International Journal of Scientific Research and Management (IJSRM)
||Volume||11||Issue||11||Pages||10-22||2023||
Website: www.ijsrm.net ISSN (e): 2321-3418
DOI: 10.18535/ijsrm/v11i11.fa01

# Fish Wastewater and Fish Scale: A Corn Soil Enhancer

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**Abstract**
This study was conducted to determine the effects of fish waste water and fish scale as soil enhancer for the growth of sweet corn. The Experimental Research design with different treatments such as treatment 1 for 100% fish scale, treatment 2 for 100% fish waste water, treatment 3 for 50% fish scale and 50% fish water waste, and treatment 4 for commercialized fertilizer were employed for the growth of corn plants in terms of height, girth of stem, number of leaves and length of leaves. Mean and Post hoc analysis were used for the data analysis. It was found out that treatment 3 which was 50% fish scale and 50% fish water waste and treatment 4 which was commercialized fertilizer had the highest average growth of corn plants in all parameters. However, 100% fish scale and 100% fish water waste had the lowest average growth of corn plants in all parameters. Meanwhile, it was found out also that there was a highly significant difference in the effect of treatment 1 as contrasted among the other treatments of fertilizer. The same with treatment 2 as contrasted with treatment 3 and 4. However, the analysis found no significant difference on the effect of treatment 3 and 4 on the growth response of corn plants in all parameters.

**Keywords***:* Corn Soil Enhancer, Fish Scale, Fish Wastewater

## Introduction

Agricultural sector plays a strategic role in the process of economic development of the country. It has already made a significant contribution to the economic prosperity of advanced countries and its role in the economic development of less developed countries is of vital importance (Macatta, 2016). Most people's main source of livelihood is farming. About 70% of people rely directly on agriculture as a livelihood (Sarma, 2017). As the trend towards healthier lifestyle continues to grow, the interest in organic farming in the Philippines is also expeditiously gaining ground. In fact, the government has mandated the Department of Agriculture to allot at least Php 1 billion (US$23.70 million) this year to exclusively promote the organic agriculture programs in the country. Organic agriculture as a definite alternative to industrial forms of agriculture in the Philippines. In recent years, organic agriculture in the Philippines has become an emergent market integrating into the national economy, (Maohong, 2018). According to the local organic group Organic Producers Trade Association (OPTA), the risk of consuming non-organic food is becoming more perilous to human health. Chemically produced plant will accumulate in the human body, toxic chemicals, which are very dangerous. It also includes the most devastating effect of chemical waste accumulation in the water bodies i.e., the water eutrophication. And when added in soil, its continuous use degrades the soil health and quality hence causing the soil pollution. Therefore, it is a high time to realize that this crop production input is depleting our environment and ecosystem. Hence its continuous use without taking any remedial measure to reduce or judicious use will deplete all the natural resources one day and will threaten all the life from the earth (Kumar, et.al., 2019). The study was conducted in Cadiz City, Negros Occidental which is known to be abundant of fish. Aside from this, it is famous for its dried fish. Therefore, fish scales are left unused. This study aimed to utilize fish scales as key component as an alternative soil enhancer.

**Objectives of the Study**

The study aimed to determine the effects of fish waste water and fish scale as soil enhancer for the growth of sweet corn. This study also aimed to make recommendations for further research and development and to promote sustainable corn production.

Specifically, this study aimed to answer the following:

1. To determine the average growth of corn in different treatments of 100% Fish Scale, 100% Fish Waste Water, 50% Fish Scale + 50% Fish Water Waste, Commercial Fertilizer-UREA in terms of:

a. Height of the plant
b. Girth of the stem
c. Number of Leaves
d. Length of Leaves

2. To determine if there is significant difference between fish waste water and fish scales and commercial fertilizer in different treatments of 100% Fish Scale, 100% Fish Waste Water, 50% Fish Scale + 50% Fish Water Waste, Commercial Fertilizer-UREA in terms of:

a. Height of the plant
b. Girth of the stem
c. Number of Leaves
d. Length of Leaves

**Materials and Methods**

The materials used in this study were categorized before the experimentation, during the experiment and after the experimentation.

**Research Design**

The researcher utilized the Experimental Research design in this investigation. This kind of research method is the only method of research that can truly test hypotheses concerning cause-and-effect relationships. It represents the most valid approach to the solution of educational problems, both practical and theoretical, and to the advancement of education as a science (Gay, 1992). This is the appropriate research design for the study because it focused on the effectiveness of the fish scales and fish waste water as corn soil enhancer. Moreover, it utilized a Complete Randomize Design (CRD) where the treatments are assigned randomly so that each experimental unit has the same chance of receiving only one treatment (Gomez & Gomez, 1984).

