International Journal of Multidisciplinary Research And Studies

Available online at https://ijmras.com/

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY RESEARCH AND STUDIES
ISSN: 2640 7272
Volume:06; Issue:04 (2023)
Doi: 10.33826/ijmras/v06i04.8

Response of Inoculated Finger Pepper *(Capsicum Annuum* Var. *Longum)* Applied with Different Fertilizer Materials

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Received Date: 10-03-2023 **Accepted Date: 09-04-2023** **Published Date:21-04-2023**

Abstract

A pot experiment was conducted to determine the growth and yield performance of inoculated finger pepper with different fertilizer materials. A 2x4 factorial in split plot design in randomized complete block design (RCBD) with four replications was employed in this study. The factors include the inoculants (A1 – with inoculant and A2 – without inoculant) and the different fertilizer materials (B1- control, B2- farmer's practice, B3- vermicast and B4- fortified organic fertilizer). The collected data were analyzed using Statistical Tool for Agriculture Research (STAR) and significant results were subjected to statistical analysis using Least Significant Difference (LSD) Test.

The results reveal that the application of root inoculant (A1) was significantly shorten the number of days from transplanting to harvesting and number of days from transplanting to flowering. While treatment B3 (vermicast) was gave the highest growth characteristics and yield components. Treatment supplemented with vermicast and fortified organic fertilizer gave the same positive effect on the height at maturity, number of days from transplanting to harvesting, number of days from transplanting to flowering, flowering to fruiting, fruiting to harvesting compared with control (B1) and farmer's practice (B2). It has an interaction effect between root inoculant and different fertilizer materials on the number of fruits per plant, weight of fruits per plant, diameter of fruit, length of fruit and computed yield per 1000 pot plants.

Keywords: *Fertilizer, Finger Pepper, Inoculation, organic fertilizer Vermicast,*

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INTRODUCTION

Finger pepper *(Capsicum annuum* var. *longum)* is locally known as "siling haba or siling panigang", it is one of the extensively cultivated crops in the Philippines. It is originated from South America, but mostly cultivated in Asia countries like the Philippines (Syafruddin, et al,. 2017). It is one of two kinds of chili common to the Philippines and Filipino cuisine, which belongs to the species *Capsicum annuum* (Frial-McBride2016) and has a great importance both in human nutrition and in the pharmaceutical industry (Stan, et al,. 2021). Garde (2016) said that chili could also fight heart attack, lung diseases and cancer. It is an excellent source of Vitamin and minerals and has no cholesterol. And also mentioned that farmers in Laguna Province includes chili in their production and found out that they experienced three times the profit than planting *palay* in a season.

The plant nutrition is the one of the vital factors to control agricultural productivity and quality, and the rates of nutrients presents in the soil affects the quality of yield Savci, S. (2012). Provision of its nutrient requirements is one of the factors to attain high chili production. These nutrients are usually provided through the application of chemical-based fertilizers. Since effect of this type of fertilizer caused easily be seen on plants, its continuous application could cause degradation of soil and water resources (Adhikari et al 2016). Adhikari et al. (2016) said that application of chemical fertilizers can supply only one or two nutrient elements to the crop, while supplying organic inputs can improve soil physical and biological environment. The use of chemical fertilizer has been reported for degrading soil and water resources. However, those implications could be eliminated by the use of organic fertilizer which avoids the use of synthetically produced fertilizer and pesticides.

High cost of chemical-based fertilizers are the common problems usually face by the farmers nowadays. Not only that, too much application of chemical fertilizer has a harmful effect on the soil. And the introduction and implementation of organic farming system also known as Organic Agriculture Act of 2010 (Republic Act 10068) is very timely not only to utilize the agricultural wastes as fertilizers but also to abandon their traditional practice of burning and have concern on environmental conservation and protection. One way of reducing the cost of fertilizer without sacrificing the yield of the farmers is by the use of microbial inoculants. Microbial inoculants can be utilized as an economic input to increase crop productivity while lowering the dosage of chemical fertilizer and it is important component of

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integrated nutrient management that leads to sustainable agriculture Chen, (2006). Islam et al. (2017) said that the most significant ways to achieve is using of organic and bio-fertilizers farming.

