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Enhancing Eggplant Yield Through Fertilizer Application Supplemented with Micronutrients and Plant Growth Regulator

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Abstract
Aim: This study aimed to evaluate the effect of micronutrients and plant growth regulator, in combination with the recommended rate of Nitrogen (N), Phosphorous (P) , and Potassium (K), on the growth and yield of eggplant.
Methodology: The experiment was conducted in a farmer's field located at Barangay Guayabal, Cauayan City, Isabela, where the soil analysis had a pH of 6.15 (slightly acidic) 0.55% organic matter, 11.33 ppm Phosphorus and 210.15 ppm available Potassium and a fertilizer recommendation of 90-40-30 kg NPK ha^{-1}. Treatments included the application of micronutrients Zinc Sulfate ($ZnSO_4$), Borax, Ferrous Sulfate ($FeSO_4$), Black Soldier Fly (BSF) frass, a combination of Zinc Sulfate + Borax + Ferrous Sulfate and gibberellic acid (GA_3), all combined to the recommended NPK rate laid out in a Randomized Complete Block Design (RCBD) with three replications.
Results: Results of the study showed that treatments involving NPK + GA_3 (T7) and NPK + $ZnSO_4$ + Borax + $FeSO_4$ (T6) significantly enhanced plant height at 90 days after transplanting (DAT), number of branches, fruits per plant, fruit diameter, and fruit weight. Although fruit length was not significantly affected, these two above - mentioned treatments (T6 and T7), closely followed by BSF frass (T2), produced the highest yields per sampling area. Likewise, the marketable fruit yield per 1000 m^2 with increased by 59.23% (T6), 47.31% (T7) and 14.23% (T2) over the sole application of NPK. This emphasizes the effectiveness of micronutrient combinations and GA_3 in improving eggplant yield.
Conclusion: The supplementation of NPK with specific micronutrients significantly enhances both vegetative growth and yield in eggplant, particularly resulting in a return on investment of 65.69% with the application of 90-40-30 kg NPK ha^{-1} + Zinc sulfate + Borax + Ferrous sulfate).
Keywords: micronutrients, gibberellic acid, growth regulator, enzymes, black soldier fly frass

INTRODUCTION

A key crop globally, especially across tropical and subtropical areas, eggplant (*Solanum melongena L.*) is appreciated for its nutritional value and ability to thrive in varied agro-ecological conditions. This low-calorie vegetable boasts significant amounts of dietary fiber, vitamins C and K, potassium, magnesium, and beneficial antioxidants (Naeem & Ugur, 2019). Beyond its use in numerous dishes, eggplant serves as an important and stable source of income for farmers and small-scale entrepreneurs due to its consistent popularity.

Representing about 28% of the total volume of the Philippines' primary vegetables, eggplant production achieves the highest market value. Grown across more than 1,875 hectares in farm sizes of 0.5 to 2.0 hectares, the average yield is 18.4 metric tons per hectare, which is roughly half the average yield in Asia and globally (DA, Region 02, 2017).

Achieving optimal eggplant yields and quality often faces hurdles, with soil fertility being a critical determinant of plant growth and productivity. This fertility is a product of the soil's physical, chemical, and biological characteristics. A significant concern in agriculture, is soil degradation—the deterioration of structure, porosity, and moisture retention—which diminishes crop yields and increases vulnerability to diseases. Furthermore, the quality of eggplant is paramount for consumer appeal, market price, and long-term sustainability. Micronutrients play a vital

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role in plant health, influencing growth, development, and the overall quality of horticultural crops. These essential elements support various physiological functions, ensuring plants achieve optimal productivity and resilience. Deficiencies in vital micronutrients like calcium, zinc, boron, and manganese are common in many areas, resulting in stunted growth and lower yields in eggplant.

