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Growth and Yield of Open Pollinated Young Corn (*Zea mayz* Linn.) as Influenced by Different Levels of Mykovam® Bio-fertilizer

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Abstract

Mykovam® bio-fertilizer was tested to evaluate the effects and performance on the growth and yield of open-pollinated variety (OPV) young corn. The result of the study showed that OPV corn fertilized with mixed Mykovam®, and inorganic fertilizer at one-half recommended rate, (T5) has the highest plant height of 282.40 cm, and the number of leaves at 50 days after planting (DAP) but did not differ significantly with T4 fertilized plants. The number of days to tasseling and silking was shorter in T4 and T5 OPV corn plants at 57 days and got the highest number of corn ears per plant of 1.37 and 1.57, respectively. The average weight of corn cobs, ten samples per treatment was recorded at T5 (1/2 RR Mykovam® + ½ RR Inorganic) with a mean value of 1.23 kg followed by Treatment 4 applied with the recommended rate of chemical fertilizer with 1.07 kg of weight. The shortest plants, the lowest number of corn leaves, the highest number of days to tasseling and silking, and the least corn ears/plant were from the unfertilized plot (T0) which did not differ statistically with plants fertilized with Mykovam® bio-fertilizer.

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Mykovam bio-fertilizer application can help in reducing the amount of inorganic fertilizer but the lone application of Mykovam® bio-fertilizer on OPV corn has less effect due to the shorter period of study and considering the soil has low phosphorous based on the result of soil analysis. Economic analysis showed the highest yield of young cobs was recorded in T5 (1/2 RR Mykovam® + ½ RR Inorganic), while the lowest net income was obtained in T2 applied with 500 kg/ha of Mykovam® bio-fertilizer.

Keywords: OPV young Corn; Mykovam®; Bio-Fertilizer; Yield Performance; Mycorrhizae.

1. Introduction

Most of the farmers cultivate their land to produce yield per growing season without practicing any cropping techniques,like crop rotation with legumes. This is to bring back the nutrient lost from the soil itself. Farmers practiced continuous application of chemical fertilizers to their field which greatly affected the life of the soil and its productivity. The utilization of inoculant bio-fertilizers specifically the Mykovam®, has great potential to help the corn farmers because aside from cheaper and locally available, it could efficiently substitute or supplement to inorganic fertilizers and environmentally friendly. This bio-fertilizer can compete with inorganic fertilizers in terms of yield and improve the soil fertility and productivity of the inorganic fertilizers [1].

Mykovam® is a soil-based bio-fertilizer containing spores. It infectes roots and propagules.[2]. According to Dr. Jocelyn T. Zarate of UPLB BIOTECH, these fungi when inoculated to seedlings will infect the roots, help absorb water and nutrients particularly phosphorus, prevent root infection by pathogens and can increase plant tolerance to drought and heavy metals. The spores and propagules germinate around the roots of the host plant. The fungi eventually invade and stabilize within the roots and produce numerous extensive external hyphae [3].

Mykovam® bio-fertilizers can replace 60-85 % of the chemical fertilizer requirement of the plants and improves soil properties and fertility. It has been tested effectively for crops, fruit trees and forest trees. Nely Aggangan, head of UPLB - Biotech for Agriculture and forestry Program, said Mykovam® also has the ability to bring dead soil back to life, particularly acidic soil a common condition on degraded soil in the Philippines [2].

One of the cereal family that has added great value to man and animals is Maize (Zea mays L). It ranks third following wheat and rice in world production [4][5]. Many Filipino farmers primarily in the rural regions of Visayas and Mindanao have traditionally planted open pollinated varieties (OPV) of corn such as Tinigib, Seniorita, Kalimpus and Pilit by saving the seeds from their harvest for the next cropping season. This practice made possible for the farmers to exchange seeds and breed varieties that are better adapted to the environment unlike to the genetically modified or hybrid [6]. Based on observations, corn serve as their staple food as substitute for rice.

One of the most important means to increase corn production is to extent the application of biological fertilizers. To reach this goal, it is necessary to moderate the use of chemical fertilizers and pesticides like through the time and in the meantime increase the soil organic matter content [7].