**Before Experimentation**

Table 1 showed the materials needed by the researcher before the experiment. The researcher will utilize the following materials in the conduct of the experiment: Sweet corn seeds, fish scales, plastic pots, plastic bottles, plastic bags, gloves, weeding knife, mask, garden soil, shovel, and plastic trays.

| Materials | Uses | Quantity |
|---|---|---|
| Sweet Corn Seeds<br><br>(East – West Philippine Seed: Macho F1) | Use as medium of experimentation | 250 grams |
| Fish Scales | Use as one of the proposed organic fertilizer | 150 grams |
| Fish Wastewater | Use as one of the proposed organic fertilizer | 250 ml |

| | | |
|---|---|---|
| Urea | Use as one of the proposed commercial fertilizer | 75 grams |
| Shovel | Use to dig for soil | 1 pc |
| Gloves | Use to protect the hands of the researcher in setting up for plot | 2 pcs |
| Mask | Use to protect the researcher from unnecessary odors | 1 pc |
| Plastic Bags | Use to collect and gathered fish scales from the market | 2 pcs (Large) |
| Plastic Bottles | Use to collect fish waste water from the market | 3 pcs(1000 ml) |
| Weeding Knife | Use to cultivate soil | 1 pc |
| Plastic Trays | Use to place for air dried sweet corn seeds | 1 pc |
| Plastic Pots | Use where sweet corn seeds will be planted | 60 pcs |

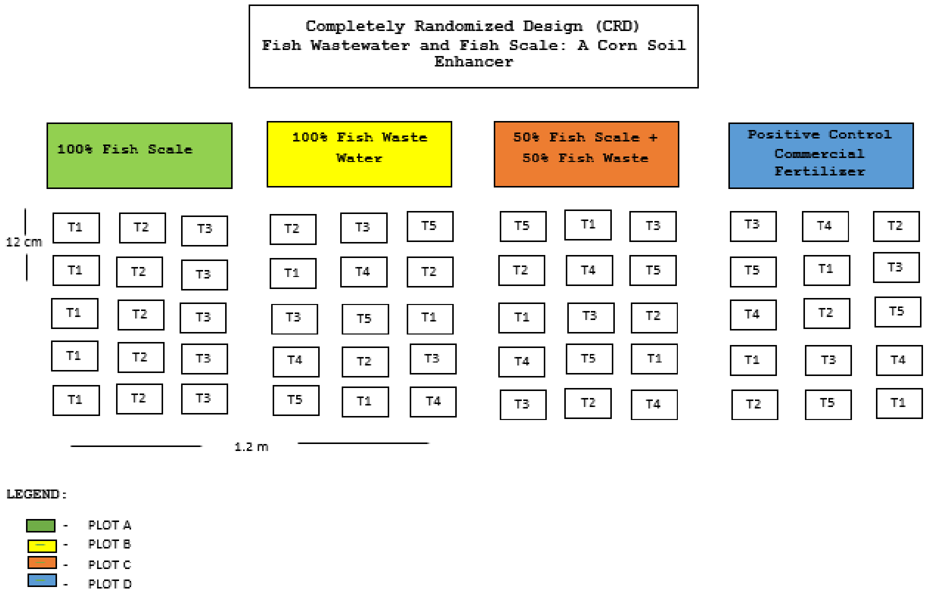
The researcher used mixed fish scales collected from the local market in the city, packed in plastic bags and placed in containers. Gathered water waste from washed fish will also be collected and placed in containers. The amount of fish scales to be used in every seed is 5g while 75 ml of water waste from washed fish was used in watering the seeds in one month. Sweet corn seeds were carefully air dried and place on plastic trays prior to planting process. The researcher set up the area using the shovel and weeding knife in ensuring that the area was ready for the planting process using garden soil. The researcher measured the growth of the corn using a tape measure and Vernier caliper for the girth every end of the week. Likewise the researcher watered the planted sweet corn seeds using from combined solution of fish scales and fish waste water in two days interval.

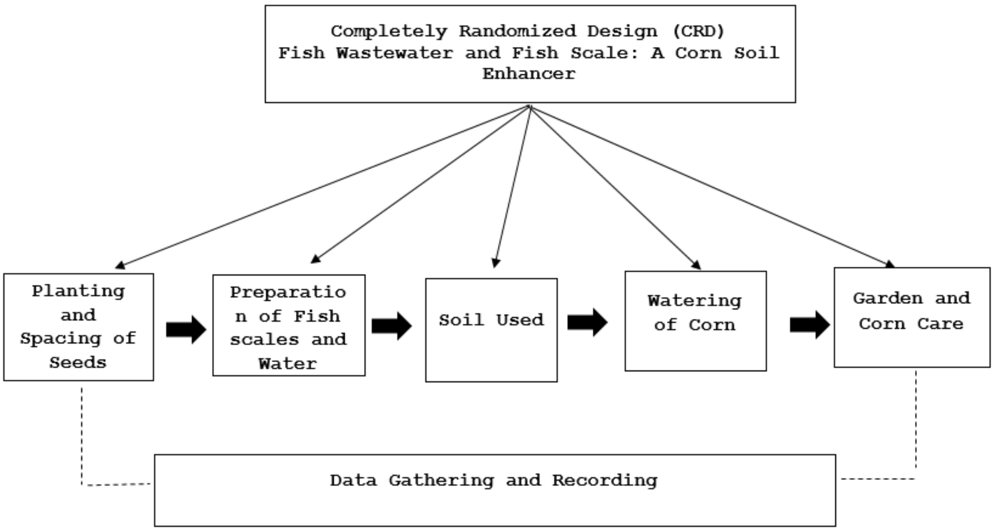
| **Materials** | **Uses** | **Quantity** |
|---|---|---|
| Fish Scales – Fish Waste Water Solution | Use as the organic fertilizer for sweet corn | 75 ml 5grams |
| Gloves | Use to protect the hands of the researcher in setting up for plot | 2 pcs |
| Mask | Use to protect the researcher from unnecessary odors | 1 pc |
| Weeding Knife | Use to cultivate soil | 1 pc |
| Measuring Tape or Meter Stick | Use to measure the growth of sweet corn in terms of height and girth | 1 pc |
| Camera | Use for the documentation | 1 pc |