Ensuring a balanced availability of micronutrients is paramount for the proper growth of eggplant, and deficiencies can lead to substantial declines in both yield and the quality of the fruit. Using sustainable practices to improve soil health and maintain long-term fertility is essential for boosting eggplant yields and ensuring high-quality crops. By fostering a balanced and nutrient-rich growing environment, farmers can achieve better productivity while promoting sustainability in agriculture.

This study highlights the use of plant growth regulators and micronutrients in combination with organic fertilizer, which might reduce the dependency on chemical fertilizers because the nutrient demands of eggplant may not be fully met by organic fertilizers alone. This management supports the Sustainable Development Goals of the nation. Additionally, micronutrient and foliar fertilizer applications not only enhance the nutritional quality of crops but also promote better human health. Moreover, sustainable nutrient management practices, such as micronutrient and plant growth regulator applications, also support improved plant efficiency and reduce the need for chemical inputs. SDG # 1 focuses on no poverty, ensuring that those in rural and vulnerable communities have access to basic services, economic resources, and opportunities to improve their livelihoods. SDG # 2 addresses zero hunger by aiming to achieve food security, improve nutrition, and promote sustainable agriculture. SDG # 3 concerns good health and well-being, and SDG # 13 focuses on decreasing the carbon footprint of agriculture, particularly through the adoption of climate-smart farming methods such as conservation tillage, crop rotation, and organic fertilizers.

While micronutrient deficiencies pose a challenge to increasing yield, addressing these deficiencies in soil is essential for boosting eggplant production. Micronutrients play vital roles in plant growth, flowering, fruit development, and disease resistance, making them crucial for healthy crop yields.

Objectives

This study aimed to determine the effect of growth regulator, micronutrients and organic fertilizer in enhancing the yield of eggplant.

Specifically, it aimed to:

1. determine the effects of growth regulator and micronutrients in combination to organic fertilizer on the on the growth, development, and fruit yield of eggplant;
2. identify the proper combinations of growth regulator, micronutrients, and organic fertilizer that increases the yield and quality of eggplant; and
3. Assess the most economical treatment using the simple cost and return analysis.

METHODS

Application of Micronutrients

Boron (B). Boron is required by direct-seeded or transplanted eggplant in the field. Boron was applied at one kilogram per hectare prior to transplanting.

Zinc (Zn). Zinc or zinc sulfate was applied prior to transplanting not to exceed 10 kilograms per hectare.

Iron (Fe). Iron or Iron sulfate was applied as foliar spray two weeks after transplanting at a rate of 1 kilogram per hectare.

Application of Plant Growth Promoter

Gibberellic acid was applied following manufacturer's recommendation of 6 grams per hectare.

Fertilization

Prior to transplanting, holes were constructed at a distance of 70 centimeters between rows and 50 centimeters between hills and the rate of inorganic fertilizer for T_1 was placed and covered with thin layer of soil. The application of foliar fertilizer was applied using the recommendation found in the label of the product. Plant growth promoter (Gibberellic acid) was applied following the manufacturer's recommendation.

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Collection of Soil Sample and Analysis

Soil samples were randomly collected before land preparation within the experimental area with the use of a shovel. The soil sample were pulverized, air dried for 3 days, and inert matter were removed using sieve with 2 mm openings. One-kilogram composite soil sample was brought to the Department of Agriculture - Cagayan Valley Integrated Agricultural Laboratory (DA-CVIAL), San Felipe, Ilagan City. Based on the soil analysis, findings, the recommended fertilizer application rate was 90-40-30 kilograms of N, P, K per hectare.