2. Scope and Limitation of the Study

The study focused mainly on the effect of growth and yield performance of Seniorita open-pollinated variety young corn (OPV) applied with different levels of Mykovam® as bio-fertilizer and with the standard check of recommended fertilizer and all other factors remain constant.

3. Materials and Methods

3.1. Research Design

The experimental design used was Randomized Complete Block Design (RCBD) with six (6) treatments and replicated three (3) times. The total experimental area was 373.5 square meters while the area for each plot was 7.2 square meters. Open-pollinated variety (OPV) Corn Seniorita variety was used in the study.

3.2. Research Environment

The study was conducted in Dairy New Zealand Research Area, College of Agriculture, Mindanao State University Main Campus, Marawi City, Lanao del Sur from October 18, 2017 to January 20, 2018.

3.3. Data Gathering Procedure

The harvested corn cobs from each treatment were placed in a separate sack to avoid misrepresentation of data during statistical analysis. Each sack was marked with the corresponding number of treatments where the corn cobs were taken. The following data were gathered for analysis and interpretation of the plant height (cm), number of days to tasseling, number of days to silking, number of days to silking, length of corn cobs (cm), the weight of corn cobs 10 samples /treatment (kg), the yield of corn/ha, and economic analysis.

3.4. Statistical Treatment of Data

The data were analyzed using the Fisher Method Analysis of Variance (ANOVA) or F-Test of the Randomized Complete Block Design (RCBD) and followed by Turkey's Honest Significant Different (HSD) Test for mean comparison. (STAR software by IRRI).

4. Results and Discussion

4.1. Plant height of OPV Young Corn

Table 1 shows the plant height of OPV corn measured at ten days intervals until sixty days of growth as influenced by Mycovam® bio-fertilizer at various rates of application. Plant heights of OPV corn vary significantly at different growth stages of growing. T5 plants applied with 1/2 RR Mykovam® + 1/2 RR – IF were the tallest with 282.40 cm and followed by plants in T4 applied with inorganic fertilizer (recommended rate) with 274.53 cm but did not vary statistically from each other. Unfertilized plants (TO – Control/ No fertilizer) was the shortest at 176.10 cm and did not differ from plants applied with Mykovam® respectively

(Figure 1).

Table 1.0: Average plant height (cm) of OPV corn (*Zea mays L.*) applied with Mykovam® bio-fertilizer taken at 10 days interval.

Treatments (kg/ha)	**Mean plant height (cm)*** DAYS AFTER PLANTING (DAP)					
	10	**20**	**30**	**40**	**50**	**60**
T0 - Control (No fert.)	17.44 ^{c}	29.88 ^{c}	55.10 ^{c}	90.15 ^{b}	128.08^{b}	176.10 ^{b}
T1 - 250 Mykovam®	18.14 ^{bc}	32.67 ^{c}	69.98 ^{b}	112.23 ^{b}	152.82^{b}	197.73 ^{b}
T2 - 500 Mykovam®	17.52 ^{c}	32.25 ^{c}	68.23 ^{b}	105.72 ^{b}	143.52^{b}	208.10 ^{b}
T3 - 333 Mykovam ®(RR)	18.04 ^{bc}	33.40 ^{c}	65.77 ^{bc}	104.25 ^{b}	143.52^{b}	185.80 ^{b}
T4 – Inorganic fert. (RR)	19.67 ^{ab}	44.52 ^{a}	106.82 ^{a}	151.38 ^{a}	214.90^{a}	274.53 ^{a}
T5 - 1/2 RR Mykovam® +1/2 RR - IF	20.75 ^{a}	42.07 ^{ab}	109.09 ^{a}	175.97 ^{a}	224.40^{a}	282.40 ^{a}