| Record Notebook | Use to record data on the growth of sweet corn seeds | 1 pc |
|---|---|---|

**Experimental Layout**

A Completely Randomized Design (CRD) with four treatment levels and three replications were utilized on the experimental research. In every treatment there were five (5) sample pots. Two (2) seeds of Macho F1 were planted using plastic pots.




Experimental Flow

**Experimental Process**

In the conduct of the experiment, the following processes and procedures were observed:

Step 1. Planting and Spacing of seeds:

Sweet corn seeds were collected from one of the accredited agricultural stores in Cadiz City which as Agrivit-Cadiz. Sweet corns were air dried for better yield. Sweet corn seed were planted in plastic pots. Each pot contained two rows planted about 5 inches apart. Sweet corns were planted at about 1 inch deep.

Step 2. Preparation of Fish scales and Water Waste:

Fish scales and water waste from washed fish were collected from the local fish market in the city. Fish scales were mixed with water waste from washed fish in 100 ml from which, 75 ml was applied on top of soil of the treated corn seeds. Each block represented one treatment.

Step 3. Soil Used:

The experimental research was conducted in the researcher's present station, location was already identified where corn seeds were planted, the researcher utilized garden soil within the school, no compost or any other fertilizers were applied to the garden soil prior to the conduct of the study.

Step 4. Watering of Corn:

Corn grows fast in hot weather and requires an even supply of moisture to avoid wilting, keeping it evenly moisture is a must. The treatment was applied in two days interval until leaves grows and tassels appeared.

Step 5: Garden and Corn Care:

Weeding corn at a time is a must to avoid competition for water and nutrients, this was done for the seeds that were treated and those seeds that receives no treatment.

**Data Gathering**

The data obtained from this experiment were analyzed. In this study, growth parameters was recorded for the measurement and evaluation of the effectiveness of fish scales and water waste from washed fish as soil enhancer on the growth of corn plant. The results were recorded and described into one aspect, analysis of variance was employed in measuring the effectiveness and significance of the treatments. For the height of the sweet corn it was measured from the base of the plant to the longest leaf using meter stick. Girth of the stem was measured using a Vernier caliper. Length of the leaf was measured from its base to the tip of the leaf using a meter tape measure and for the numbers of leaf descriptive counting was utilized.

**Statistical Analysis**

The data obtained from this experiment was analyzed. In this study, growth parameters were recorded for the measurement and evaluation of the effectiveness of fish scales and water waste from washed fish as soil enhancer on the growth of corn plant. The results were recorded and described into one aspect, analysis of variance was employed in measuring the effectiveness and significance of the treatments.

**Statistical Data Analysis Procedure**

The data were collected, tallied, tabulated and subjected to statistical processes.

To determine the average growth of the corn in terms of height, girth, and leaf formation mean was used.

To determine if there is a significant difference on between fish waste water – fish scale and commercial fertilizer in terms of height, girth, leaf formation, t – test was used.

To determine the significant difference on the level of effectiveness between fish scales – fish waste water and commercial fertilizer, t – test was used.

Post Hoc analysis was utilized to check the closeness of the data whether there was a close significance between the data gathered and recorded in the experiment.

**Results and Discussion**

The data gathered from the investigation were hereby presented, analyzed and interpreted in the order that they were required as determined by the statement of the problem. To answer the problems, tabular results were presented as well as the analyses of data and their interpretation.