Application of inoculants one of the favorable approaches to restore the rejuvenated soil to its healthy form, hence it lessens the utilization of chemical fertilizers and maximize the utilization of available nutrients present in the soil. With this, it is necessary to address how to increase the yield rate of the crop while reducing the cost of production by using eco-friendly strategies and practices. Root inoculant according to Islam et al (2014) could promote growth and yield of plants in a pot experiment. The effective plant growth promoter and biocontrol agent is Vesicular Arbuscular Mycorrhizzal Root Inoculant (VAMRI) assists the plant roots in absorbing water and nutrients and thus reduces the chemical fertilizer requirements of crops.

Another way is by using different organic fertilizers and one of which is vermicomposting. Arancon et al. (2005) mentioned that the use of organic fertilizers provides soil with essential nutrients and adsorbs nutrients against leaching. Also improve soil texture, increase ion exchange capacity of soil, increase soil microbial populations and activity, improve moisture-holding capacity of the soil and enhanced soil fertility. A vermicomposting are methods of converting agricultural wastes into vermicast. Vermicast is very good fertilizer and soil conditioner and it has more beneficial impact on plants than compost (Gajalakshmmi and Abbasi., 2003). While Adhikari (2016) concluded that vermicast are better for growth and development of sweet pepper as compared to the other organic manures and chemical fertilizers. Another organic fertilizer introduced is fortified organic fertilizer (FOF) which is prepared with the combination of chicken manure, rice bran, garden soil, carbonized rice hull and concoctions of IMO, FPJ and FFJ.

OBJECTIVES OF THE STUDY

The general objective of this study is to determine the effect of microbial inoculation and the different fertilizer material application on the growth and yield performance of finger pepper in terms of growth characteristics, yield components, economic components used in pepper production.

MATERIALS AND METHODS

An experimental design was used in this study. A total of 320 finger pepper pot plants were grown in 2x4 factorial experiment in split-plot in Randomized Complete Block Design

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(RCBD). Each treatment was composed of 10 finger pepper pot plants replicated 4 times. The blocking factor was the soil from different parts of the experimental area that was used as growing medium. Hence, the nutrient content present in the soil varies from all the pots used in the study. This study was conducted at Brgy. Natividad Ext. Pangil Laguna near Pangil River Eco-Park on November 2018 to May 2019.

The seeds of Finger pepper Django F1 Hybrid variety were purchased at Agri-Supply at Siniloan Market, Siniloan, Laguna, while the VAMRI were secured from Biotech, University of the Philippines Los Banos, Laguna. The fertilizer materials such as Vermicast was requested at the Laguna State Polytechnic University Siniloan, Laguna. Fortified Organic Fertilizer was secured from Agrie's Integrated Natural Farm at Magdalena, Laguna while Commercial fertilizers [Urea (46-0-0) and Complete fertilizer (14-14-14)] were bought from Reagan Agri-Supply Siniloan, Laguna.

The subject of the study is the performance of inoculated-finger pepper with different fertilizer materials. All of the sample experimental plants were utilized in the collection of data needed in the study. The data collected includes the growth characteristics and yield components of inoculated finger pepper.

Application of Treatments

The different fertilizer materials were applied on finger pepper with root inoculant and finger pepper with root inoculant.

A1: With inoculants, A2: Without inoculants

B1: Control no fertilizer was supplied on the experimental plants.

B2: Inorganic Fertilizer (46-0-0) was applied one day before transplanting and repeated 14 days after transplanting and complete (14-14-14) based on the analysis of the soil which recommended rate was 90-40-0.

B3: Vermicast was applied into the growing medium 14 days before transplanting to permit further decomposition.

B4: Fortified Organic Fertilizer was applied into the growing medium 14 days before transplanting to permit further decomposition.

Data gathered were organized and presented in textual and tabular forms and analyzed using the Analysis of Variance (ANOVA) in factorial Split-plot design to determine significant differences among treatment means. Significant results were subjected to further statistical

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analysis using Least Significant Differences (LSD). To facilitate easy computations, the collected data were analyzed with the use of Statistical Tools for Agricultural Research (STAR).

RESULTS AND DISCUSSION

Height at Maturity

The result of analysis on the height at maturity are presented in Table 1.