**** Means followed with the same letter are not significantly different at 1% level based on HSD Test*.**

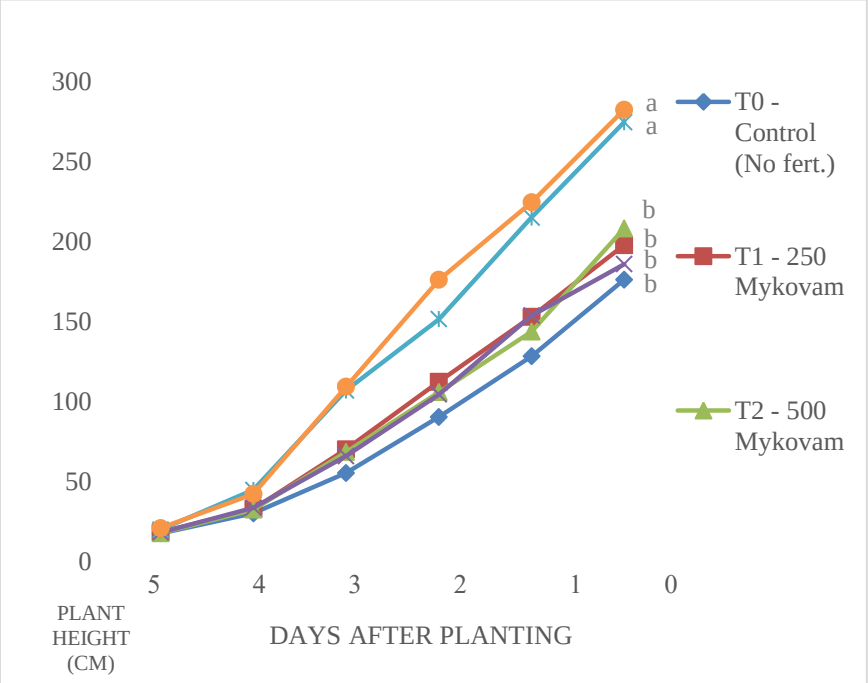

Figure 1: Mean plant height (cm) of young OPV corn applied with differentlevels of Mykovam® bio-fertilizer

The results of the study on plant growth indicate that OPV corn responded to inorganic applied fertilizer added with Mykovam®. This further indicates that the application of Mykovam® can reduce the rate of application of inorganic fertilizer considering corn is a voracious consumer of fertilizer. The reduction in the rate of fertilizer

application would also reduce the cost of production hence helping corn farmers in their input expenses. A related study that would prove the influence of bio-fertilizers on plant growth on the performance of wheat (*Triticum aestivum* L.) as influenced by different levels of fertilizers along with bio-fertilizers with the recommended cultural practices and plant protection measures. The application of 125 percent RDF + Azotobacter + PSB (T8) recorded significantly higher plant height, number of effective tillers per plant, panicle length, dry matter per plant, number of spikelets per panicle, number of grains per panicle, the weight of grains per panicle, grain yield, straw yield and biological yield than all other treatments [8].

4.2. Number of leaves per plant

The number of leaves at 50 DAP varies among fertilized with inorganic and Mykovam® applied plants and plants without fertilizer (T0) (Figure 2). The highest number of leaves was counted from T5 plants fertilized with ½ RR inorganic fertilizer added with ½ RR Mykovam® (T5) with 10.7 leaves but did not vary statistically with corn plants applied with recommended inorganic fertilizer (T4) with 10 leaves. The lowest number of leaves was observed from unfertilized (T0) plants with 7.33 leaves.

