (*Sargassum* spp.) and fish waste hydrolysate. *Squalen Bulletin of Marine and Fisheries Postharvest and Biotechnology, 5*, 59-66.

Canatoy, R.C. (2018). Effects of Fertilization on the Growth and Yield of Sweet Corn under No Tillage in Bukidnon, Philippines. *International Journal of Scientific and Research Publications (IJSRP)*, 443-450.

Chbani, A*.,* Majed S., Mawlawi H., & Kammoun M. (2015). The use of seaweed as a bio-fertilizer: Does it influence Proline and Chlorophyll concentration in plants treated? ***Arabian Journal of Medicinal and Aromatic Plants***, [S.l.], v. 1, n. 1, p. 67-77. ISSN 2458-5920. doi:<https://doi.org/10.48347/IMIST.PRSM/ajmap-v1i1.3259>.

Chen, D., Zhou, W., Yang, J., Ao, J., Huang, Y., Shen, D., & Shen, H. (2021). Effects of seaweed extracts on the growth, physiological activity, cane yield and sucrose content of sugarcane in China. *Frontiers in Plant Science*, *12*, 659130.

Diananda, Q. A., & Lukiwati, D. R. (2020). Growth and Production of Sweet Corn (*Zea mays* var. Saccharata) with Organic and Anorganic Fertilizer in Kendal. *Jurnal Online Pertanian Tropik*, *7*(2), 200-208.

El-Gawad, A., & Morsy, A. (2017). Integrated Impact of Organic and Inorganic Fertilizers on Growth, Yield of Maize (*Zea mays* l.) and Soil Properties under Upper Egypt Conditions. *J. Plant Production, Mansoura Univ*, *8*(11), 1103–1112. https://jpp.journals.ekb.eg/article\_41121\_dee1ec79ceae7369774ca39f9401fdbe.pdf

El-Gizawy, N. (2019). Effect of organic, inorganic and nano fertilizers on agronomic traits of maize. *Annals of Agricultural Science, Moshtohor*, *57*(1), 11-20.

Eshghizadehb, A. H. K. 2011. Yield response of corn to single and combined application of cattle manure and urea. Commun. *Soil Sci. Plant Anal*. 42(10):1200-1208.

Faisal, S., Bashir Ahmad, B. A., Inamullah, I., Kashif Akhtar, K. A., Shahzad Ali, S. A., & Ihteram Ullah, I. U. (2015). Effect of organic and inorganic fertilizers on penology of maize varieties. *Pure and Applied Biology*, Vol. 4, No. 3, 434-440.

Fatimah, S., & Daud, N. (2018). The effect of seaweed extract (*Sargassum* sp) used as fertilizer on plant growth of *Capsicum annum* (chilli) and *Lycopersicon esculentum* (tomato). *Indonesian Journal of Science and Technology*, *3*(2), 115-123.

Fatriana, Caronge, M.W., Djawad, Y.A., Bourgougnon, N., Makkulawu, A.T., & Jumadi, O. (2020). Effect of application of algae *Sargassum* spp. extract to corn plants (*Zea mays* L.) and microbial response. *IOP Conference Series: Earth and Environmental Science, 484*.

Fauziah, L., Rahmawati, D., Ratnawati, T., Hanifah, S., Sa’adah, S. Z., & Istiqomah, N. (2022, December). Study of the efficiency N, P, and K fertilizer application to increase yield of sweet corn on inceptisol. In *IOP Conference Series: Earth and Environmental Science* (Vol. 1107, No. 1, p. 012033). IOP Publishing.

Fitriyah, F., Aziz, M. A., Wahyuni, S., Fadila, H., Luktyansyah, I. M., Sulastri, S., & Siswanto, S. (2022). Biostimulant activity of Sargassum sp. extracts on early growth of Zea mays L. and the phytohormones content analysis. *Journal of Tropical Biodiversity and Biotechnology*, *7*(2), 69178.

Gill, B.S., Khehra, S., Kaur, G., & Singh, S. (2015). Effect of inorganic fertilizers on the plant growth and fruit quality in phalsa (*Grewia asiatica* D.C.). *Advance Research Journal of Crop improvement, 6*, 100-104.

Gopi, K., R., & Munisamy, S. (2024). Synergistic Effect Of Tropical Seaweed Based Biostimulant With Humic Products On Grain Yield Of Maize (Var. Syngenta Nk-6240) Farmed Under Semi-Arid Region. *Malaysian Journal of Sustainable Agriculture* (MJSA), 8(2), 126-132.

