Efficacy of Varying Levels and Brewing Durations of Vermitea Foliar Spray Applications on the Growth and Yield of Eggplant (*Solanum melongena* L.)

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Abstract- Vermitea is a water extract from vermicast brewed for beneficial organisms. This study was conducted at Campo, Kinoguitan, Misamis Oriental, Philippines from December 2012 to June 2013 to determine the efficacy of varying levels and brewing durations of vermitea foliar spray applications on the growth and yield of eggplant. A study was laid-out in a 4 x 4 factorial arrangement in Randomized Complete Block Design (RCBD) and replicated 3 times, with concentration levels as Factor A and brewing durations as Factor B. Results revealed that plants sprayed with 20% concentration level of vermitea had the tallest plants (29.69 cm), most resistant to pests and diseases (3.8), earliest to produce 50% flowers (50.33 days), produced the most number of flowers (144.92), highest percent fruit set (74.72%), longest fruit (20.79 cm), largest fruit (3.56 cm), obtained the highest total fruit yield (9.21 tons/ha) and the highest ROI (228.93%). Brewing vermitea for two days produced the tallest plants (25.21 cm), most resistant to pests and diseases (3.35), most number of flowers (133.67), highest percent fruit set (76.19%), longest fruit (21.75), largest fruit (3.50 cm), highest fruit yield (9.44 tons/ha) and highest ROI (232.49%). Plants with no foliar application consistently showed very poorly in all growth and yield parameters.

Index Terms- *eggplant, vermitea, foliar sprays, brewing and fruit set*

I. INTRODUCTION

The increasing cost of chemical fertilizers with the reduction of yield potential of soil and nutritional value of foods due to chemical fertilizing practices has led to an in-depth search for an economically viable alternative (http://www.pinoybisnes.com/agri-business/starting-a-vermiculture-business/).

Organic agriculture is an ecological production management system that promotes and enhances biodiversity, biological cycles and soil biological activity. It is based on minimal use of off-farm inputs and on management practices that restore, maintain and enhance ecological harmony. The principal guidelines for organic production are to use materials and practices that enhance the ecological balance of natural systems and that integrate the parts of the farming system into an ecological whole (Sunny Ridge Microbial Solutions, 2011).

Organic agriculture practices cannot ensure that products are completely free of residues, however, methods are used to minimize pollution from air, soil and water. Organic food handlers, processors and retailers adhere to standards that maintain the integrity of organic agricultural products. The primary goal of organic agriculture is to optimize the health and productivity of interdependent communities of soil life, plants, animals and people.

Compost is an inexpensive alternative to chemical fertilizers, and it is less likely to harm sensitive roots. It can be extremely harsh on plants. Chemical fertilizers can also leave heavy metals like lead, arsenic and cadmium that can build up over time. A big shock of chemical fertilizers can also kill the very microbes that make soil fertile, dooming anybody to depend on using chemical fertilizers over and over again.

The presence of earthworms in soil ecosystems is an indicator of the well- being of a system. Earthworms have the unique ability to convert elements such as minerals, nutrients and microbes from the soil or composting systems into an excretion that contains the vastest amount of plant nutrients, microbes and growth elements that do exist. The excretion is called vermicast or vermicompost. The chemical and biological composition of vermicasts can be regarded as the closest resemblance of a balanced and healthy soil ecosystem. Elements and nutrients in vermicasts are also presented to plants in a more absorbable form compared to any other product in nature or industry. Earthworms also have the unique ability to convert toxic elements into complex organic compounds that are harmless to the environment. This is done by an organic conversion process inside the earthworm's gut called chelation (Joubert et al., 2008).

Earthworms helped cultivated, aerated, hydrated and fertilized the soil. Plants can more easily absorb nutrients from organic matter after the worm has broken it down. They burrow deep into the ground to search for moisture and to keep away from the light, as much as 12 feet below the surface (Sunny Ridge Microbial Solutions, 2011).

Vermicompost produced higher quality crops and better yields than chemical fertilizers. It has shown that worm castings contain 10–20 times as much microbial activity as the soil and organic matter that the worm ate. It added more beauty to flowerbeds since vermicompost is "green." It does not harm nor pollute anything. It is 100% recycled. Castings were coated with mucus membranes from the worm that keep the nutrients from releasing all at once, making them available when the plants need

them. Humus makes possible for the plants to naturally feed on the nutrients in the soil. It also helps the soil hold nutrients, air, and moisture. It broke down bad intrusions such as pathogens and harmful bacteria (Sunny Ridge Microbial Solutions, 2011).