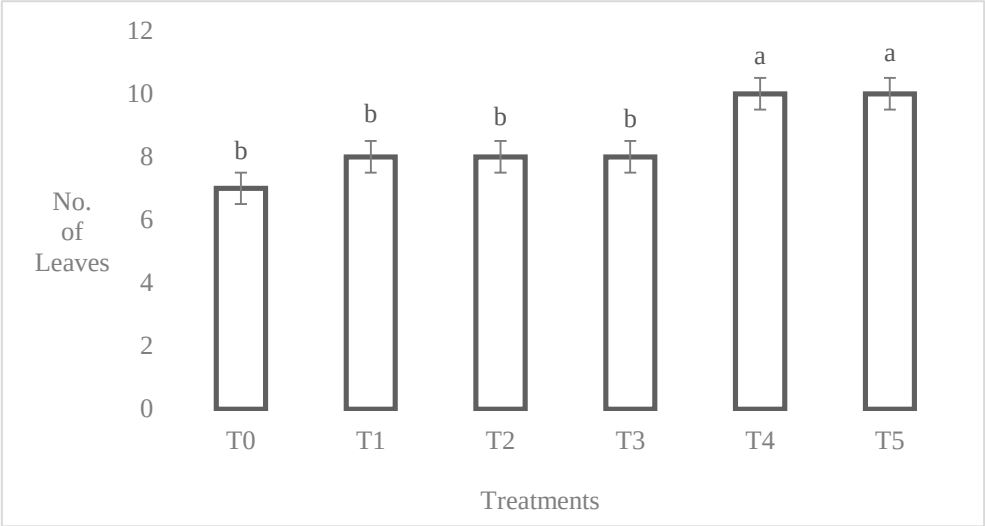

Figure 2: Average number of leaves of OPV corn at 50 Days after planting (DAP) applied with different levels of Mykovam® bio-fertilizer

4.3. Reproductive stage of OPV Yong Corn

The result of the average number of days to flowering/tasselling and silking of OPV corn is shown in Table 2 and Fig.3 and 4. Corn plants applied with mixed inorganic fertilizer did not vary added to purely inorganic. Moreover, there were no significant differences between controlled plants (T0) and those applied with Mykovam® at various levels. Both stages of T5 plants fertilized with ½ RR inorganic fertilizers added with ½ RR Mykovam® and T4 purely inorganic fertilizer shows early flowering and silking and did not vary statistically but varied among the treatments applied with Mykovam® alone. Thus the application of Mykovam® in combination with inorganic has the potential technology for the farmers to reduce the cost of production, especially in fertilizer utilization, and also increase its yield since Mykovam® can compete with

inorganic fertilizers.

Table 2.0: Average number of days to flowering/tasseling and silking applied with different rates of Mykovam® bio-fertilizer.

Treatment, kg/ha	Number of Days to Tasseling	Number of Days to Silking
T0(Control)	63^{b}	69^{b}
T1(250 Mykovam®)	62^{b}	68^{b}
T2(500 Mykovam®)	62^{b}	68^{b}
T3(333 Mykovam® RR)	62^{b}	68^{b}
T41(100 N-60 P2O5-30 K2O)	57^{a}	62^{a}
T5(1/2 RR Mykovam®+1/2 RR Inorganic)	57^{a}	62^{a}

Note: Means follows with the same letter are not significantly different at 5% level based on HSD Test

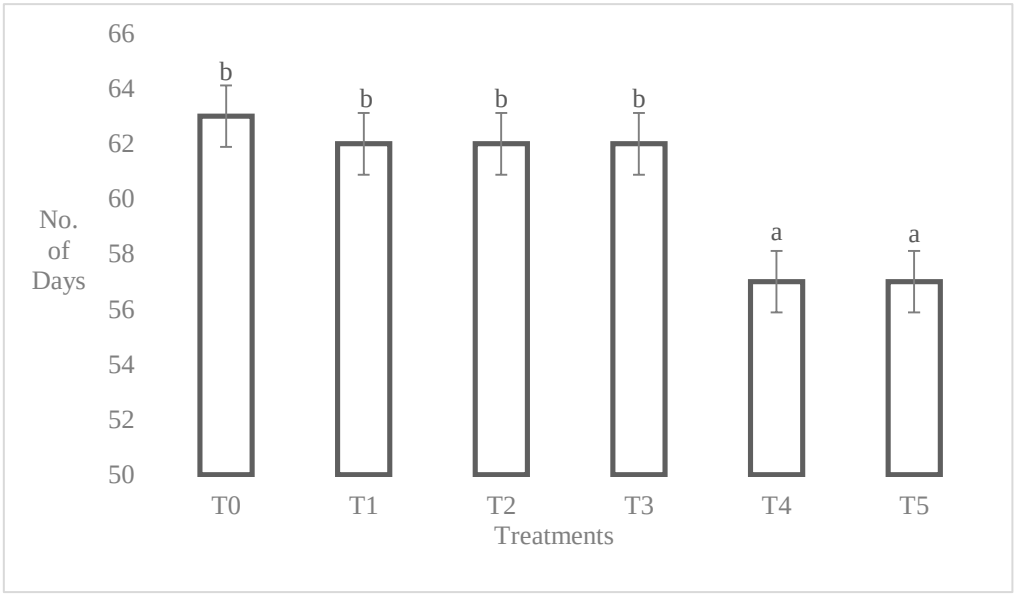

Figure 3: Average number of days to flowering/tasseling applied with different levels of Mykovam® bio-fertilizer