Hassan, H. (2015). Effect of Nitrogen Fertilizer Levels in the Form of Organic, Inorganic and Biofertilizer Applications on Growth, Yield and Quality of Strawberry. *Middle East Journal of Applied Sciences*. ISSN 2077-4613. Vol. 05, 604-617.

Indika, G., Silva, P.N., Makawita, Wickramasinghe, I., & Wijesekara, I. (2021). Using brown seaweed as a biofertilizer in the crop management industry and assessing the nutrient upliftment of crops. *Asian Journal of Agriculture and Biology*, 1-10 https://doi.org/10.35495/ajab.2020.04.257

Jaikumar, M., Ramadoss, D., Surendran, S., & Behera, A. K. (2024). Current Prospects of Indian Seaweed and Its Value-added Products. Retrieved from <https://doi.org/10.1039/9781837675654-00136>

Jobouri, S.M., & Anwer, A.M. (2010). Influence of Different Levels and Application Dates of Nitrogen Fertilizer on Growth of Two Corn Varieties (*Zea mays* L.). *Jordan Journal of Agricultural Sciences,* 5.

Jumadi, O., Annisi, A. D., Djawad, Y. A., Bourgougnon, N., Amaliah, N. A., Asmawati, A., Manguntungi, A. B., & Inubushi, K. (2023). Brown algae (*Sargassum spp.*) extract prepared by indigenous microbe fermentation enhanced tomato germination parameters. *Biocatalysis and Agricultural Biotechnology*, *47*, 102601. <https://doi.org/10.1016/j.bcab.2023.102601>

Junaidi, M., & Wulandari, Y. A. (2017, August). Effect of The Combination of Organic and Inorganic Fertilizers on The Growth and Production of Melons (*Cucumis melo* L). In *International Conference on Science and Technology (ICOSAT 2017)-Promoting Sustainable Agriculture, Food Security, Energy, and Environment Through Science and Technology for Development* (pp. 84-87). Atlantis Press.

Jupri, A., Fanani, R. A., Syafitri, S. M., Mayshara, S., N., Pebriani, S. A., & Sunarpi, H. (2019). Growth and yield of rice plants sprayed with *Sargassum polycystum* extracted with different of concentration. *AIP Conference Proceedings*. Retrived from https://doi.org/10.1063/1.5141323

Kara, B., & Uygur, V. (2020). Organic or conventional agriculture? A Study on yield and nutritional status of sweet corn. *Maydica, 65*, 7.

Kumari, S., Tzudir, L., Chishi, H. M., Yosung, L., Malemnganbi, T., Zion, G., & Roy, S. (2024). Growth allometry of sweet corn as influenced by tillage and seaweed under Tarai region of Nagaland. *International Journal of Economic Plants*, *11*(2), 104-110.

Kurane, R. A. (2014). Response of sweet corn to different fertilizer levels and plant densities in summer season (Doctoral Dissertation, Department 0f Agronomy, Mahatma Phule Krishi Vidyapeeth). Retrieved from https://krishikosh.egranth.ac.in/server/api/core/bitstreams/6fa67f26-a38b-4d0d-abf2-272c2d570257

Lin, H. T. V., Huang, M. Y., Kao, T. Y., Lu, W. J., Lin, H. J., & Pan, C. L. (2020). Production of lactic acid from seaweed hydrolysates via lactic acid bacteria fermentation. *Fermentation*, *6*(1), 37.

Maurya, D. K., Pal, R. K., Singh, R., Kumar, S., Yadav, M., Kumar, M., & Maurya, S. K. (2023). Effects of Planting Method and a Combination of Organic and Inorganic Nitrogen on Maize (*Zea mays*) Growth. *Int. J. Environ. Clim. Change*, *13*(12), 730-734.

Mohammed, S., El-Sheekh, M. M., Saadia Hamed Aly, Maha Al-Harbi, Amr Elkelish, & Aziza Nagah. (2023). Inductive role of the brown alga *Sargassum polycystum* on growth and biosynthesis of imperative metabolites and antioxidants of two crop plants. *14*. https://doi.org/10.3389/fpls.2023.1136325

Mutmainnah, M., Sudiarso, S., & Wicaksono, K. (2024, May). Response of Potassium Fertilizer Application to Production and Sugar Content of Several Varieties of Sweet Corn (*Zea mays* saccharata Sturt.). In *Proceedings of the 3rd International Conference on Education, Humanities, Health and Agriculture, ICEHHA 2023, 15-16 December 2023, Ruteng, Flores, Indonesia*.