Brewing aside from extracting vermitea or vermicompost teas helps microbes wake-up and multiply exponentially double their count every 20 minutes while it takes 24 hours to make a batch of brew (Sunny Ridge Microbial Solutions, 2011). The longer the brewing time, the more soluble materials were extracted or the more food for the beneficial bacteria and fungi. Therefore, more nutrients were available to the plants. However, there should be optimal time for tea production to attain balance between extracted and growth of organisms. Short brewing may cause a tendency to produce anaerobic biofilm. Longer brewing time will make organisms to use up all their food and go to sleep and/or may colonize the surface of containers and begin to develop anaerobic layers on the container walls (Rex Compost Tea Brewer, 2009).

Vermicompost is a compost that has been digested by worms (vermi) and does not need to be turned, because worms "turn" the organic matter in their digestive tract, eliminating work for gardeners. Vermicompost tea (VCT) is a specific type of compost tea derived from soaking or brewing vermicompost in water (Balfanz et al., 2011).

Compost tea is a liquid derived from soaking and or brewing compost in water and is used as a foliar and soil application to plants (Balfanz et al., 2011). Vermicompost tea protected the leaves and stems of plants from the top down and not only from the soil. Direct application on the plant dramatically boosted its growth and vitality. The extract was rich in microbes, which helps restore plants after being exposed to pesticides and other environmental damage **(**Sunny Ridge Microbial Solutions, 2011). It can contain the three basic plant nutrients: nitrogen in the form of nitrate or ammonium ($N0_3$ and NH_4); phosphorus (P); and potassium (K). One analysis of VCT brewed at a 1:10 ratio showed on average: nitrate (NO_3) at 77 ppm; ammonium (NH_4) at 3.7 ppm; P at 18 ppm; and K at 186 ppm (Balfanz et al., 2011).

A 20% increase in plant growth and a 150% increase in root mass is possible by adding just 1 part of worm castings to 9 parts of soil, however if it is added to the soil at low rates may result in improved disease resistance. Worm castings provide beneficial microbes that compete with disease causing organisms; it enhances germination, plant growth, and crop yield; It improves root growth and structure. Worm castings fed to poultry stimulate their immune system (Organic Material Review Institute, 2010).

Eggplant is a good source of vitamins, fibers, and minerals. Eggplant is the leading vegetable crop in the Philippines in terms of area and volume of production. Small-scale farmers in many provinces grow eggplant and depend on it for their livelihood (JICA TCP, 2008).

Barangay Campo in Kinoguitan, Misamis Oriental, Philippines is known for eggplant production and is advocating or showcasing organic farming practices. It has a total land area of 415.2502 hectares which is 10.14 percent of the total land area of the municipality. Major land use of Barangay Campo is agricultural where 96% of its total land area is devoted to agricultural production. Generally, the topography of Barangay Campo is rolling (60%). However, 30% of its total land area is plain. Only 10% is hilly. It has a Type II climate which has no distinct dry season with a very pronounced maximum rainfall from November to January. Maximum precipitation falls on the last quarter of the year which may even extend to mid-February. It is situated at an elevation ranging from 300 – 500 meters above sea level (MAO, 2011).

Conducting this study will serve as a learning site using an alternative organic foliar fertilizer and organic control of pests and diseases on eggplants. The barangay has an existing backyard gardening with eggplant as the common vegetable planted and on-going vermi-culture projects. The Campo Farmers Association (CFA) as well as the purok groups were engaging in vegetable production as their source of livelihood. Vermicasts were available in the barangay which were needed in making vermi-compost tea. Vermicompost tea showed the other uses of vermicast instead of using it as basal fertilizer in plants.

Thus, this study was conducted to determine the response of eggplant on varying levels and brewing durations of vermitea foliar spray applications under the condition of Campo, Kinoguitan, Misamis Oriental, Philippines.

II. Materials and Methods

This study was conducted at Campo, Kinoguitan, Misamis Oriental, Philippines from December 2012 to June 2013.