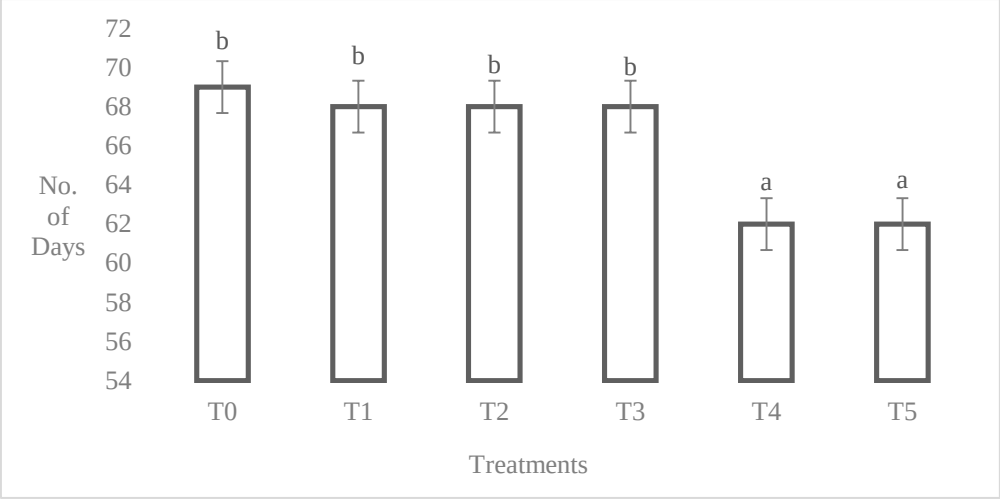

Figure 4: Average number of days to silking applied with different levels of Mykovam® bio-fertilizer

4.4. Yield component (green corn cobs)

The yield data of OPV corn is shown in Figures 5 and 6. The average corn ears per plant differ significantly among treatments. T4 and T5 treated plants have a greater number of corn ears compared to unfertilized plots (T0). Plants with Mykovam® added with inorganic fertilizer had the highest mean having 1.57 compared to the other treatments but statistically did not vary significantly among the treatments. The unfertilized plot got the lowest number of corn ears per plant with a mean of 1.07 respectively. A related study was done to evaluate the effect of bacterial inoculation on different growth parameters of rice variety JP 5. Plant growth promotion was observed in all inoculated treatments, which was evident from the increase in the number of tillers, straw and grain yields, and the total weight of the plants. The study reveals that beneficial strains of PGPR can be used as bio-fertilizer for rice [9].

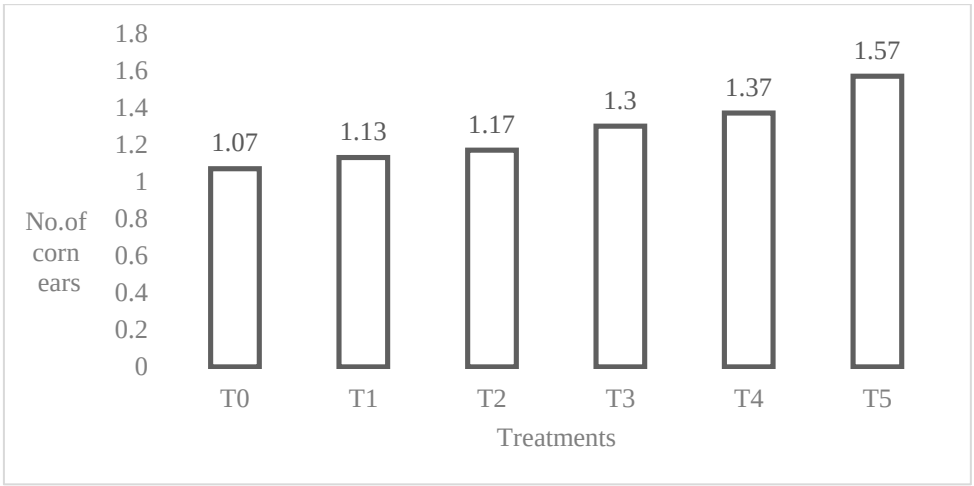

Figure 5: Average number of corn ears/plant applied with different levels of Mykovam® bio-fertilizer