Data Gathered

1. **Plant Height.** A total of ten sample plants were randomly selected from the central region of each experimental plot. Plant height measurements were conducted at 30-day intervals, specifically at 30, 60, and 90-days post-transplanting. Measurements were taken from the basal region of the plant to the apex of the primary stem to ensure consistency in data collection.
2. **Number of Branches per Plant.** The total number of branches from the ten selected plants was added together and then divided by ten to determine the average number of branches per plant.
3. **Number of Marketable Fruits.** The total number of fruits harvested from the first to the last priming for each plant was added together and then divided by ten to calculate the average number of fruits per plant.
4. **Length of Marketable Fruits.** A random selection of ten fruits was made from ten sample plants in each treatment group to measure their length.
5. **Weight of Marketable Fruits per Plant.** During each harvest, the weight of marketable fruits was measured and documented. After the final collection, the cumulative recorded weight was calculated and then divided by ten sample plants to obtain the average fresh fruit weight per plant.
6. **Weight of Marketable Fruits per Plot.** The harvestable fruits from the central portion of each plot were measured and documented at every priming. Once the final harvest was completed, the total recorded weights were summed up to calculate the overall marketable fruit yield for the sampling area.
7. **Computed Fruit Yield Per 1000 Square Meters.** The predicted weight of marketable fruits per 1,000 square meters was derived using yield data from designated sampling areas. The calculation was based on the observed mean production within these reference plots to ensure accuracy and representativeness.
8. **Cost and Return Analysis.** The return on investment was analyzed using a basic financial evaluation. Production expenses were estimated based on the current market rates for agricultural inputs and labor within the region. Earnings were estimated by considering the market price of eggplant per kilo. To get the net income, the total earnings were reduced by the production expenses. Finally, the return on investment was worked out by dividing the net income by the production cost and then multiplying by 100.

Statistical Analysis

The collected data was analyzed using the ANOVA for Randomized Complete Block Design in the Statistical Tool for Agricultural Research (STAR) computer package. Any differences among treatment means were compared using Tukey's Honestly Significant Difference test (HSD).

RESULTS and DISCUSSION

The plant height at 30, 60, and 90 Days after transplanting is shown in table 1.

Table 1. Plant Height at 30, 60 and Days After Transplanting (cm). as Affected by Inorganic Fertilizer Supplemented with Micronutrients and Growth Regulator

TREATMENTS	30 DAT	60 DAT	90 DAT
T_1- 90-40-30 kg NPK ha^{-1} (Control)	32.13	64.50	89.93^{d}
T_2 - 90-40-30 kg NPK ha^{-1} + Black Soldier Fly Frass	36.67	69.47	112.30^{c}
T_3 - 90-40-30 kg NPK ha^{-1} + Zinc sulfate	30.83	63.40	108.47^{c}

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T_4 - 90-40-30 kg NPK ha^{-1} + Borax	37.03	69.17	113.40^{bc}
T_5 90-40-30 kg NPK ha^{-1} + Ferrous sulfate	31.70	63.63	114.67^{bc}
T_6 - 90-40-30 kg NPK ha^{-1} + Zinc sulfate + Borax + Ferrous sulfate	40.33	72.53	120.80^{ab}
T_7 - 90-40-30 kg NPK ha^{-1} + Gibberellic Acid	35.67	72.13	125.70^{a}
F- RESULTS	ns	ns	**
C. V. (%)	9.45	6.04	2.46

Means with the same letter are not significantly different using HSD Test
ns-not significant
***- significant at 1% level*

Applying a combination of growth regulators and micronutrients, alongside the recommended inorganic fertilizer rate, led to relatively uniform plant growth across all treatments. At 30 days after transplanting (DAT), average plant height ranged from 31.70 cm to 40.33 cm, showing no significant variations. By 60 DAT, heights spanned from 63.40 cm to 72.53 cm, reflecting consistent development among treatments. These results suggest that integrating growth regulators and micronutrients with standard inorganic fertilization supports stable growth during early to mid-growth stages. Interestingly, these findings differ from those reported by Naga et al. (2013), who observed the highest plant height with micronutrient application alone. Likewise, Jakhar et al. (2018) noted that plants treated with gibberellic acid (GA3) exhibited superior growth across multiple parameters, including height.

The lack of significant differences in plant height across treatments was likely due to the consistent application of inorganic fertilizers across all plots. This uniform nutrient supply appeared sufficient to support early plant development. Similar trends were observed in plots receiving only the recommended inorganic fertilizer rate, suggesting that essential nutrients—particularly nitrogen, phosphorus, and potassium—ensured stable and comparable growth patterns.