Average Growth of the Corns' Height with Different Treatments

Table 1.a showed the results of the corns' height. It presented the different treatments. Treatment 1 for 100% fish scale, treatment 2 for 100% fish waste water, treatment 3 for 50% fish scale and 50% fish waste water, and treatment 4 for commercialized fertilizer. The data on the table revealed the mean scores of each treatment and it presented also the grand mean of all treatments. Based on the table presented, treatment 1 which was pure 100% fish scale got the lowest mean. It implies that using this type of treatment, the corn did not develop well. According to Harikrishna et. al. (2017), the components of fish scales include a surface layer containing hydroxyapatite, calcium carbonate and a deeper layer made up of mostly collagen type I. Elements like Ca, Mg, P, Na, S are also present in minute concentrations. Since fish scales were applied at 100% to corn, excessive Ca is present in the rhizosphere solution, plants may suffer Ca toxicity. This may prevent the germination of seeds and reduce plant growth rates (White & Broadly, 2018). The highest mean

was 147.5000 for treatment 3 which was the 50% fish scale and 50 % fish water waste. The results implied that fish scales and waste water fish can be a potential source of nutrients in the soil when combined. According to the study of Alkhafaji & Elkheralla (2019), it was found out that by applying fish scales and fish organic materials can significantly decrease the soil acidity because of the salt present in the scales. Furthermore, the amount of organic matter in the soil after the harvest increased with the level of addition fish scales and increased compare with control. The table below showed the aforementioned results.

**Table 1.a. Average Height of the Corn Plant**

| TREATMENT | REPLICATION | | | Mean |
|---|---|---|---|---|
| | I | II | III | |
| Treatment 1 100% Fish Scale | 7.40 | 7.40 | 8.30 | 7.70 |
| Treatment 2 100% Fish Waste Water | 26.30 | 25.50 | 25.50 | 25.77 |
| Treatment 3 50% Fish Scale + 50% Fish Water Waste | 49.60 | 47.70 | 50.20 | 49.17 |
| Treatment 4 Positive Control (Commercial Fertilizer-UREA) | 47.90 | 46.10 | 49.00 | 47.67 |
| Grand Mean | | | | 27.54 |

**Average Growth of the Girth of the Corns' Stem with Different Treatments**

Table 1.b showed that girth of the corns' stem as applied with different treatments. It can be noticed that treatment 1 has the lowest mean, which means that the growth of the stem did not significantly increase. It be further noticed that it is significantly lowered compared to other lowest mean. The highest mean among all treatments was treatment 3 which was 50% fish scale and 50 % fish waste water. It can be noticed that treatment 4 which was commercialized fertilizer (urea) had the second highest mean. It can be further noticed that their significant values were closed. This maybe because of the interaction of urea to calcium present in the soil. In the study of Millikan & Bjarnason (2015), it revealed that the interaction between urea and calcium level on plant growth was different and varies. It means that the lower the calcium content in the soil, the better the yield. The results implied that too much nutrients applied in the soil can affect the growth of the corn. Moreover, Pal & Laloraya, (2015) posited that calcium levels exert a profound effect on the protein and soluble nitrogen content in different parts of the plants and that the effects seem to vary from harvest to harvest. This implied that since the level of fish scales and fish waste water are applied at a maximum percentage, it definitely affected the girth of corns. Over all, balanced nutrients can potentially increase the girth of the corn. In the study of Mohammad & Buang (2018) on the effects of waste water on plants, they conclude that lower concentration of fish extracts was the best treatment for improving the growth, yield and quality of plants. The table below showed the aforementioned discussions and results.

**Table 1.b. Average Girth of the Stem (cm)**

| TREATMENT | REPLICATION | | | Mean |
|---|---|---|---|---|
| | I | II | III | |
| Treatment 1 100% Fish Scale | .3990 | .3030 | .3890 | .3637 |
| Treatment 2 100% Fish Waste Water | 1.1820 | 1.1030 | 1.2140 | 1.1663 |
| Treatment 3 50% Fish Scale + 50% Fish Water Waste | 1.6900 | 1.5380 | 1.7020 | 1.6433 |
| Treatment 4 Positive Control (Commercial Fertilizer-UREA) | 1.6000 | 1.5530 | 1.6610 | 1.6047 |
| Grand Mean | 1.2178 | 1.1243 | 1.2415 | 1.1945 |
| Coefficient Variation | 46.62% | | | |

**Average Growth of the Number of Corns' leaves with Different Treatments**

Table 1.c showed the mean results of corns' number of leaves as applied with different treatments. The results revealed that treatment 1 which used 100% fish scale has the lowest mean among treatments followed by treatment 2 which used 100% fish waste water. It be inferred that based on the data, both concentrations delayed the growth of the corn in a period of time. In the table presented, treatment 4 which

was the commercialized fertilizer garnered the highest mean compared to treatment 3 which was the 50% fish scale and 50% fish water waste. The result was supported by Karatas, et.al. (2020), application of urea to plants as fertilizer resulted in larger heads, weightier heads and plants as well as higher plants. In regard to the nutrient content, it can be interfered that soil nitrogen fertilization and foliar urea applications increased the content of almost all nutrients in leaves.

The results indicated based on the data, treatment 3 and 4 were closed based on the mean presented. Urea when applied on plants, the number of leaves depends on how much fertilizer is applied (Chowdhury et. al. 2020). The components needed in plants should be sufficient most especially the Nitrogen, Phosphorus, and Potassium (Fontanelle Hybrids, 2020). The overall data suggested that urea fertilizer has the highest mean and had a close results with the treatment 3. The table below showed the above aforementioned discussion.