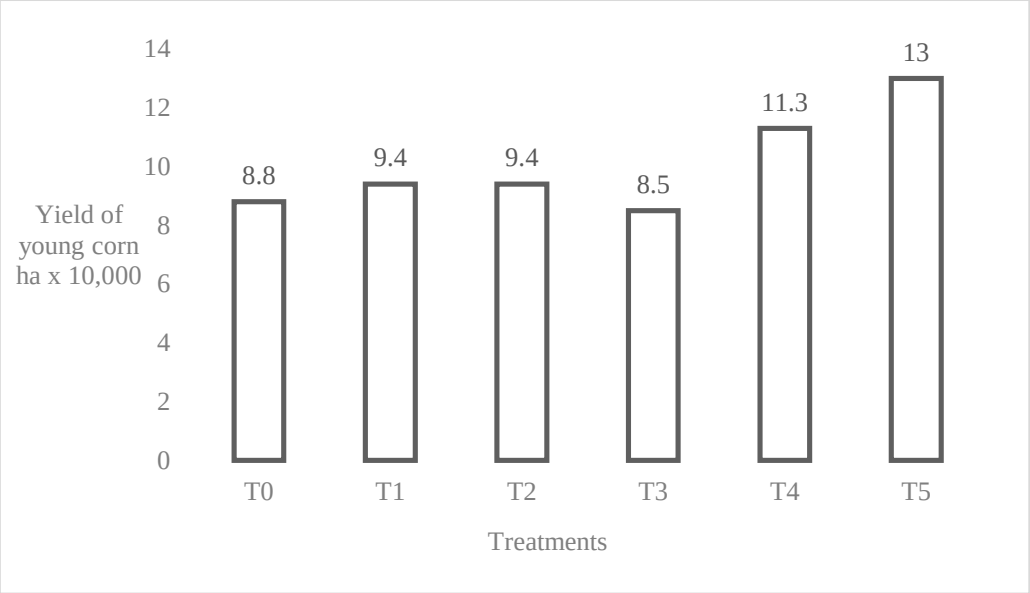

Figure 6: Yield of OPV young corn applied with different levels of Mykovam® bio-fertilizer

4.5. Average length of young corn cobs (cm)

The length of corn cobs reveals that plants with mixed inorganic fertilizer added with Mykovam® bio-fertilizer (T5) had the longest corn cob with a mean of 15.85 cm followed by T4 with 14.85 cm but did not vary statistically from each other (Fig.7). Unfertilized plants (T0) got the shortest corn cob with a mean of 12.63 cm. The application of the Mykovam® bio-fertilizer gave a positive effect on OPV corn. This could be due to the efficient P absorption as mediated by mycorrhizae.