Table 1. Average height (cm) of the experimental plants at maturity

Inoculant	Fertilizer Material)				Inoculant
	B1	B2	B3	B4	Means
A1	28.28	37.00	41.35	42.59	37.31
A2	30.22	34.22	40.25	39.50	36.05
Fertilizer Means	29.25[c]	35.61[b]	40.80[a]	41.05[a]	

Note: Fertilizer means with the same letter are not significantly different by LSD Test

CVa= 5.87% *CVb= 9.00%*

**significant* *ns – not significant*

Legend

Factor A. Inoculant
A1-With Inoculant
A2-Without Inoculant

Factor B. Fertilizer Material
B1-Control
B2-Urea + Complete
B3-Vermicast
B4-Fortified Organic fertilizer

The result of analysis on the height at maturity shows that Finger pepper fertilized with vermicast and fortified organic fertilizer was the same tallest height at maturity with a mean of 40.80 and 41.05 centimeter respectively while the plants with the shortest height was found on the control plants with a mean of 29.25 cm. Analysis of variance show significant difference among fertilizer materials used in this study but no significant difference on inoculant and interaction effect.

The result of the study is supported the findings of Berova et al. (2010) who found out that Lumbrical biofertilizer produced by the Californian earthworm *(Lumbricus rubellus)* accelerated the growth of the pepper plants *(Capsicum annuum)*. And also supported by the findings Adhikari et al. (2016) that the plant height obtained from application of poultry manure and vermicompost was similar, both which were significantly taller than the ones produced by the other treatment.

Number of Days from Transplanting to Harvesting

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The result of analysis on the height at maturity are presented in Table 2.

Table 2. Average number of days from transplanting to harvesting

Inoculant	Fertilizer				Inoculant
	B1	B2	B3	B4	Means
A1	63.25	60.31	57.47	57.78	59.70[a]
A2	63.94	60.72	57.76	58.44	60.21[b]
Fertilizer Means	63.59[a]	60.52[b]	57.61[c]	58.11[c]	

Note: Inoculant and fertilizer means with the same letter are not significantly different by LSD Test

CVa= 5.87% *CVb= 9.00%*
**significant* *ns – not significant*

Legend

Factor A. Inoculant
A1-With Inoculant
A2-Without Inoculant

Factor B. Fertilizer Material
B1-Control
B2-Urea + Complete
B3-Vermicast

Number of days from transplanting to harvesting showed that finger pepper with Inoculant has a short days of maturing with a mean of 59.70 days. The shortest day was noted on plants with vermicast and fortified organic fertilizer with a mean of 57.61 and 58.11 while the control plants were the longest day with a mean of 63.59 days respectively. Analysis of variance showed highly significant difference among fertilizer materials use in this study while inoculant has significant difference but no significant difference on their interaction effect. The result of the study follows with the findings of Adhikari (2016) who concluded that vermicast are better for growth and development of sweet pepper as compared to the other organic manures and chemical fertilizers.

Number of Days from Transplanting to Flowering

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The result of analysis on the height at maturity are presented in Table 3.

Table 3. Average number of days from transplanting to flowering

Inoculant	Fertilizer				Inoculant
	B1	B2	B3	B4	Means
A1	34.43	31.72	29.38	29.69	31.30[b]
A2	35.19	32.06	29.69	30.16	31.77[a]
Fertilizer Means	34.81[a]	31.89[b]	29.53[c]	29.92[c]	

Note: Inoculant and fertilizer means with the same letter are not significantly different by LSD Test

CVa = 1.23 CVb = 1.49

**significant ns – not significant*

Legend

Factor A. Inoculant
A1-With Inoculant
A2-Without Inoculant

Factor B. Fertilizer Material
B1-Control
B2-Urea + Complete
B3-Vermicast
B4-Fortified Organic fertilizer

Number of days from transplanting to flowering with inoculant bear the first flower earlier. The earliest to bear first flower was noted on plants with vermicast and fortified organic fertilizer with a mean of 29.53 and 29.92 while the control plants were the last with a mean of 34.81 days respectively. Analysis of variance showed highly significant difference among fertilizer materials use in this study while inoculant has significant difference but no significant difference on their interaction effect.

The result of this study was supported with the findings of Saini et al (2019) who concluded that the inoculated *Gazania rigens* showed earlier flowering as compared to the control due to the enhanced production of auxin and gibberellin that induces bud production due to higher levels of potassium absorption by the plant.

Number of Days from Flowering to Fruiting

The result of analysis on the height at maturity are presented in Table 4.