At 90 days post-transplanting, plants supplemented with a combination of inorganic fertilizers, micronutrients, and growth regulators attained greater heights compared to those receiving only the recommended inorganic fertilizer rates. The tallest plants were recorded in the treatment that applied 90-40-30 kg NPK ha^{-1} along with gibberellic acid (T_7). This can be attributed to the rapid nutrient availability from inorganic fertilizers and the physiological effects of gibberellic acid, which enhances stem and root elongation, expands leaf area, and promotes flowering and seed germination, leading to increased plant height (Dhakar & Singh, 2015). Meanwhile, foliar application of zinc sulfate, borax, and ferrous sulfate (T_6) resulted in plant heights comparable to those observed in T_7, suggesting that these micronutrients are equally effective in stimulating plant growth.

Plants treated with ferrous sulfate and borax exhibited growth comparable to those receiving black soldier fly frass. Conversely, the control group (T_1), which was supplied solely with the recommended 90-40-30 kg NPK ha^{-1} without supplemental micronutrients or growth regulators, produced the shortest plants. This highlights the critical role of micronutrients in facilitating essential physiological functions, enhancing enzyme activity, promoting reproductive development, and improving plant resilience to stress.

Table 2. Number of Branches, Number of Fruits, Length and Diameter of Fruits as Affected by Inorganic Fertilizer Supplemented with Micronutrients and Growth Regulator

TREATMENTS	Number of branches	Number of fruits	Length of fruits	Diameter of fruits
T_1- 90-40-30 kg NPK ha^{-1} (Control)	4.80c	11.77^{b}	21.72	3.03^{b}
T_2 - 90-40-30 kg NPK ha^{-1} + Black Soldier Fly Frass	5.33bc	13.17^{b}	22.90	3.19^{ab}
T_3 - 90-40-30 kg NPK ha^{-1} + Zinc sulfate	6.53a	11.87^{b}	21.23	3.07^{b}
T_4 - 90-40-30 kg NPK ha^{-1} + Borax	4.90c	12.07^{b}	21.86	3.15^{ab}

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T_5 90-40-30 kg NPK ha^{-1} + Ferrous sulfate	5.97ab	13.47^b	22.09	3.06^b
T_6 - 90-40-30 kg NPK ha^{-1} + Zinc sulfate + Borax + Ferrous sulfate	5.27bc	17.90^a	21.98	3.28^a
T_7 - 90-40-30 kg NPK ha^{-1} + Gibberellic Acid	6.57a	17.27^a	21.91	3.28^a
F- RESULTS	**	**	ns	**
C. V. (%)	5.47	5.47	3.72	2.20

Means with the same letter are not significantly different using HSD Test
*** - significant at 1% level*

Number of branches. The data in Table 2 shows the effect of different treatments on the number of branches per plant and clearly indicates the significant effect of combining inorganic fertilizer and gibberellic acid as well as single application of zinc sulfate and ferrous sulfate resulted in the highest branch count (6.57, 6.53 and 5.97). These findings suggest that plant development can be enhanced through the application of GA_3 (which stimulates cell elongation and division) leading to taller plants; zinc sulfate (which is essential for synthesis of auxins responsible for elongation and growth of plant cells); and ferrous sulfate (which is critical for chlorophyll formation). These elements greatly improve different aspects of growth, such as height, leading to increased number of branches. Similarly, the application of ferrous sulfate yielded an average of 5.97 branches, which is comparable to the aforementioned treatments. On the other hand, the number of branches was higher in the plots treated with the combination of inorganic fertilizer and Black Soldier Fly Frass (T_2), as well as with Zinc sulfate + Borax + Ferrous sulfate (T_6), while the lowest number was observed in the plots treated with inorganic fertilizer plus Borax alone (T_4) and in the control treatment (T_1).