**Table 1.c Average number of corn leaves**

| TREATMENT | REPLICATION | | | Mean |
|---|---|---|---|---|
| | I | II | III | |
| Treatment 1 100% Fish Scale | 4.00 | 4.00 | 4.00 | 4.00 |
| Treatment 2 100% Fish Waste Water | 10.00 | 10.00 | 10.00 | 10.00 |
| Treatment 3 50% Fish Scale + 50% Fish Water Waste | 11.00 | 12.00 | 12.00 | 12.00 |
| Treatment 4 Positive Control (Commercial Fertilizer-UREA) | 11.00 | 12.00 | 12.00 | 12.00 |
| Grand Mean | | | | 10.00 |

**Average Growth of the Length of Corns' leaves with Different Treatments**

Table 1.d showed the mean of each treatment. Treatment 1 was 100% fish scale, treatment 2 was 100% fish waste water, treatment 3 was Fish Scale + 50% Fish Water Waste, and treatment 4 was commercialized fertilizer (urea). In the data presented, the lowest mean was garnered by treatment 1. This indicates that high concentrations delayed the growth of the corn, the same as the mean results garnered by treatment 2 which garnered the second lowest mean. This implies that higher concentration imparts a negative effect Barnali & Ajit (2015). The highest mean was garnered by treatment 3 and seconded by treatment 4. Based on the results of both mean, it can be inferred that treatment 3 contains the right concentrations for the growth of corns' leaves. However, it can be inferred also that treatment 4 was closed to treatment 3. This also concludes that both of them contributes to the growth of the corns' leaves significantly. Urea produces the right amount of NPK to corns necessary for its growth and development Khan, et.al (2015). The table below showed the above aforementioned discussions above.

**Table 1.d Average length of corns leaves (cm)**

| TREATMENT | REPLICATION | | | Mean |
|---|---|---|---|---|
| | I | II | III | |
| Treatment 1 100% Fish Scale | 14.00 | 14.50 | 13.80 | 14.10 |
| Treatment 2 100% Fish Waste Water | 58.00 | 58.00 | 58.90 | 58.30 |
| Treatment 3 50% Fish Scale + 50% Fish Water Waste | 78.40 | 77.90 | 79.90 | 78.73 |
| Treatment 4 Positive Control (Commercial Fertilizer-UREA) | 78.50 | 77.80 | 78.80 | 78.37 |
| Grand Mean | | | | 50.38 |

**Significant difference of the different treatments in the parameters of the number of corns' height**

Table 2.a showed the post hoc analysis on significant difference of fish waste water and fish scales and commercial fertilizer in the parameters of corns' height. The data further revealed that treatment 1 versus

other remaining treatments were highly significant. The same data revealed in treatment 2 and 3 which showed highly significant among other treatments. This implied that null hypothesis was rejected since the p value is equal to 0.000. Furthermore, all treatments had different effects and response on the growth of corn in terms of height. Based on the analysis, there is an effect in specific treatments used in the experiment. This supports the findings of Ahuja, et. al. (2020) that fertilizers produced from captured fish promote the recycling of nutrients from the sea and back to terrestrial environments. Nutritional composition of fish waste has potential supply plant nutrients such as nitrogen, or a combination of nitrogen and phosphorous, or to enrich a compost. Additionally, Organic fertilizers are organic materials that are more environmental friendly compare to chemical fertilizer. It has better growth and productivity of crops. They are easily producible, eco-friendly and one of the best organic growth regulators. However little information is available that demonstrate the potential of organic liquid fertilizer and their role in supplying a balanced nutrient supply, the present work when taken up (Thankachan & Chitra, 2021).

On the other hand, the p value of treatment 4 vs treatment 3 was 0.2300 which resulted in failed to reject the null hypothesis. Furthermore, the data implied that their effectivity was almost the same and the treatments' effectivity does not vary. The data implied that highest mean was garnered by treatment 3 but has a close significant values to treatment 4. In Study of Shahsavani et. al., (2017) in the effect of fish waste, chemical fertilizer and biofertilizer on yield and yield components of bean (vigna sinensis) and some soil properties revealed that the there was no significant difference on effect of fish waste, psodomonas bacteria and their interactions compare to chemical Fertilizer had increased effect on plant height. The table below showed the above aforementioned discussions above.