Nurjannah, K. A. I., Amaliah, N. A., Junda, M., Iriany, N., Makkulawu, A. T., Karim, H., & Jumadi, O. (2021). The influence of fermented brown algae extract (*Sargassum spp.*) on corn plant growth (*Zea mays* L.). In *IOP Conference Series: Earth and Environmental Science* (Vol. 911, No. 1, p. 012051). IOP Publishing.

Nurliawati, G., & Faqih, A. (2024). The Effect Of Crop Spacing And Dossage Of Potassium Fertilizer On Growth And Yield Of Sweet Corn (*Zea mays* Var. saccharata Sturt) Bonanza Cultivar. *Devotion : Journal of Research and Community Service*. <https://doi.org/10.59188/devotion.v5i2.684>.

N'Yeurt, A., & Iese, V. (2014). Sustainable agro-fertilizers from marine plants in Pacific Small Island Developing States (SIDS). *IGI Global*, 1-31.

Omidire, N. S., Shange, R., Khan, V., Bean, R., & Bean, J. (2015). Assessing the impacts of inorganic and organic fertilizer on crop performance under a microirrigation-plastic mulch regime. *Professional Agricultural Workers Journal (PAWJ)*, *3*(1).

Pal, A., Dwivedi, S. K., Maurya, P. K., & Kanwar, P. (2015). Effect of seaweed saps on growth, yield, nutrient uptake and economic improvement of maize (sweet corn). *Journal of Applied and Natural science*, *7*(2), 970-975.

Patmawati, A. N. I. S., Suriaatmaja, M. E., & Widuri, N. I. K. E. (2021). Analisis pendapatan usahatani jagung manis di Kelurahan Tani Aman Kecamatan Loa Janan Ilir Kota Samarinda. *Jurnal Agribisnis Dan Komunikasi Pertanian*, *4*(2), 67-74.

Pei, B., Zhang, Y., Liu, T., Cao, J., Ji, H., Hu, Z., Wu, X., Wang, F., Lu, Y., Chen, N., Zhou, J., Chen, B., & Zhou, S. (2024). Effects of seaweed fertilizer application on crops' yield and quality in field conditions in China-A meta-analysis. *PloS One*, 19(7), e0307517. <https://doi.org/10.1371/journal.pone.0307517>

Possinger, A.R. (2013). Using Seaweed as a Soil Amendment: Effects on Soil Quality and Yield of Sweet Corn (*Zea mays* L.). Retrieved from https://digitalcommons.uri.edu/theses/78

Prasedya, E. S., Pebriani, S. A., Ambana, Y., Anggit, L. S., Widyastuti, S., Nikmatullah, A., & Sunarpi, H. (2019). Ekstrak Cair dan Padat Lombok *Sargassum aquifolium* Merangsang Pertumbuhan dan Hasil Tanaman Mentimun (*Cucumis sativus* L.). *Jurnal Biologi Tropis*, *19*(2), 250-259.

Purnomo, J., & Subiksa, I. (2021). Effect of P fertilizer formula to the growth and yield of sweet corn on peatland. *IOP Conference Series: Earth and Environmental Science, 648*.

Rahayu, A., Rochman, N.T., Lestari, N.D., & Agustina, K. (2018). Response of Sweet Corn Plants (*Zea mays* saccharata L.) Affected the Aplication of Biological Liquid Compound Fertilizer and Synthetic Fertilizer N, P and K. *JURNAL AGRONIDA*, 4 (1).

Raksun, A., Merta, I. W., Mertha, I. G., & Ilhamdi, M. L. (2021). Response of Sweet Corn (*Zea mays* L. Saccharata) Growth on the Treatment of Organic and NPK Fertilizer. *Jurnal Biologi Tropis*, *21*(1), 131-139.

Rumhungwe, M., Kurangwa, W., Masama, E., & Tembo, L. (2016). Effects of inorganic fertilizer on growth, yield and quality of Irish potato (*Solanum tuberosum* L.) grown in synthetic plastic bags. *African Journal of Plant Science, 10*, 97-104.

Sariñana-Aldaco, O., Benavides-Mendoza, A., Robledo-Olivo, A., & González-Morales, S. (2022). The biostimulant effect of hydroalcoholic extracts of *Sargassum* spp. in tomato seedlings under salt stress. *Plants*, *11*(22), 3180.

