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Response of Finger Pepper (Capsicum annuum L.) to Biofertilizer under different Tillage Methods

De Leon, Sheryll C *, Joel Maliwat, M.S.A.

Pampanga State Agricultural University, Magalang, Pampanga 2011, Philippines
*Corresponding Author: sherylldeleon11372@gmail.com

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ABSTRACT

In order to improve crop productivity and profitability, practices such as tillage and fertilization are vital. The study was conducted to evaluate finger pepper as affected by bio fertilizers under different tillage methods. It was done from May to October 2020 at the BASC Palayamanan Site on San Ildefonso, Bulacan. Three commercially available bio fertilizers, Biozim, BioGroe, and Mykoplus were tested for finger pepper in the study. No-tillage, strip tillage and conventional tillage were the tillage methods adopted for this study. The experiment adopted the Split Plot Design in RCBD with four replications; the tillage was as main plots while biofertilizers as sub-plots. Findings revealed that conventionally provided the highest plant height and heavy fruit, but no-tillage obtained the highest root dry weight. BioGroe attained the earliest flowering days, highest fruit set, the highest number of fruits per plant, longest fruit length, heavy fruit weight, and highest total fruit yield. In terms of economic analysis, strip-tillage achieved a good financial attribute as a result of high net income (Php 35,895.00) and ROI (36.46%). BioGroe® influenced profitability which generated positive responses on Net Income (Php44, 134.83) and Return on Investment (41.76%). BioGroe and conventional tillage improved finger pepper productivity and profitability but a further study must be conducted to generate verifiable findings.

Keywords: Finger Pepper, Tillage Methods, Biofertilizers

Introduction

Pepper (Capsicum sp.) is considered an economically valuable spice crop due to its integral part in many cuisines with its fruit botanically classified as a berry and part of the Solanaceae or Nightshade family (Zhigilaet al., 2014). The crop is prolific due to its production of many long, tapering fruits as adaptation to the tropical conditions. The fruits are usually sold in bundles of five to six. The Philippines produces around 15 MIT/ ha peppers (DA-RFO2, 2017). Major pepper producing regions in the country are Cordillera Administrative Region (45%), Northern Mindanao (17%) and Ilocos Region (13%). Soil conditions that are expressed in terms of soil looseness, the soil layer density, friable soil structure and moisture content are vital in crop production. Soil tillage provides a high quality soil situation critical for crop emergence, root growth, and development. Soil tillage alters the soil's physical and chemical properties by using either machinery or tools to provide optimal tilth, increased germination and subsequent crop growth. Additionally, it contributes benefits such as promoting root growth by using growing soil quality, introducing organic matter and fertilizer into the soil, minimizing weeds and various pests through plowing, and enabling to proper drain and distribution.

Intensive soil cultivation, which is a common method among vegetable farmers, is capable of breaking soil clods, incorporating crop residues, eliminating weeds, and providing convenience in building up beds. Although tillage is good for the soil, intensive tillage can lead to soil structure destruction and may restrict crop production due to additional labor expenses as stated by Kladivko (2001). Modern agriculture adopts the conventional way of soil cultivation to thorough crushing of massive soil clods, deeply expand the soil, incorporate crop stubbles, and effortlessly remove the weeds. According to Prasad, Pathak, Patra, and Shivay (2014), application of fertilizers satisfies nutritional requirements of crops. Due to immobilization, soil nutrients are no longer readily available for absorption, but released after decomposition. Furthermore, with the current scarcity of petroleum-based products, synthetic fertilizers are available at constantly high costs. Despite the high fee of chemical fertilizers and the bad effect of long-term use of artificial fertilizer, farmers still count on the use of artificial fertilizer to manipulate crop nutritional needs.

The concept of minimizing the use of synthetic fertilizers is gradually becoming a reality due to the introduction of soil microorganisms that can serve the same function or perform even better. The depletion of soil nutrients by leaching into the waterways and causing pollution is one of the negative effects of chemical fertilizers which impelled the need for appropriate alternatives and led to the idea of using microbes, which can be produced for use as biological fertilizers (or biofertilizers). They are environmentally friendly since they are natural living organisms that, in developing countries, help to increase crop yield and production, and are cheaper than chemical fertilizers (Olanrewajuet al., 2017).