The study used Casino F_1 eggplant seeds, vermicast, vermi tea , plow, harrow, sixteen (16) units of aerator/air pump, sixteen (16) pieces of bucket, eight (8) pieces of seedling trays and sixteen (16) units of hand pump sprayer, banana leaves, galloons, empty sacks and newspapers. This was laid-out following a 4 x 4 factorial arrangement in Randomized Complete Block Design (RCBD), replicated three times. The varying levels of vermitea served as Factor A and brewing durations as Factor B, as indicated: Factor A [A_1-Control (No foliar application), A_2-5% Concentration, A_3 - 10% Concentration, A_4 - 15% Concentration and A_5 - 20% Concentration] and Factor B [B_1- one day, B_2-two days, B_3-three days and B_4-four days].

A total land area of 297.5 sq. was used in the study. The area was divided into five double-hedge rows. Each row was measured 35 meters long and 2 meters wide between replications. Each treatment had 4 plants. Soil and vermicast samples were collected before land preparation for N, P, K, OM and pH analysis.

The field was plowed at 15-20 cm apart two to three times to help eliminate weeds, hibernating insect pests, and soil-borne diseases.Then, it was harrowed twice to break the clods and level the field.

Eggplant seedlings were raised in beds before they were transplanted. Raised seedlings in seedbeds were exposed to adverse conditions. Raising seedlings was noted because in trays required less seeds, promoted uniform growth of superior seedlings, minimized transplanting shock, and lessened seedling mortality.

The sowing media were prepared by mixing thoroughly 2 parts compost (vermicast) and 2 parts of garden soil. The holes of the tray were filled with the media and slightly compacted using the hand palm. A seedling tray with 100 holes was used.

One seed was sown per hole of the plastic tray at a depth of 0.5 cm. Seeds were covered with the media. Sprinkler with fine

droplets was used to water the seeds. The tray was covered with banana leaves, old newspaper or plastic sacks. To maintain soil moisture and temperature,. The cover was removed when 1 or 2 seeds had sprouted.

The trays were placed on the platforms of a simple nursery made of bamboo slats and waved coco leaves with nursery nets. Eggplant seeds germinated in 5-6 days. Watering was done early in the morning and afternoon. Hand weeding was likewise employed.

Beds were raised at 20 cm height and 1 m wide. The beds were spaced 1meter apart to serve as pathway for manual watering and other activities.The beds were watered a day before transplanting to cool down the soil. A 30 to 35-day-old seedlings were transplanted bearing 3-4 true leaves. Only one seedling was transplanted per hole in the afternoon. The transplants were watered immediately with a sprinkler. Vermicast application at rate of half kilogram (500 grams) per hill was done.

Preparation of Vermicompost Tea (VCT). A bucket was filled with 5 liters of tap water and let set for 24 hours for the chlorine to evaporate. The aerator tips were placed into the bucket of water and turned on the aerator for at least 2 hours before adding the compost to increase oxygen levels in the water and reduce chlorine levels that can be harmful to beneficial microbes. Vermicast measured (0.25, 0.5, 0.75 & 1.0 kg) to achieve the desired solid to water ratio. Vermicast was placed inside a bucket so that the vermicast submerged in water. Then the bucket was covered. The brewing Vermicompost Tea (VCT) was placed in a shaded area out of direct sunlight. The time and date were noted down when brewing started. After 24, 48, 72 & 96 hours of brewing, water turned to yellow-brown color. The freshly brewed vermicompost tea was harvested by straining it with the fine cloths. The freshly brewed vermicompost tea was transfered into a sprayer. The vermicompost tea was applied within 4 to 5 hours, otherwise the microbes will die and the tea will smell very foul.

Vermicompost tea was sprayed on 1st to10th week after transplanting (WAT). One liter of vermicompost tea was diluted with 15 liters of water. Vermicompost tea was applied late afternoon, but not earlier than 4:00 PM.

Spot manual weeding was applied in the area. Uprooted weeds were thrown in a compost pit at the nearby area. Pests and diseases were managed through sanitation and proper disposal of infested plant parts to prevent pests build-up. Two border furrows of eggplants were established as buffer.

Data on plant height, pest resistance, number of days to 50% flowering, number of flowers produced, percent fruit set, length and diameter of fruits and total yield were collected. The cost and return analysis was likewise computed.

The Analysis of Variance (ANOVA) using a 4 x 4 factorial in Randomized Complete Design (RCBD) was used to solve for the level of significance with Tukey's Test being used to compare significant differences among treatment means.