The positive impact observed in the eggplant trials suggests that the addition of growth regulators and micronutrients to the standard inorganic fertilizer application is highly beneficial. This is likely because these added elements play vital roles in plant growth and various physiological functions. This result supports the findings of Sathya et al. (2010), who highlighted that even in small quantities, micronutrients are very effective in regulating plant growth by influencing enzymatic activity, particularly when working in conjunction with inorganic fertilizers.

Number of fruits. Different treatments have a noticeable impact on fruit production per plant, as shown in Table 2. A significant increase in fruit count was observed when the recommended rate of inorganic NPK fertilizer was combined with zinc sulfate, borax, and ferrous sulfate (T_6), as well as gibberellic acid (T_7), resulting in 17.90 and 17.27 fruits per plant, respectively. The impressive results of these treatments indicate that gibberellic acid, when supplemented with the recommended fertilizer and micronutrients, leads to the highest fruit yield. Essential micronutrients such as boron, sulfur, zinc, and ferrous sulfate contribute greatly to plant health and the overall development of eggplant fruits, enhancing productivity.

The findings of Meena et al. (2006) support these results, emphasizing that zinc sulfate and ferrous sulfate enhance the synthesis of enzymes like indole acetic acid (IAA) and stimulate protein production, both of which contribute to stronger vegetative growth. Similarly, research by Suganiya and Harris (2015) indicates that boron application improves both the yield and quality of various crops, including eggplant. Additionally, their study highlights the effectiveness of micronutrients such as boron, zinc, and iron in enhancing fruit set, yield, and overall fruit quality. Beyond micronutrients, plant growth regulators like gibberellic acid (GA3) play a vital role in guiding plants from vegetative to reproductive phases, significantly influencing flower development, fertilization, and fruit formation, as observed by Plackett and Wilson (2016).

Length of Fruits (cm). The results for the length of eggplant fruits as shown in Table 2 indicates that combining inorganic fertilizer with a plant growth promoter and micronutrients had no significant effect on the fruit length of eggplant which ranged from 21.23 cm to 22.09 cm across treatments. Inasmuch as the study only employed one variety which restricts genetic diversity, it does not accurately reflect possible variation in fruit length. The non-significant difference on the varietal traits, particularly on fruit length, might be due the possibility that genetic factors, rather than environmental or experimental settings, primarily control this trait, similar to the claim of

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(Luo et al. 2024). These results clearly indicate that fruit length is a relatively stable trait that does not easily change in response to external factors and nutrient combinations.

Fruit Diameter (cm). There was a significant improvement on the fruit diameter of eggplant after the application of treatments (Table 2). The analysis on the fruit diameter of eggplant showed that those plots treated with 90-40-30 kg NPK ha^{-1} + Zinc sulfate + Borax + Ferrous sulfate (T_6) and Treatment 7 (90-40-30 kg NPK ha^{-1} + Gibberellic Acid) both had the biggest fruit diameter measuring 3.28 centimeters.

The critical roles of micronutrients in plant physiological systems are responsible for this improvement. As such, the synergistic effect of these elements likely improved nutrient uptake and hormonal balance, resulting in better fruit development and increased diameter. The consistent performance of this treatment across replications underscores its potential effectiveness in enhancing eggplant fruit quality. Moreover, the presence of a sufficient number of micronutrients enhances the photosynthetic capability of the plant that will be converted by plants for their growth and development (Sabijon & Sudaria, 2018).

Notably, Treatment 2 (90-40-30 kg NPK ha^{-1} + Black Soldier Fly Frass) and Treatment 4 (90-40-30 kg NPK ha^{-1} + Borax) had comparable fruit diameters, measuring 3.19 cm and 3.15 cm, respectively. This indicates that Black Soldier Fly Frass (BSFF) as a biofertilizer possesses beneficial biological properties proven to have a good effect on plants because there are groups of nitrogen-fixing bacteria and phosphate-solubilizing bacteria (Hernahadini, 2022). On the other hand, borax combined with inorganic fertilizer likewise has a potential in increasing fruit diameter, as it facilitates the transport of carbohydrates through cell membranes involved in the flowering and fruiting of the plant (Sharma, 2006).