**Table 2.a: POST HOC ANALYSIS on Significant Difference of fish waste water and fish scales and commercial fertilizer in the parameters of corns' height.**

| | **Mean Difference** | **P-Value** | **Interpretation** |
|---|---|---|---|
| Treatment 1 vs Treatment 2 | -18.0667* | 0.0000 | Highly Significant |
| Treatment 1 vs Treatment 3 | -41.4667* | 0.0000 | Highly Significant |
| Treatment 1 vs Treatment 4 | -39.9667* | 0.0000 | Highly Significant |
| Treatment 2 vs Treatment 3 | -23.4000* | 0.0000 | Highly Significant |
| Treatment 2 vs Treatment 4 | -21.9000* | 0.0000 | Highly Significant |
| Treatment 4 vs Treatment 3 | -1.5000 | 0.2300 | Not Significant |

**Significant difference of the different treatments in the parameters of the number of corns' girth**

Table 2.b showed the post hoc analysis on significant difference of fish waste water and fish scales and commercial fertilizer in the parameters of corns' girth. The data revealed that treatment 1 vs among other treatments showed highly significant. The same results with treatment 2 and treatment 3 vs other treatments. This implied that the null hypothesis was accepted that there was no significant relationship on the different treatments of fertilizers on corns' girth. The treatments showed that the data presented in the treatments had a variations of growth and do not show any closeness. This could be in inappropriate levels of NPK and water levels applied in different treatments. Abdelhady, et. al. (2017) revealed on their study of Effect of deficit irrigation levels and NPK fertilization rates on tomato growth, yield and fruits quality. The longest root was found in deficit irrigation treatment. All growth measurements of tomato were significantly affected by the bilateral interaction between deficit irrigation levels and NPK fertilization rates. On the other hand, the analysis of treatment 3 and 4 showed no significant. This means that both were effective in the growth of girth of corn since the p-value was 0.4760 therefore, the null hypothesis was rejected. However, it can be further viewed in the mean results that treatment 3 has the highest mean. This implied that treatment 3 was slightly effective on girth of the corn as compared to treatment 4. In field cultivation of the two leafy vegetables, the biodegraded fishmeal wastewater showed better fertilizing ability than commercial fertilizers because of its high amino acid content (Kang, et. al., 2018). Another factor could be the presence the saline solution from fish waste water and scale. The average amount of urea applied in rice is much higher in Bangladesh compared to Bihar and Nepal. Generally, average rates of urea and DAP applied in both rice and wheat were lowest in study sites in Nepal when compared with India and Bangladesh.

Unlike urea and DAP, farmers did not apply manure to all fields in the survey sample. In Bihar, (India) and Nepal, 47% of rice plots received manure, while 26% applied manure in Bangladesh. Manure was applied in 24% of plots cultivated to wheat in Nepal. Across all locations, farmers in focus groups indicated that their use of manure is decreasing over time. They reported that educated young household members are less interested in carrying manure to plots, and as a result, the use of chemical fertilizer is increasing over time. In Haryana, the average amounts of manure use in rice and wheat fields were 1,899 and 1,680 kg ha−1 , respectively, while they were 925 and 1,250 kg ha−1 in rice and wheat fields in Bihar (Al-Taey, 2018).

**Table 2.b: POST HOC ANALYSIS on Significant Difference of fish waste water and fish scales and commercial fertilizer in the parameters of corns' girth.**

| | Mean Difference | P-Value | Interpretation |
|---|---|---|---|
| Treatment 1 vs Treatment 2 | -.8027* | 0.0000 | Highly Significant |
| Treatment 1 vs Treatment 3 | -1.2797* | 0.0000 | Highly Significant |
| Treatment 1 vs Treatment 4 | -1.2410* | 0.0000 | Highly Significant |
| Treatment 2 vs Treatment 3 | -.4770* | 0.0000 | Highly Significant |
| Treatment 2 vs Treatment 4 | -.4383* | 0.0000 | Highly Significant |
| Treatment 3 vs Treatment 4 | 0.0387 | 0.4760 | Not Significant |

**Significant difference of the different treatments in the parameters of the number of corns' number of leaves**

Table 2.c presented difference among the different treatments such as treatment 1 for 100% fish scale, treatment 2 for 100% fish waste water, treatment 3 for 50% fish scale and 50% Fish Water Waste, and treatment 4 for commercialized fertilizer in terms of the number of corns' plant leaves. It showed that the number of corns' plant leaves in treatment 1 which was pure 100% fish scale as contrasted among the three treatments such as treatment 2 for 100% fish waste water, treatment 3 for 50% fish scale and 50% Fish Water Waste, and treatment 4 for commercialized fertilizer obtained a p-value of 0.000 which interpreted as highly significant. There was a significant difference in the number of leaves of corn plants in different treatments. Treatment 1 which was 100% pure fish scale showed the mean differences of ±6.2333 in treatment 2 which was 100% fish waste water, ±7.6000 in treatment 3 which was 50% fish scale and 50% Fish Water Waste, and ±7.7333 in treatment 4 which was commercialized fertilizer. This implied that the interaction effect of treatment 1 which was pure 100% fish scale in the growth of corns' plant number of leaves was differ among the other treatments due to the amount of fish scale applied as fertilizer for the growth of corns' plant. This means that the response of the growth of corns' plant number of leaves varies on the different amount of percentage of the fish scale, fish waste water and commercial fertilizer applied as plant fertilizer. Meanwhile, the number of corns' plant leaves in treatment 2 which was 100% fish waste water as contrasted to treatment 3 for 50% fish scale and 50% Fish Water Waste and treatment 4 for commercialized fertilizer obtained a p-value of 0.000 which interpreted as highly significant. There was a significant difference in the number of leaves of corn plants in different treatments. Treatment 2 which was 100% fish waste water showed the mean differences of ±1.3667 in treatment 3 which was 50% fish scale and 50% Fish Water Waste, and ±1.5000 in treatment 4 which was commercialized fertilizer. This implied that the interaction or effect of treatment 2 which was 100% fish waste water in the growth of corns' plant number of leaves was differ among the two treatments due to the amount of fish waste water applied as fertilizer for the growth of corns' plant. It was supported by the study of Ellyzatul et al., (2018), in the effect of fish waste extract on the growth, yield and quality of Cucumis sativus L. revealed a significant difference with the means differences number of leaf in the different composition of fish waste extract such as 20 mL of fish waste extract showed the highest number of leaf with 26.00 ± 2.08 followed by 50 and 40 mL of fish waste extract with a value of 23.33 ± 2.03 and 22.00 ± 1.15, respectively. The results was supported also by the findings of Oladimeji et al. (2018), who reported that application fish waste increase the number of pumpkin leaf. The applied fish waste increased the activity of microorganism present in the soil, increased