The use of biofertilizers offers an ecological advantage in finding alternative ways to increase the yield of pepper fingers. Their utilization is gaining momentum due to increased emphasis on soil health safety, reduced air pollution and mitigated use of chemical inputs in agriculture.

Biofertilizers are used as one of the key components of nutrient management compared with artificial fertilizers, and are easily sustainable and cost-effective (Akram, Cheena, Wagas Bilal, and Saeed, 2020). Finger pepper as the most cultivated spice in the Philippines, like other vegetable crops, requires sustainable agricultural practices such as proper tillage and application of biofertilizer. This study intended to evaluate the effect of biofertilizers and tillage on methods to finger pepper production. Moreover, the study provided opportunity to investigate their potential as a long-term agricultural practice among farmers.

Literature Review

The common practice of nutrient management is the use of chemical fertilizers but intensive chemical-based farming has led to degradation in the quality of the environment and soil systems that makes the practice unsustainable and with this biofertilizer utilization became one of the important components in integrated nutrient management. Biofertilizers are not commonly used agricultural inputs but its nature provides an ecological way of nourishing the crops needed for growth and development. They are classified as microbial based-fertilizers that when applied may increase the availability of plant nutrients by binding to plant root systems. Aside being an environmentally friendly material, it is said to be low-cost and can be supplemented by both organic and inorganic fertilizers (Kumawat, 2017). Due to their potential in increasing crop production and food health, the use of microbes as bio-fertilizers distinguish to some degree as an alternative to chemical fertilizers in agricultural areas. Some microorganisms like plant growth-promoting bacteria, fungi, cyanobacteria, etc. have been known to have been reported biofertilizer-like things to do in the agricultural sector. Extensive research on bio-fertilizers has imprinted their capability of supplying the crop with the necessary nutrients in adequate quantities that lead to better crop yields (Mahantyet al., 2016).Improved plant productivity and seed quality of sunflower was reported in the findings of Akbariet al. (2011).

Effectiveness of biofertilizer at different concentration influenced productivity of soybean in which at 50% bio-fertilizer application improved soybean yield (Sudiartiet al., 2019). The combined application of the biofertilizer mixture (Azotobacterchrocoocum, AMF, and Bacillus circulans) with organic fertilizers enhanced maize growth, yield, and nutrient uptake in the study of Gao, et al. (2020). Various strains of microorganisms found to boost crop yields for their purpose. Soil microbes have flexible enzyme systems that perform different nutrient transformations in the soil that are very necessary for maintaining the balance and health of the soil. The transformations of nitrogen and phosphorus are important among the nutrient transformations, since they are the key plant nutrients derived from the soil.

Plant Growth Promoting Bacteria encourage crop production either as a bio-protective agent, or as a bio-stimulant. Few PGPB can contribute to the fine root development and thus result in increased plant root absorption. PGPB generates hormones such as indole acetic acid (IAA), gibberellins, and cytokinins in plants. Free-living PGPR as a bio-fertilizer results in good plant growth, increased yields, P (phosphorus) or K (potassium) solubilization, N (nitrogen) absorption, and some other nutrients (Souza, 2015). Plant Growth Promoting Rhizobacteria Bacillus M3 either applied solely or in combination with Bacillus OSU-142 can improved raspberry production, growth and nutrition under organic conditions as concluded by Orhanet al. (2006).The application of biofertilizer such as Azotobacter either alone or combined with farmyard manure resulted in high maize grain yield increased when integrated with low nitrogen application compared to higher nitrogen application according to Meena et al. (2012).Two major types of mycorrhiza, ectomycorrhiza and endomycorrhiza, differ with host plant structure and physiological relationship. Mycorrhizal fungi often induce plants to reduce root biomass but, at the same time, increase the absorption potential of nutrients by spreading well beyond the root surfaces and proliferating in soil pores that root hairs are difficult to enter. Rhizobia and mycorrhizalfungi, invade and colonize the legume roots (Mohammadiet al., 2011).