Plants treated with 90-40-30 kg NPK ha^{-1} combined with zinc sulfate, NPK rate plus ferrous sulfate and the control plots recorded a slightly smaller fruit diameter of 3.07 cm, 3.06 and 3.03 centimeters, respectively indicating that supplementing NPK with micronutrients like zinc sulfate and ferrous sulfate may contribute to a marginal increase in fruit size.

Table 3. Weight of Fruits per Plant and per Sampling Area (kg/6 m^2) as Affected by Inorganic Fertilizer Supplemented with Micronutrients and Growth Regulator

TREATMENTS	Weight of Fruits per Plant (kg)	Weight of Fruits per Sampling Area (kg)
T_1- 90-40-30 kg NPK ha^{-1} (Control)	1116.80c	5.58^{d}
T_2 - 90-40-30 kg NPK ha^{-1} + Black Soldier Fly Frass	1275.93^{b}	6.38^{abc}
T_3 - 90-40-30 kg NPK ha^{-1} + Zinc sulfate	1162.93^{bc}	5.81^{cd}
T_4 - 90-40-30 kg NPK ha^{-1} + Borax	1182.53^{bc}	5.91^{bcd}
T_5 90-40-30 kg NPK ha^{-1} + Ferrous sulfate	1247.60^{bc}	6.24^{bcd}
T_6 - 90-40-30 kg NPK ha^{-1} + Zinc sulfate + Borax + Ferrous sulfate	1778.20^{a}	7.11^{a}
T_7 - 90-40-30 kg NPK ha^{-1} + Gibberellic Acid	1645.07^{a}	6.58^{a}
F- RESULTS	**	**
C. V. (%)	3.97	4.16

Means with the same letter are not significantly different using HSD Test
*** - significant at 1% level*

Weight of fruits per plant. As presented in Table 3, eggplant fruit weight varied significantly due to the influence of plant growth regulators and micronutrients. The supplementation of zinc sulfate, borax, ferrous sulfate, and gibberellic acid alongside the recommended NPK fertilizer rates notably increased the fruit weight per plant, yielding 1778.20 grams (T6) and 1645.07 grams (T7). These results indicate that both treatments enhanced plant growth and development, ultimately leading to higher fruit yields.

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This yield improvement supports the findings of Roitsch et al. (2003), who explained that increased yield is associated with the efficient transport of photoassimilates from production sites (sources, such as leaves) to growth and storage sites (sinks, such as fruits, roots, or seeds). The enzyme responsible plays a vital role in sugar transport by breaking down sucrose outside the cells, facilitating sugar uptake into plant tissues where it is needed for growth and development, thereby promoting overall plant productivity.

On the other hand, lower fruit yield was recorded in plants applied with Black Soldier Fly Frass; however, it indicates a significant improvement over the control plots (T_1) and those plants treated with single-element micronutrients**.** Similarly, there were comparable and moderate yield improvements in Treatment 3 (1162.93 grams), Treatment 4 (1182.5 grams) and Treatment 5 (1247.60 grams). These yields were comparable to that of the control plots with a mean yield of 1116.80 grams. These results are in line with those of Dubey et al. (2013), who found that applying micronutrients along with NPK fertilizers significantly increased fruit weight compared to applying NPK alone. This demonstrates how micronutrients work in increasing fruit development and nutrient uptake efficiency, which in turn improves yield performance.

Weight of Fruits per Sampling Area (kg/6 m^2). The data on the weight of fruits per sampling area of eggplant in response to different micronutrients and plant growth regulators are shown in Table 3. The statistical results showed a highly significant variation in weight, with the highest total yields of 7.11 kg (17.92% increase in T_6) and 6.58 kg (27.41% increase in T_7). Additionally, the plants in T_2 – NPK + Black Soldier Fly Frass (14.33% increase) significantly attained heavier fruits compared to the control. However, the application of zinc sulfate, borax, and ferrous sulfate, although showing an improved yield over the control treatment, was only slightly effective compared with the other treatments (T_6, T_7, and T_2).