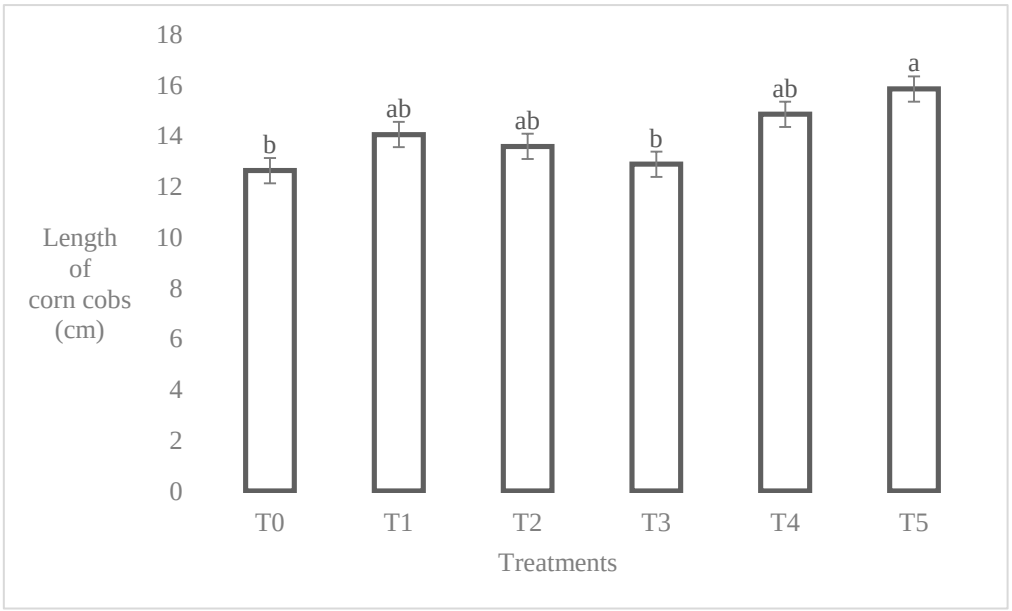

Figure 7: Average length of young corn cobs applied with different levels ofMykovam® bio-fertilizer

4.6. Average weight of young corn cobs (kg)

Based on the result as shown in Figure 7, sample corn cobs in T5 (1/2 RR Mykovam® + ½ RR Inorganic) had the highest weight with a mean value of 1.23 kg followed by Treatment 4 with 1.07 kg of weight/plot applied with the recommended rate of chemical fertilizer. Analysis of variance revealed highly significant among the treatments and mean comparison using HSD Test. T4 and T5 sample cobs did not vary statistically with each other. No significant differences in the average weight of corn cobs sample plants in T0, T1, T2, and T3. However, the mix application of Mykovam® and inorganic fertilizer gave the heaviest corn cobs. A related study conducted by Ram RatanSingh, K Prasad about the efficacy of bio-fertilizer on the growth and productivity of wheat (*Triticumaestivum*) revealed significant responses applied either alone or combined. This further indicates that the application of Mykovam® to OPV corn is an alternative way to recommend to the farmers as their source of organic fertilizer [10].

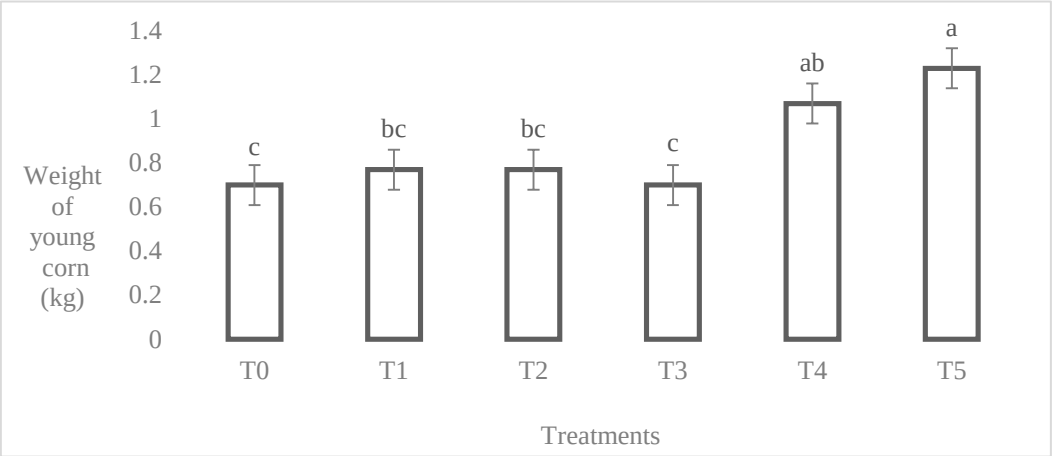

Figure.7: Average weight of young corn cobs applied with different levels of Mykovam® bio-fertilizer

Results showed that height growth and dry matter production of corn plants were comparable in the three chemical fertilizer treatments (0, ½ RRC as 60-30-30 and full RRC as 120-60-60 kg NPK/ha). Soil amendment treatment such as Mykovam (M) alone, vermicompost (V) alone, or combined Mykovam® and vermicompost (M+V) significantly promoted shoot dry matter weight by 9%, 28%, and 22%, respectively over the control. In terms of height increment, ½ RRC + M gave the biggest height increment at 93.97 cm or a 15% increase over the uninoculated and unfertilized control (0 fertilizer). The heaviest cob yield was in full RRC + Mykovam®, followed by full RRC and M + V. This indicated that Mykovam® and vermicompost can potentially improve vegetative growth and enhance corn yield and are effective soil amendments to chemical fertilizers for better corn growth and dry matter production [11].