Methodology

Data Collection

Data were obtained from the ten plants randomly selected via draw lots in each plot in which growth and yield parameters gathered and computed were the following:

1. Plant height (cm). The initial and final height of the sample plants were measured from the ground level to the tip of the main stem by a tape measure. Initial height is measured at 14 DAT and final height at 45 DAT.
2. Number of days from transplanting to 1st flowering- This was obtained achieved by counting the number of days from the sample plants to the 1st flowering day.
3. Days to 50% flowering. Days to 50 percent flowering was determined by recording the number of days following transplanting (DAT) until 50% of plants in a plot had at least one open flower.
4. Percent Fruit Set (%). Fifteern flowers were tagged at the pedicel. The number of fruits was divided by the total number of blossoms.

$$\%\ \text{Fruit set} = \frac{\text{number of set flowers}}{\text{total number of marked flowers}} \times 100$$

5. Number of branches. The number of branches was counted and recorded 30 DAT
6. Number of fruits per plant. The fruits harvested from the sample plants were counted and weighed with a digital weighing scale including damaged fruits also pierced by insects or rotted at any point
7. Fruit length (cm). The maximum length of ten fruits harvested per sample plant was measured using a ruler.

8. Fruit weight (g).Fruits in a sample plant was weighed individually using a digital weighing scale.
9. Weight of harvested fruits (g/plant). All fruits including the damaged fruits were harvested and weighed in a sample plant.
10. Total Fresh Weight (g/plant). The total fresh weight was obtained at the last harvest and all collected parts of the plant except the fruits were weighed.
11. Root dry weight (g). Root dry weight was measured by weighing air dried roots with the use of a digital weighing scale.
12. Shoot dry weight (g). Shoot dry weight was measured by weighing the air dried stems, branches and leaves with the use of digital weighing scale.
13. Root-Shoot ratio. Root-Shoot ratio was computed by dividing the root dry mass by the dry mass of the shoot.

$$\text{Root-Shoot Ratio} = \frac{\text{root dry weight}}{\text{Shoot dry weight}}$$

14. Total fruit yield per hectare (kg). All fruits harvested with or without damage were weighed per plot to determine the computed yield per hectare.

$$\text{Yield (kg/ha)} = \frac{\text{Actual Yield (kg)}}{\text{Area (m}^2\text{) /10,000 m}^2}$$

15. Cost and Return Analysis in Hectare Basis
In terms of economic analysis, the net income and Return on Investment (ROI) was computed using the following formula:
Net Income (P) = Gross Profit- Total Cost of Production

$$\text{ROI(\%)} = \frac{\text{Net Income - Cost of Production}}{\text{Cost of Production}}$$

Results

The effect of biofertilizer and tillage methods on the initial plant height is presented in Table 1. Data show that there were significant differences among treatments oftillage methods which imply that tillage influenced plant growth in terms of height as conformed to the findings of Abrouguiet al. (2014). Tillage method treatments were comparable with one another regardless of the applied biofertilizers where conventional tillage attained the highest initial plant height. Similar results the ones reported by Khan et al. (2017) and Motevaet al. (2017)

As gleaned in Table 1, the mean initial height was obtained by MykoPlusbiofertilizer but no significant difference among treatments.

Likewise, no significant differences observed on the interaction of tillage methods and bio-fertilizers within each treatment on the plant height 14 days after transplanting.

Plant height at maturity was significantly affected by the tillage methods as also observed in Table 1. Regardless of biofertilizers, data also revealed conventional tillage had the highest plant height at 41.97 cm while the two tillage methods were not comparable with one another. This significant reaction confirmed the findings of Amanullah et. al (2015). The effect of biofetilizers did not significantly affect plant height at 35 days after transplanting as observed in Table 1. Likewise, no significant difference was obtained from the interaction of tillage treatments and bio-fertilizers within the treatments on plant height at thirty days after transplanting.

Table 1: The average initial height (cm) of finger pepper at 14 DAT applied With biofertilizers under different tillage method

	Plant height (cm)	
	Initial (14 DAT)	**Final (35 DAT)**
Main Treatment	Mean*	
T_1-No tillage	18.03b	39.16b
T_2-Strip tillage	17.53b	38.39b
T_3-Conventional tillage	21.96a	41.97a
Sub-Treatment	Mean	
B_1-Farmers Practice	19.22	39.44
B_2- Biozim	18.94	39.36
B_3- BioGroe®	19.19	40.37
B_4-MykoPlus	19.34	40.19