This is in conformity with the claims of Afrin et al. (2024) that foliar application of GA_3 with micronutrients is an effective strategy for increasing crop yields of eggplant.

Table 4. Computed Marketable Fruit Per 1000 Square Meters (kg)

TREATMENTS	MEAN
T_1- 90-40-30 kg NPK ha^{-1} (Control)	29.78^{c}
T_2 - 90-40-30 kg NPK ha^{-1} + Black Soldier Fly Frass	34.02^{b}
T_3 - 90-40-30 kg NPK ha^{-1} + Zinc sulfate	31.01^{bc}
T_4 - 90-40-30 kg NPK ha^{-1} + Borax	31.53^{bc}
T_5 90-40-30 kg NPK ha^{-1} + Ferrous sulfate	33.27^{bc}
T_6 - 90-40-30 kg NPK ha^{-1} + Zinc sulfate + Borax + Ferrous sulfate	47.42^{a}
T_7 - 90-40-30 kg NPK ha^{-1} + Gibberellic Acid	43.87^{a}
F- RESULTS	**
C. V. (%)	3.97

Means with the same letter are not significantly different using HSD Test
*** - significant at 1% level*

The computed fruit yield per 1,000 square meters varied significantly between the treatment groups. Notably, a 59.23% yield improvement was noted over the control plots treated with a combination of recommended rates of NPK plus zinc sulfate, borax, and ferrous sulfate and the plots treated with GA_3, a 47.313% increase in yield was noted. The combined application of NPK and Black Soldier Fly Frass resulted in a yield advantage of 14.23%

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while yield increases ranging from 4.13% to 11.47% were observed in treatments that combined NPK with ferrous sulfate, borax and zinc sulfate.

Table 5. Cost and Return Analysis for Eggplant Production in a 1000 m^2 Area

Particulars	T_1	T_2	T_3	T_4	T_5	T_6	T_7
Total Cost of Production	16640.5	16990.53	17075.	17002.3	16990.53	17172.3	17074.5
Gross Income	17868	20412	18606	18918	19962	28452	26322
Net Income	1227.5	3421.47	1531	1915.7	2971.47	11279.7	9247.5
ROI (%)	**7.38**	**20.14**	**8.97**	**11.27**	**17.49**	**65.69**	**54.16**

Cost of eggplant at P60.00/kg

The cost and return analysis of the different treatments in table 5 showed that plants applied with 90-40-30 kg NPK ha^{-1} + zinc sulfate + borax + ferrous sulfate produced the highest return on investment (ROI) at 65.69 percent while the lowest ROI of 7.38 percent was recorded in 90-40-30 kg NPK ha^{-1} (Control). This indicates that the addition of zinc (Zn), boron (B), and iron (Fe) likely lead to an increase in productivity and profit.

Conclusions

Based on the results of the study, it has been found that the recommended rates of NPK in combination to micronutrients and PGRs have positive affect eggplant production. Among the micronutrients, the combination of NPK + zinc sulfate + borax + ferrous sulfate and NPK + gibberellic acid were found to enhance not only vegetative growth but also the overall crop productivity. However, economic analysis showed that the addition of 90-40-30 kg NPK ha^{-1} + zinc sulfate + borax + ferrous sulfate attained the highest return on investment.

Recommendations

Based on the results of this study, it is recommended that for increased yield and profits in eggplant, the application of the recommended rates of NPK fertilizer in combination with zinc sulfate + borax + ferrous sulfate greatly increases both productivity and economic returns. This combination has been shown to be effective in increasing the fruit yield of eggplant. Further studies exploring different levels of NPK and timing of application are also recommended to validate these results.

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