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Table 4. Average number of days from flowering to fruiting

Inoculant	Fertilizer				Inoculant
	B1	B2	B3	B4	Means
A1	4.47	4.44	4.06	4.03	4.25
A2	4.41	4.28	4.00	4.06	4.19
Fertilizer Means	4.44[a]	4.36[a]	4.03[b]	4.05[b]	

Note: Fertilizer means with the same letter are not significantly different

CVa = 1.23 *CVb* = 1.49

**significant* *ns – not significant*

Legend

Factor A. Inoculant
A1-With Inoculant
A2-Without Inoculant

Factor B. Fertilizer Material
B1-Control
B2-Urea + Complete
B3-Vermicast
B4-Fortified Organic fertilizer

The data revealed that the average number of days from flowering to fruiting of inoculated-finger pepper with different fertilizer materials. It was shown that without inoculant bear first fruit earlier. Finger Pepper with vermicast and fortified organic fertilizer was the first to produce fruits with a mean of 4.03 and 4.05 days while the last were the control plants with a mean of 4.44 days respectively. Analysis of variance showed highly significant differences among fertilizer means but failed to show significant difference between inoculant and interaction effect. The result was correlated with the findings of Pischl and Barber (2017) that Arbuscular Mycorrhizal Fungi tended to benefit plant growth and flower production (but not fruit production) compared to non-mycorrhizal plants.

Number of Days from Fruiting to Harvesting

The result of analysis on the height at maturity are presented in Table 5.

Table 5. Average number of days from fruiting to harvesting

Inoculant	Fertilizer				Inoculant
	B1	B2	B3	B4	Means
A1	24.34	24.19	24.03	24.06	24.16
A2	24.34	24.38	24.09	24.22	24.26
Fertilizer Means	24.34[a]	24.28[a]	24.06[b]	24.14[b]	

Note: Fertilizer means with the same letter are not significantly different

Data on Number of days from fruiting to harvesting shows that fruits of finger pepper with inoculant was harvested earlier than without inoculant with a mean of 24.16 days after fruiting, while vermicast and fortified organic fertilizer were the first harvested with a mean of

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24.06 and 24.14 days after fruiting. Analysis of variance shows significant difference among fertilizer materials used in this study but no significant difference on inoculant and interaction effect.

YIELD COMPONENTS OF FINGER PEPPER

Number of Fruits per Plant

The result of analysis on the height at maturity are presented in Table 6.

Table 6. Average number of fruits per plant

Inoculant	Fertilizer				Inoculant
	B1	B2	B3	B4	Means
A1	4.91^{de}	4.19^{e}	22.13^{a}	20.57^{bc}	12.95
A2	3.86^{e}	6.22^{d}	21.60^{ab}	20.04^{c}	12.93
Fertilizer Means	3.86	5.21	21.87	20.31	

Note: Fertilizer means with the same letter are not significantly different

The result of analysis of variance on the number of fruits per plant of finger pepper on inoculant and fertilizer materials. Significant interaction effect between inoculant and fertilizer materials on the number of fruits per plant of finger pepper has been observed. The highest number of fruits per plant was noted among the finger pepper with inoculant (A1) and fertilized with vermicast (B3). The mean number of fruits per plant however, does not differ significantly from those observed among the finger pepper without inoculant (A2) fertilized with fortified organic fertilizer (B4). The lowest number of fruit per plant was observed among the finger pepper either with (A1) or without inoculant (A2) fertilized with either control (B1) and Farmer's Practice (B2).

Weight of Fruit per Plant

The result of analysis on the height at maturity are presented in Table 7.

Table 7. Average weight of fruits per plant

Inoculant	Fertilizer				Inoculant
	B1	B2	B3	B4	Means
A1	46.81^{b}	55.35^{b}	207.57^{a}	219.16^{a}	132.22
A2	47.44^{b}	66.66^{b}	223.13^{a}	215.53^{a}	138.19
Fertilizer Means	47.13	61.06	215.55	217.345	

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The result of analysis of variance on the weight of fruits per plant of finger pepper on inoculant and fertilizer materials. The heaviest weight of fruits per plant was noted among the finger pepper with inoculant (A1) and fertilized with vermicast (B3). The mean weight of fruits per plant however, does not change significantly from those observed among the finger pepper without inoculant (A2) fertilized with either vermicast (B3) or fortified organic fertilizer (B4). The lowest weight of fruit per plant was observed among the finger pepper either with (A1) or without inoculant (A2) fertilized with either control (B1) or Farmer's Practice (B2). Significant interaction effect between inoculant and fertilizer materials on the weight of fruits per plant of finger pepper has been observed.