*means having the same letter are not significantly different (LSD) at 5% level

Number of Days to 1st Flowering

Table 2 shows no significant differences on the number of days to first flowering among treatments of tillage methods. The shortest number of days to flowering was recorded in no tillage at 29 days, while the longest was in 30 days regardless of biofertilizers. Regardless of tillage method, there were significant differences on number of days to 1st flowerings shown in Table 2. Farmers' practice provided the longest number of days to flowering at 32 days, while the shortest was observed in BioGroe at 29 days. This implies that application of bio-fertilizer can reduce the number of days taken to first flowering as confirmed in the findings of Kumar *et. al,* (2006). There is no significant interaction of tillage methods and bio-fertilizers within the treatments were significantly different on the number of days to first flowering.

Table 2: The average number of days from transplanting to 1stflowering as affected by different tillage methods

Treatment	**Number of days to 1st flowering**
Main Treatment	Mean
T_1-No tillage	29.8
T_2-Strip tillage	30.7
T_3-Conventional tillage	30.41
Sub-Treatment	Mean*
B_1-Farmers Practice	32.33a
B_2-Biozim	30.23b
B_3- BioGroe®	28.48c
B_4=MykoPlus	29.34bc

*means having the same letter are not significantly different (LSD) at 5% level

Table 3: The average number of days from transplanting to 50% flowering applied with biofertiilizers under different tillage methods

Treatment	Number of days to50% flowering
Main Treatment	Mean
T_1-No tillage	33.03
T_2-Strip tillage	33.57
T_3-Conventional tillage	33.81
Sub-Treatment	Mean*
B_1-Farmers Practice	36.15a
B_2- Biozim	33.90b
B_3- BioGroe®	31.42c
B_4=MykoPlus	32.41c

*means having the same letter are not significantly different (LSD) at 5% level

Percentage Fruit Set

The effect of tillage on fruit set was not significant among the treatments (Table 4). The effect of biofertilizers on the fruit set was significantly different among the treatments as also shown in Table 10. Regardless of tillage adopted, BioGroe and Mykoplus had the highest number of days with 70% and 71%, respectively. There was no significant difference observed on the interaction effect of biofertilizers and tillage within the treatments on the fruit set.

Table 4: The fruit set (%) of flowers of finger pepper applied with biofertilizers under different tillage methods

Treatment	Fruit set (%)
Main Treatment	Mean
T_1-No tillage	69.02
T_2-Strip tillage	69.37
T_3-Conventional tillage	67.71
Sub-Treatment	Mean*
B_1-Farmers Practice	66.00b
B_2- Biozim	66.50b
B_3- BioGroe®	70.42a
B_4=MykoPlus	71.75a

*means having the same letter are not significantly different (LSD) at 5% level

Number of Branches

Table 5 presents the number of branches on the effect of different methods of tillage. Statistics show that there were no significant differences observed among treatments. The effect of bio-fertilizers on the number of branches was significant as shown in Table 5 where BioGroe and Mykoplus attained the most number of branches. Likewise, no significant difference was noted from the interaction of tillage method and biofertilizers within the treatments on number of branches.

Table 5: The average number of branches as affected by biofertilizer application under different tillage methods

	Number of branches
Main Treatment	Mean
T_1-No tillage	7.19
T_2-Strip tillage	7.13
T_3-Conventional tillage	7.61
Sub-Treatment	Mean*
B_1-Farmers Practice	6.94b
B_2- Biozim	7.08b
B_3- BioGroe®	7.70a
B_4=MykoPlus	7.78a

*means having the same letter are not significantly different (LSD) at 5% level

Number of Fruits per Plant

Table 6 presents the number of fruits of finger pepper on the effect of different tillage method practices. Statistics show that there were no significant differences observed among treatments. The effect of biofertilizers on the number of fruits was significantly different as shown in Table 6 where BioGroe and MykoPlus produced more fruits. No significant difference was obtained from the interaction of tillage method and bio-fertilizers within the treatments on number of fruits.