the root growth and plant growth regulators activity. Thus, number of cucumber leaf is increased. Moreover, Khandaker et al. (2013) reported that application of growth regulators increased the vegetative growth of flowering and fruiting plants.

However, it was revealed that the number of corns' plant leaves in treatment 3 which the 50% fish scale and 50% Fish Water Waste and treatment 4 for commercialized fertilizer obtained a p-value of 0.7930 which interpreted as not significant. There was no significant difference in the number of leaves of corn plants in treatment 3 and 4 Treatment 3 which was 50% fish scale and 50% Fish Water Waste, showed the mean differences of ±0.1333 in treatment 4 which was commercialized fertilizer. This implied that the same interaction effect of the treatment 3 which the 50% fish scale and 50% Fish Water Waste and treatment 4 for commercialized fertilizer in the growth of corns' plant number of leaves were closed to each other. It was supported by Brotodjojo & Arbiwati, (2018) in their study about the Growth and Yield of Hybrid Corn under Different Fertilizer Applications revealed that the number of leaves did not significantly affected by different fertilizers application. Furthermore, plants treated with inorganic fertilizers significantly had higher chlorophyll content and produced higher yield than those treated with Granular Organic Fertilizer at various doses.

**Table 2.c: POST HOC ANALYSIS on Significant Difference of fish waste water and fish scales and commercial fertilizer in the parameters of corns' number of leaves.**

| | **Mean Difference** | **P-Value** | **Interpretation** |
|---|---|---|---|
| Treatment 1 vs Treatment 2 | -6.2333* | 0.0000 | Highly Significant |
| Treatment 1 vs Treatment 3 | -7.6000* | 0.0000 | Highly Significant |
| Treatment 1 vs Treatment 4 | -7.7333* | 0.0000 | Highly Significant |
| Treatment 2 vs Treatment 3 | -1.3667* | 0.0080 | Highly Significant |
| Treatment 2 vs Treatment 4 | -1.5000* | 0.0040 | Highly Significant |
| Treatment 4 vs Treatment 3 | -0.1333 | 0.7930 | Not Significant |

**Significant Difference of the different treatments in the parameters of the length of corns' plant leaves**

Table 2.d presented the significant difference among the different treatments such as treatment 1 for 100% fish scale, treatment 2 for 100% fish waste water, treatment 3 for 50% fish scale and 50% Fish Water Waste, and treatment 4 for commercialized fertilizer in terms of the length of corns' plant leaves. It showed that the length of corns' plant leaves in treatment 1 which was pure 100% fish scale as contrasted among the three treatments such as treatment 2 for 100% fish waste water, treatment 3 for 50% fish scale and 50% Fish Water Waste, and treatment 4 for commercialized fertilizer obtained a p-value of 0.000 which interpreted as highly significant. There was a significant difference in the length of leaves of corn plants in different treatments. Treatment 1 which was 100% pure fish scale showed the mean differences of ±44.2000 in treatment 2 which was 100% fish waste water, ±64.6300 in treatment 3 which was 50% fish scale and 50% Fish Water Waste, and ±64.2667 in treatment 4 which was commercialized fertilizer. This implied that the interaction or effect of treatment 1 which was pure 100% fish scale in the growth of corns' plant length of leaves was differ among the other treatments. It was supported by the study of Ellyzatul et al., (2018), in the effect of fish waste extract on the growth, yield and quality of Cucumis sativus L. revealed a statistically different at level in case of leaf area. The higher value of leaf area was showed in 50 mL of fish waste extract with 263.94 ± 17.97 followed by 20 and 40 mL of fish waste extract with a leaf area 258.47 ± 26.88 and 256.57 ± 19.92, respectively. The smaller leaf was observed in control treatment with 198.42 ± 9.89. In our study, we did not notice the significant effect of fish waste extract on leaf area. On the other hand, Oladimeji et al (2018) reported positive significant effect of fish effluent on leaf area of pumpkin plants. The fish waste extract elevated the levels of plant nutrient and plant growth regulators which increased the leaf area cucumber. Another study reported that application of gibberellin and phloemic stress significantly increased the leaf area showed the lowest number of flower with 4.00 ± 1.15 followed by 40 mL of fish