This result supported with the finding of Akhzari et al., (2018) that the application of mycorrhiza combined vermicompost had a significant impact on the dry weight of leaves and roots and these two variables had an increasing trend.

Diameter of Fruit in cm

The result of analysis on the height at maturity are presented in Table 8.

Table 8. Average weight r of fruits per plant

Inoculant	Fertilizer				Inoculant
	B1	B2	B3	B4	Means
A1	1.40^{d}	1.44^{cd}	1.66^{a}	1.60^{ab}	1.53
A2	1.54^{bc}	1.48^{ab}	1.61^{ab}	1.60^{ab}	1.56
Fertilizer Means	1.47	1.46	1.64	160	

The widest diameter of fruit was noted among the finger pepper with inoculant (A1) and fertilized with vermicast (B3). The mean diameter of fruit however, does not change significantly from those observed among the finger pepper with inoculant (A1) fertilized with FOF (B4) and without inoculant fertilized with either Farmer's Practice (B2) or vermicast (B3) and FOF (B4). The thinnest diameter of fruit was observed among the finger pepper with inoculant (A1) fertilized with either control (B1) or Farmer's Practice (B2).

Length of Fruit in cm

The result of analysis on the height at maturity are presented in Table 9.

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Table 9. Length of fruit in cm

Factor A (Inoculant)	Fertilizer				Inoculant Means
	B1	B2	B3	B4	
A1	10.68^{ab}	11.61^{ab}	11.18^{ab}	10.80^{ab}	11.31
A2	9.59^{b}	12.25^{a}	10.48^{ab}	9.59^{b}	10.59
Fertilizer Means	11.10	11.93	10.83	10.20	

Any two inoculant and fertilizer materials mean with different letter(s) are significantly different; else they are not significant different at 5% level of significant using LSD Test

The longest length of fruit was noted among the finger pepper without inoculant (A2) and fertilized with farmer's practice (B2). The mean length of fruit however, does not change significantly from those observed among the finger pepper with inoculant (A1) fertilized with either vermicast (B3). The shortest length of fruit was observed among the finger pepper without inoculant (A2) fertilized with either B1, B3 and B4 and with inoculant (A1) fertilized with B1, B2 and B4.

Weight of Fruit in grams (g)

The result of analysis on the height at maturity are presented in Table 10.

Table 10. Weight of fruit in g

Inoculant	Fertilizer				Inoculant Means
	B1	B2	B3	B4	
A1	9.95	9.78	11.41	10.78	10.48
A2	8.88	10.00	10.47	10.02	9.84
Fertilizer Means	9.41	9.89	10.94	10.40	

Heavier fruit of finger pepper was noted on plants with vermicast while the least was obtained on control with a mean of 10.94 and 9.41 grams. Analysis of variance failed to show significant difference among inoculant, fertilizer material and their interaction effect. This indicates that inoculant and fertilizer material used in this study had no significant effect on the weight of finger pepper fruit.

Computed Yield per 1000 Pots

The heaviest computed yield per 1000 pots was noted among the finger pepper with inoculant (A1) and fertilized with vermicast (B3). The mean computed yield per 1000 pots however, does not change significantly from those observed among the finger pepper with

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inoculant (A1) fertilized with fortified organic fertilizer (B4) and without inoculant (A2) fertilized with vermicast (B3). The lowest weight of computed yield per 1000 pots was observed among the finger pepper either with inoculant (A1) or without inoculant (A2) fertilized with control (B1) and with inoculant (A1) fertilized with Farmer's Practice (B2). These results were conforming with the findings of Arancon et. al (2006) that there was significantly increased in growth and yields of tomatoes and peppers with the application of vermicompost.

CONCLUSIONS & RECOMMENDATION

Based on the results of this study on the performance of inoculated finger pepper with different fertilizer materials it was found that inoculated-finger pepper was only significantly different on the growth characteristics, likewise different methods of application of VAM root Inoculant with the same study must be evaluated. Performance of finger pepper fertilized with vermicast and fortified organic fertilizer gave the same effects on the height at maturity, total number of days from transplanting to harvesting, number of days from transplanting to flowering, number of days from flowering to fruiting, number of days from fruiting to harvesting, thus, combination of vermicast and fortified organic fertilizer with different levels is highly recommended. Replication of the same study in field experiment on other environmental condition and utilization of vermicast and fortified organic fertilizer inoculated with VAM Root Inoculant is also recommended.

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