Table 6: The number of fruits per plant of finger pepper applied with biofertilizers under different tillage method

Treatment	Number of fruits per plant
Main Treatment	Mean
T_1-No tillage	27.10
T_2-Strip tillage	29.13
T_3-Conventional tillage	29.36
Sub-Treatment	Mean**
B_1-Farmers Practice	27.61b
B_2- Biozim	27.32b
B_3- BioGroe®	29.58a
B_4=MykoPlus	29.61a

*means having the same letter are not significantly different (LSD) at 5% level

Fruit Length

The effect of tillage method on the fruit length was not significantly different among the treatments. There were significant differences observed on the effect of biofertilizers on fruit weight as revealed in Table 7. Statistical analysis showed that BioGroe and MykoPlus provided the same longest fruit length at 9.35 cm and 9.19 cm, respectively, while Farmers Practice and BioZim were the lowest at 8.10 cm and 8.74 cm, respectively. Analyses of data show that there were no significant differences within the treatments on the interaction effect of different tillage method and biofertilizer of finger pepper on fruit length.

Table 7: The fruit length (cm) offinger pepper applied with biofertilizers under different tillage method

Treatment	Fruit length (cm)
Main Treatment	Mean
T_1-No tillage	8.89
T_2-Strip tillage	8.89
T_3-Conventional tillage	8.75
Sub-Treatment	Mean**
B_1-Farmers Practice	8.10c
B_2- Biozim	8.74b
B_3- BioGroe®	9.35a
B_4=MykoPlus	9.19a

*means having the same letter are not significantly different (LSD) at 5% level

Fruit Weight

The effect of tillage on the number of fruits was significantly different among treatments wherein conventional tillage produced the highest fruit weigh at 24.86 g. Likewise, the effect of biofertilzer was highly significant different among treatments was revealed on the fruit weight, which confirmed the findings of Kamilet al. (2015) and Orhanet. al. (2006) implying that biofertilizer application boost fruit production. BioGroe recorded the highest at 23.01 g, while the lowest was in B_1 (Farmers practice) and B_2 (Biozim) at 19.47 g and 20.95 g, respectively. The interaction effect of tillage and biofertilizer on the fruit weight was not significant as shown in Table 8.

Table 8: The fruit weight of finger pepper applied with bio-fertilizers under different tillage method

Treatment	Fruit weight (g)
Main Treatment	Mean*
T_1-No tillage	18.09c
T_2-Strip tillage	21.32b
T_3-Conventional tillage	24.86a
Sub-Treatment	Mean**
B_1-Farmers Practice	19.47c
B_2- Biozim	20.95bc
B_3- BioGroe®	23.01a
B_4=MykoPlus	22.27ab

*means having the same letter are not significantly different (LSD) at 5% level

Weight of Harvested Fruits per Plant

The effect of tillage on the weight of harvested fruits per plant was not significant among the treatments (Table 9). The effect of biofertilizer on the weight of harvested fruits was significantly different among the treatments as shown in Table 9. Regardless of tillage method adopted, Biogroe andMykoPlus had the highestweight of harvested fruits at 0.57 and 0.53, respectively. There is no significant difference observed on the interaction effect of fertilizers and varieties within the treatments on the non-productive tillers of rice as shown in Table 9.

Table 9: The weight (kg $plant^{-1}$) of harvested fruits of finger pepper applied with bio-fertilizers under different tillage method

	Weight Harvested fruits (kg $plant^{-1}$)
Main Treatment	Mean
T_1-No tillage	0.51
T_2-Strip tillage	0.49
T_3-Conventional tillage	0.51
Sub-Treatment	Mean**
B1- Farmers Practice	0.39c
B_2- Biozim	0.53b
B_3- BioGroe®	0.57a
B_4=MykoPlus	0.53b

*means having the same letter are not significantly different (LSD) at 5% level

Total Fresh Weight

Table 10 presents the total fresh weight on the effect of biofertilizers on finger pepper using different tillage methods. The effect of biofertilizerson the total fresh weight was not significant as shown in Table 10. Likewise, no significant difference was noted from the interaction of fertilizers and varieties within the treatments on total fresh weight.