III. Results and Discussion

Plant height. Table 1 shows the average height of eggplant as affected by the varying levels and brewing durations of vermitea. The height was significantly affected by the concentration levels of vermitea (F_c = 4.5385**, 0.01 =< p < .05), but not with brewing durations (F_c = 0.1795^{ns}, p >= .05). No significant interaction effect (Fc =1.1145^{ns}, p >= .05) was found between the two factors. The 20% concentration level of vermitea produced the tallest plants (29.69 cm). It is significantly different from the rest of the treatment means. Plants with no foliar application (control) showed the shortest with 18.42 cm. Based on the results of the laboratory analysis for vermicast, it showed 1.28%N, 0.29% P and 0.21% K. The vermicast used contained essential nutrients which are responsible for the growth and development of eggplant. Nitrogen is responsible for the increase and differentiation of cells and helps in the metabolism of foods for plant growth and development (Pava, 1995). The over-all shorter heights obtained by the plants was also due to the Verticillium wilt (*Verticillium albo-atrum)* being noticed at early growth stage of the plant that caused the plants to be stunted in their growth (Organic Material Review Institute, 2010).

Regardless of non-significant results among treatment means on the brewing duration of vermitea, however, plants applied with foliar spray of vermitea brewed for 2 days, obtained the tallest height with 29.69 cm, while the shortest by those sprayed with vermitea and brewed for 1 day with 25.21 cm. According to Rex Compost Tea Brewer (2009), that the longer the brewing time, the more soluble materials were extracted or the more foods for the beneficial bacteria and fungi. Therefore, more nutrients were available to the plants. However, there should be optimal time for tea production to attain balance between extracted and growth of organisms. Short brewing may cause a tendency to produce anaerobic biofilm. Longer brewing time will make organisms to use up all their food and go to sleep and/or may colonize the surface of containers and begin to develop anaerobic layers on the container walls.

Table 1. Average plant height (cm) of eggplant as affected by varying levels and brewing durations of vermitea foliar spray applications.

Factor A *(Levels of Vermitea)*	Factor B *(Brewing Durations)*				Mean (A)
	1 day	2 days	3 days	4 days	
Control (no foliar spray)	-	-	-	-	48.52^{c}
5% conc.	52.50	53.75	52.00	53.83	53.02^{b}
10% conc.	53.50	52.92	52.50	52.25	52.79^{b}
15% conc.	49.97	58.00	51.58	53.58	53.28^{b}
20% conc.	62.08	67.58	55.25	57.17	60.52^{a}
Mean (B)	54.51	58.06	55.58	54.21	
F-test: A**, B^{ns}, AxB^{ns}					
CV: 11.11%					

Means within same column followed by a common letter is not significantly different at 5% using Tukey Test

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Pest Resistance. Pest resistance of eggplant was not significantly affected by the concentration levels (F_c = 1.6189^{ns}, p >= .05) and brewing durations (F_c = 0.6777^{ns}, p >=.05) of vermitea. No significant interaction effect (Fc = 0.8483^{ns}, p >= .05) was likewise observed between the two factors (Table 2).

However in Factor A, the Casino F_1 eggplant sprayed with 20% concentration levels of vermitea showed tolerance to pests and diseases with a resistance rating of 3.80, followed by those sprayed with 10% level with 3.21 rating (moderately tolerant), 5% level with 3.06 (moderately tolerant) and 15% level with 2.88 (moderately tolerant). The control treatment obtained the lowest rating with 2.67 (susceptible to moderately resistant). It was likewise observed that plants were attacked by shoot and fruit borer *(Leucinodes orbonalis).* Vertilcillium wilt was noticed at early growth stage of the plant. Plant height was greatly affected causing the plant looked stunted in growth. *Vertilcillium* wilt, caused by two species of soil-borne fungi-*Vertilcillium dahliae* and *Vertilcillium albo-atrum*, infects more than 200 species of plants, including many vegetables. *V. albo-atrum* prefers cooler soils while *V. dahliae* can become a problem in greenhouse vegetable production. Sometimes, both species will occur in the same field. A yellowing of lower leaves followed by wilting is the first sign of disease. Brown, necrotic tissue within lesions is surrounded by a large, irregular area of yellowing due to a systemic leaf toxin produced by the fungi. Leaf necrosis is followed by wilting, stunting, and plant death. When the stems of infected plants are cut lengthwise, the vascular tissue exhibits a brown discoloration. Vertilcillium wilt affected 11.27% of the population which was 23 plants out of 204 but it was minimized due to foliar sprays with vermitea.

Table 2. Pest resistance of eggplant as affected by varying levels and brewing durations of vermitea foliar spray applications.