Shabani, E., Ansari, N. A., & Fayezizadeh, M. R. (2023). Plant growth bio-stimulants of seaweed extract (*Sargasum boveanum*): Implications towards sustainable production of cucumber. *Yuzuncu Yıl University Journal of Agricultural Sciences*, *33*(3), 478-490.

Shahin, S. K., Rao, M. S., Rao, A. U., Gurumurthy, P., & Basu, B. J. (2022). Performance of sweet corn under various nutrient management practices. *Biochemical & Cellular Archives*, *22*(2).

Sofyan, E. T., Sara, D. S., & Machfud, Y. (2019, December). The effect of organic and inorganic fertilizer applications on N, P-uptake, K-uptake and yield of sweet corn (*Zea mays* saccharata Sturt). In *IOP Conference Series: Earth and Environmental Science* (Vol. 393, No. 1, p. 012021). IOP Publishing.

Speede, R., Alleyne, K., & Cox, S. A. L. (2024). Innovations for Sargassum Resilience. Retrieved from http://dx.doi.org/10.18235/0013107

Sridhar, S., & Rengasamy, R. (2010). Studies on the effect of seaweed liquid fertilizer on the flowering plant *Tagetes erecta* in field trial. *Advances in Bioresearch*, *1*(2), 29-34.

Sugiono, Latifah, E., Krismawati, A., Antarlina, S.S., Angraeni, L., Handayati, W., & Sihombing, D. (2023). Application of inorganic fertilizer NK (18-32) on growth and yield of sweet corn on clay soil. *IOP Conference Series: Earth and Environmental Science*, 1230.

Sujatha, S. (2016). Organic seaweed nano powder effect on growth and yield attributes of pigeon pea. *Legume Research, 40*, 731-734.

Sunarpi, H., Nikmatullah, A., Ambana, Y., Ilhami, B. T. K., Abidin, A. S., Ardiana, N., & Prasedya, E. S. (2021, March). Phytohormone content in brown macroalgae *Sargassum* from Lombok coast, Indonesia. In *IOP Conference Series: Earth and Environmental Science* (Vol. 712, No. 1, p. 012042). IOP Publishing.

Teñedo, D. (2024, October 17). *Corn Production Survey | Philippine Statistics Authority | Region I*. Rsso01.Psa.gov.ph. Retrieved from <https://rsso01.psa.gov.ph/statistics/cps>

Türk, M., & Alagöz, M. (2018). The effect of nitrogen fertilizer on the yield and quality in the sweet maize. *Agronomy*, Vol. LXI, 408-411.

Villaver, J. P. (2019). Physiological Efficiency of Sweet Corn (*Zea mays* L. var. saccharata) as Influenced by Indigenous Microorganisms (IMO) 7 and Biofertilizers. *International Journal of Science and Management Studies (IJSMS)*, *2*(4), 55-66.

Villaver, J. P. (2022). Physiological and yield parameters of sweet corn (*Zea mays* L. var. rogusa) in response to biofertilizer application under low elevation condition. *International Journal of Agricultural Technology*, Vol. 18(5):2307-2314

Wang, Y., Fu, F., Li, J., Wang, G., Wu, M., Zhan, J., Chen, X., & Mao, Z. (2016). Effects of seaweed fertilizer on the growth of *Malus hupehensis* Rehd. seedlings, soil enzyme activities and fungal communities under replant condition. *European Journal of Soil Biology*, 75, 1-7. <https://doi.org/10.1016/J.EJSOBI.2016.04.003>.

Yakaka, K. M., & Alkali, A. (2021). Comparative Effects of Sole and Combined Application of Manure and Inorganic Fertilizer on Growth and Yield of Sweet Corn in Maiduguri, Nigeria. *International Journal of Scientific Research in Science, Engineering and Technology*, 112-116. <https://doi.org/10.32628/ijsrset218122>.

Yao, Y., Wang, X., Chen, B., Zhang, M., & Ma, J. (2020). Seaweed Extract Improved Yields, Leaf Photosynthesis, Ripening Time, and Net Returns of Tomato (*Solanum lycopersicum* Mill.). *ACS Omega, 5*, 4242 - 4249.

Yukui, R., Yun-feng, P., Zheng-rui, W., & Jianbo, S. (2012). Stem perimeter, height and biomass of maize (*Zea mays* L.) grown under different N fertilization regimes in Beijing, China. *International Journal of Plant Production, 3*, 85-90.