Table 10: The average total fresh weight (g) applied with biofertilizer under different tillage methods

	Fresh weight (g/plant)
Main Treatment	Mean
T_1-No tillage	121.90
T_2-Strip tillage	131.78
T_3-Conventional tillage	122.14
Sub-Treatment	Mean
B_1-Farmers Practice	116.15
B_2- Biozim	135.15
B_3- BioGroe®	121.37
B_4=MykoPlus	127.64

*means having the same letter are not significantly different (LSD) at 5% level

Root Dry Weight

The effect of tillage method was significantly different among treatments on root dry weight as indicated in Table 11 as confirmed in the study of Guan et.al (2015).Results revealed that highest root dry weight was attained at no tillage method and the least at strip tillage. The effect of no tillage to root dry weight was conformed to the findings of Huanget al. (2012). Bio-fertilizer application effect was statistically different among the treatments which imply that application of biofertilizer influence root dry mass. Further analysis revealed farmer practice as significantly different with other biofertilizers treatments and yielded the least root dry weight. Biofertilizers resulted to increased root growth as conformed to the findings of Javaidet al. (2010).

There were no significant differences observed from different tillage methods and their interaction within the treatments on dry matter distribution to roots.

Table11: The root dry mass (g) of finger pepper applied with biofertilizers under different tillage methods

Treatment	Root dry weight (g)
Main Treatment	Mean*
T_1-No tillage	19.62a
T_2-Strip tillage	16.64b
T_3-Conventional tillage	17.32b
Sub-Treatment	Mean**
B_1-Farmers Practice	15.78b
B_2- Biozim	19.03a
B_3- BioGroe®	18.46a
B_4=MykoPlus	18.17a

*means having the same letter are not significantly different (LSD) at 5% level

Shoot Dry Weight

Table 12 presents the total fresh weight on the effect of differentbiofertilizers cultivated using different tillage methods. The effect of biofertilizerson the total fresh weight was not significant as shown in Table 12. Likewise, no significant difference was obtained from the interaction of fertilizers and varieties within the treatments on total fresh weight.

Table 12: The shoot dry weight (g) of finger pepper applied with biofertilizers under different tillage methods

	Shoot Dry Weight (g)
Main Treatment	Mean
T_1-No tillage	31.11
T_2-Strip tillage	32.75
T_3-Conventional tillage	29.69
Sub-Treatment	
B_1-Farmers Practice	30.067
B_2- Biozim	32.74
B_3- BioGroe®	30.541
B_4=MykoPlus	31.225

*means having the same letter are not significantly different (LSD) at 5% level

Root-Shoot Ratio

The effect of tillage method was significantly different among treatments on root root-shoot ratio on tillage method as indicated in Table 13.Results revealed that highest root-shoot ratio weight was attained at no tillage method and the least at strip tillage. No significant reaction was noted among biofertilizers treatments on the root shoot ratio. Likewise, there is no significant interaction among treatments of biofertilizers and tillage treatments.

Table 13: The root-shoot ratio of finger pepper applied with biofertilizers under different tillage methods

	Root-shoot ratio
Main Treatment	Mean
T_1-No tillage	0.644a
T_2-Strip tillage	0.519b
T_3-Conventional tillage	0.596a
Sub-Treatment	Mean
B_1-Farmers Practice	0.54
B_2- Biozim	0.59
B_3- BioGroe®	0.62
B_4=MykoPlus	0.60

*means having the same letter are not significantly different (LSD) at 5% level

Total Fruit Yield per Hectare

The effect of tillage on the total fruit yield per hectare obtainedno significantly different among the treatments as revealed in Table 14. Statistics show significant differences among the biofertilizer treatments on the total fruit yield wherein Biogroe contributed highestfruit yield as presented in Table 14. No significant effect was observed on interaction of tillage and biofertilizer on the total fruit yield within the treatments.

Table 14: The total fruit yield (kg ha^{-1}) of finger pepper applied with biofertilizers under different tillage method

Treatment	Total fruit yield (kg ha^{-1})
Main Treatment	Mean
T_1-No tillage	2794.56
T_2-Strip tillage	2935.392
T_3-Conventional tillage	3198.736
Sub-Treatment	Mean*
B1- Farmers Practice	1393.65c
B_2- Biozim	3278.04b
B_3- BioGroe®	3773.89a
B_4=MykoPlus	3285.40b

*means having the same letter are not significantly different (LSD) at 5% level

Economic Analysis

There is a significant interaction in terms of the cost of production among treatments of tillage and biofertilizer (Table 15). Cost of production across tillage was significantly different in which conventional tillage has the highest cost of production; there was no significant difference on conventional tillage applied with biofertilizer as shown in Table 15 which implies that data on cost of production of biofertilizers using conventional tillage were not comparable. In terms of strip tillage and no tillage, the cost of production applied with farmers practice and strip tillage were not comparable likewise with Biozim and Mykoplus.