5. Economic Analysis

Table 3 shows the economic analysis of the application of mycorrhizae and inorganic fertilizers. The result on the net income presented implies that all the treatments are profitable even the unfertilized plot. There is a big difference in the net income of corn that received Mykovam® and inorganic fertilizers. The economic analysis of the study indicates that the highest return of income among the treatments responded to inorganic applied fertilizer in combination with Mykovam® bio-fertilizer (T5) with a ₱260,066.00 yield. Results of the study in

Isabela and Bukidnon conducted by Palis about increasing corn yield at lower cost through Bio-fertilizer Inoculation showed that inoculation of Mykovam® + ½ RR and the combined inoculation of Mykovam® and BIO-N + ½ RR gave high yield which is comparable with the yield obtained from corn plants applied with the full inorganic fertilizer treatment. This could be an alternative lower input technology that could significantly reduce the production costs of corn farmers.

Table 3.0: Summary of cost of production and net income of OPV corn as affected by different rates of Mykovam® bio-fertilizer

A. Expenses	**T_0 (₱)**	**T_1 (₱)**	**T_2 (₱)**	**T_3 (₱)**	**T_4 (₱)**	**T_5 (₱)**
Plowing	3,300	3,300	3,300	3,300	3,300	3,300
Harrowing / Furrowing	6,500	6,500	6,500	6,500	6,500	6,500
Planting	2,500	2,500	2,500	2,500	2,500	2,500
Fertilizer Application	-	-	-	-	5,000	5,000
Weeding	2,500	2,500	2,500	2,500	2,500	2,500
Harvesting	8,000	8,000	8,000	8,000	8,000	8,000
Sub-total	22,800	22,800	22,800	22,800	27,800	27,800
B. Materials						
Seeds	600	600	600	600	600	600
Fertilizer	-	37,500	75,000	49,000	9,900	29,925
Contingency	5,000	5,000	5,000	5,000	5,000	5,000
Sub-total	5,600	43,100	80,600	54,600	15,500	35,525
Total Expenses	28,400	65,900	103,400	77,400	43,300	63,325
Yield(green cobs/ha)	88,533	94,066	94,066	85,766	113,433	130,033
Gross Income (yield green cobs/ha x ₱2.00)	177,066	188,132	188,132	171,532	226,866	260,066
Net Income	**148,666**	**122,232**	**84,732**	**94,132**	**183,566**	**196,741**

6. Conclusion

The results of the study showed the performance of OPV young corn applied with Mykovam® bio-fertilizer has a significant effect on plant height, number of leaves, number of days to flowering, silking, and number of corn cobs per plant, average length, and an average weight of corn cobs. In terms of its yield, the combination of Mykovam® which serves as an organic bio-fertilizer, and the inorganic fertilizer gave a better performance that is highly profitable based on the economic analysis provided. For environmental reasons, best to use Mykovam® bio-fertilizer since it is organically produced which had no cause of pollution and no great effect on the environment, plants, consumers, and most especially on the soil itself. With the findings of this study, a

combination of organic and inorganic fertilizer is recommended because it stabilizes the growth and yield of OPV corn. It helps local farmers address the high cost of chemical fertilizers and save the continuous soil depletion due to its heavy application. Hence, a comparative study should be conducted among organic fertilizers (i.e. vermicompost, vermicast, and animal manure and compost materials) in comparison to Mykovam® in the growth and yield of other field crops.

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Appendix Figure.1: Experimental Area at Dairy Farm MSU-Main Campus, Marawi Citys,Lanao del Sur

Appendix Figure.2: Harvested OPV young corn applied with different levels of Mykovam® bio-fertilizer