waste extract with 6.67 ± 1.20. We found that higher concentration of fish waste increase the flower number of cucumber but at lower concentration did not produce any effect. It has been reported earlier that fish waste extract contains the growth regulators and these plant growth regulators may be play a significant role to develop the flower bud. Moneruzzaman et al. (2013) also reported that localized application of gibberellin increased the number of flower of wax apple plants.

Meanwhile, the length of corns' plant leaves in treatment 2 which was 100% fish waste water as contrasted to treatment 3 for 50% fish scale and 50% Fish Water Waste and treatment 4 for commercialized fertilizer obtained a p-value of 0.000 which interpreted as highly significant. There was a significant difference in the number of leaves of corn plants in different treatments. Treatment 2 which was 100% fish waste water showed the mean differences of ±20.4333 in treatment 3 which was 50% fish scale and 50% Fish Water Waste, and ±20.0667 in treatment 4 which was commercialized fertilizer. This implied that the interaction or effect of treatment 2 which was 100% fish waste water in the length of corns' plant leaves was differ among the two treatments.

However, it was revealed that the length of corns' plant leaves in treatment 3 which the 50% fish scale and 50% Fish Water Waste and treatment 4 for commercialized fertilizer obtained a p-value of 0.8590 which interpreted as not significant. There was no significant difference in the length of leaves of corn plants in treatment 3 and 4 Treatment 3 which was 50% fish scale and 50% Fish Water Waste, showed the mean differences of ±0.3667 in treatment 4 which was commercialized fertilizer. This implied that the interaction or effect of the treatment 3 which the 50% fish scale and 50% Fish Water Waste and treatment 4 for commercialized fertilizer in the length of corns' plant leaves were the same.

**Table 2.d: POST HOC ANALYSIS on Significant Difference of fish waste water and fish scales and commercial fertilizer in the parameters of corns' length of leaves.**

| | **Mean Difference** | **P-Value** | **Interpretation** |
|---|---|---|---|
| Treatment 1 vs Treatment 2 | -44.2000* | 0.0000 | Highly Significant |
| Treatment 1 vs Treatment 3 | -64.6333* | 0.0000 | Highly Significant |
| Treatment 1 vs Treatment 4 | -64.2667* | 0.0000 | Highly Significant |
| Treatment 2 vs Treatment 3 | -20.4333* | 0.0000 | Highly Significant |
| Treatment 2 vs Treatment 4 | -20.0667* | 0.0000 | Highly Significant |
| Treatment 3 vs Treatment 4 | 0.3667 | 0.8590 | Not Significant |

Summary of **Findings**

Based on the result of the study, the researcher summary of findings were the following:

1. It was found out that treatment 1 which was 100 % fish scale had the lowest mean followed by treatment 2 which was 100% fish waste water in height, girth, number of leaves, and length of leaves of corn plants.
2. Treatment 3 which was 50% fish scale and 50% fish water waste had the highest mean in height, girth, and length of leaves of corn plants.
3. Treatment 4 which was commercialized fertilizer had obtained the same mean on the number of leaves with treatment 3.
4. Treatment 1 versus among other treatments was highly significant. The same results with treatment 2 and treatment 3 contrasted to other treatments when it comes the height of the corns.
5. The analysis of treatment 3 and 4 showed no significant difference in the height of corns
6. Treatment 1 versus among other treatments showed high significant difference. The same results with treatment 2 and treatment 3 as contrasted to other treatments when it comes to corns' girth.
7. The analysis of treatment 3 and 4 showed no significant difference.
8. Both treatments 3 and 4 garnered the same mean in the corns' number of leaves.
9. Treatment 3 and 4 showed no significant difference in the corns' length of leaves.

**Conclusions**

Based on the summary of the findings, the following conclusions were drawn.

The growth response of the corn plants in terms of height, girth, number of leaves, and length of leaves varies on the different treatments. The 100 % fish scale and 100% fish waste water were not an effective fertilizer in corns' height, girth, number of leaves, and length of leaves. While 50% fish scale and 50% fish waste water was effective and commercialized fertilizer for corns. Unbalanced soil nutrients can affect the growth of the corn plants. These nutrients were too much NPK and calcium components in the garden soil can greatly affect the growth of the corn.Proper nutrient concentrations in the soil greatly affect the growth of the corn.

Soil acidity can delay the growth of the corn. 100% fish waste water can be consider an option in enhancing the soil for sweet corn growth (height, girth of stem, number of leaves and length of leaves). Commercial fertilizer, being statistically most effectively though is chemically prepared can still be the option is enhancing the growth of sweet corn.

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