This implies that BioZim and Mykoplus cost of production were higher compared to Biogroe and farmers practice.

Table 15: Comparison of tillage in each bio-fertilizer treatment level

	Cost of Production			
	Biofertilizers			
Tillage Method	Farmers Practice	Biozim	BioGroe®	Mykoplus
No	200154.82b	125114.83a	92067.55b	100511.39a
Strip	210154.82b	110567.55a	98567.55b	97893.50a
Conventional	319025.055a	100250.00a	135934a	101124.89a

Means with the same letter are not significantly different at 5% level

Table 16 shows the return on investment on finger pepper production as affected by tillage method and biofertilizer application. It indicates significant differences among treatments where the highest ROI was obtained by strip tillage while the application of Biogroe acquires the highest ROI in terms of biofertilizer application.

Table 16: The Return on Investment of finger pepper as affected by biofertilizers under different tillage method

	Tillage			Biofertilizer			
	No	Strip	Conventional	Farmers Practice	Biozim	BioGroe®	Mykoplus
% ROI	37.96b	50.51a	46.79a	29.57c	50.37ab	55.07a	45.32b

*Means with the same letter are not significantly different at 5% level

Cost and Return Analysis

Providing the same cultural management on all treatments, it was found out that the conventional tillage gave the highest net income of Php 157,963.01but low ROI due to high labor cost. The least income was obtained by zero tillage due to low yield that consequently led to low gross income. The highest ROI was obtained by strip tillage at 36.46% which, according to Naresh et al. (2015), tends to be cost effective. Adopting the same cultural management on all treatments, it was found out that the BioGroe obtained the highest net income of Php 44,134.83. Due to high cost fetilizers that contributed to high cost of production, farmers practice' obtained the lowest net income. Lowest gross income was obtained by BioZim.Biogroe obtainedthe highest ROI at 41.67% (Table 17)

Table 17: Cost and Return Analysis of the tillage methods and biofertilizers

	Production Cost	Gross Income	Net Income	ROI (%)
Tillage methods				
No tillage	76,431.64	125.754.96	29,651.83	38.80
Strip tillage	78,775.39	134,754.96	35,895.78	45.57
Conventional	80,251.71	157,963.01	27,289.83	34.01
Biofertilizers				
Farmers Practice	126,723.18	134,754.96	8,031.77	6.34
Biozim	105,086.938	125,342.65	20,255.72	19.28
BioGroe®	105,683.1883	149,818.01	44,134.83	41.76
Mykoplus	120,903.18	144,463.01	23,559.83	19.49

Conclusion

The study was conducted to determine the performance of finger pepper applied with different biofertilizers under different cultivation methods. The field experiment was conducted at BASCPalayamanan are , Brgy. Pinaod, San, Ildefonso, Bulacan from May 2020 to October 2020. Treatments were arranged following the procedure of Split-Plot Design in RCBD using four replications. Tillage methods were the main plot factor (zero/ no tillage, strip tillage, conventional tillage) and biofertilizers (Farmers Practice, Biozim, BioGroe and MykoPlus) as sub plot factor. The following were concluded:

- Tillage method influenced the growth of finger pepper where conventional tillage directly affects plant growth of finger pepper.
- Bioferlizer application enhanced yield of finger pepper which conformed to the findings of this study in which BioGroe had resulted to early days of flowering, high fruit productivity. Biofertilizer has no effect to growth based from the result of the study.
- This study concludes no significant interaction between tillage and biofertilizer.
- Strip tillage was found to be cost effective among the two other tillage method. BioGroe showed a promising economic influence on finger pepper production.

Recommendations

The following recommendations were generated:

- Adoption of no tillage should be considered since it influenced root growth but still requires further study to find more conclusive findings in terms of growth and yileld.
- BioGroe is suggested to use since it resulted to good finger pepper productivity. Further study on biofertilizer should be conducted to other vegetable crops.
- Further study is recommended to evaluate more the interaction between tillage and biofertilizer.
- Strip tillage is recommended in terms of cost efficiency while BioGroe is suggested to use as a cost-efficient fertilizer.

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