Factor A *(Levels of Vermitea)*	Factor B *(Brewing Durations)*				Mean (A)
	1 day	2 days	3 days	4 days	
Control (no foliar spray)	-	-	-	-	2.67
5% conc.	2.67	2.83	3.25	3.00	2.94
10% conc.	3.17	3.25	3.25	3.08	3.19
15% conc.	3.25	2.50	3.42	2.83	3.00
20% conc.	2.75	4.00	3.50	3.83	3.52
Mean (B)	2.96	3.14	3.35	3.18	
F-test: A^{ns}, B^{ns}, AxB^{ns}					
CV : 2.57%					

Rating scale: [*1- very susceptible (80-100% damage), 2 - susceptible (60-79% damage), 3- moderately tolerant (40-59% damage),4 - tolerant, (20-39% damage), 5 - very tolerant (0-19% damage)*]

The low resistance of the plants to insect pests was due to the occurence of shoot and fruit borers during the flowering and fruit setting stages which the plants were greatly affected. Shoot and fruit borers affected 14.70% of the total population which was 30 plants out of 204 plants. Shoots and fruit borer were manually controlled. No botanical or biological control measured was employed to the plants. However, the presence of leaf miners (*Tildenia inconspicuella*), lady bugs *(Coccinellidae)* and flea beetles (*Epitrix hirtipennis*) were also noticed but thier population and damages were minimized.and controlled through spraying of vermi tea. According to Rex Compost Tea Brewer (2009) that the greater the diversity of microbes in the tea, the greater the livelihood that the pathogenic organisms will be out complete on leaves, stems and roots surfaces and in the soil beneficial for the growth of the plant. The Vermicompost tea (VCT) contained beneficial microbes that also reduced or controlled diseases and improved soil health (Jack and Thies, 2006; Lowenfels *et al*, 2006). Studies indicated that VCT had a positive effect on suppressing tomato diseases (Zaller, 2006). Worm castings also provide beneficial microbes that compete

with disease causing organisms, thus giving more resistance to the plants (Organic Material Review Institute, 2010).

On the brewing duration, eggplant sprayed with vermitea brewed for 2 days obtained the highest resistance rating of 3.35 (moderately tolerant), while the lowest were those sprayed with vermitea and brewed for only one day. This finding also conformed to the findings of Rex Compost Tea Brewer (2009) such that the longer the brewing time, the more soluble materials were extracted or more foods for the beneficial bacteria and fungi. Therefore, more nutrients were available to the plants. However, there is an optimum time of brewing for tea production to attain balance between extract and growth of organisms.

There should be optimal time for tea production to attain balance between extracted and growth of organisms. Short brewing may cause a tendency to produce anaerobic biofilm. Longer brewing time will make organisms to use up all their food and go to sleep and/or may colonize the surface of containers and begin to develop anaerobic layers on the container walls.

Number of Days to 50% Flowering. The varying levels (F_c = 2.8795^{ns}, p >= .05) and brewing durations (F_c = 0.2455^{ns}, p >= .05) of vermitea foliar applications did not significantly affect the flowering of Casino F1 eggplants to produce 50% flowers among the plants under study (Table 3). No significant interaction effect (F_c = 0.4538^{ns}, p >= .05) was likewise observed between the two factors.

Nevertheless in Factor A, plants sprayed with 20% concentration level of vermitea produced flowers at 50.33 days after transplanting as compared with those in the control treatment produced flowers the latest time only after 58.33 days. In Factor B, plants sprayed with vermitea and brewed for 3 days produced flowers first after 52.75 days, while the latest was those sprayed with vermitea being brewed at 2 days. However, differences were not that statistically far from each other.

Table 3. Average number of days to 50% flowering of eggplant as affected by varying levels and brewing durations of vermitea foliar spray applications.

Factor A *(Levels of Vermitea)*	Factor B *(Brewing Durations)*				Mean (A)
	1 day	2 days	3 days	4 days	
Control (no foliar spray)	-	-	-	-	58.33
5% conc.	56.50	57.67	53.83	53.67	55.42
10% conc.	55.17	52.83	52.67	52.33	53.25
15% conc.	56.30	54.17	54.33	55.67	55.12
20% conc.	52.67	47.17	50.17	51.33	50.33
Mean (B)	55.16	52.96	52.75	53.25	
F-test: A^{ns}, B^{ns}, AxB^{ns}					
CV : 8.91%					

Number of Flowers Produced. The production of flowers was highly affected by the applications of varying levels (F_c = 127.1892**, 0.01 =< p < .05) and brewing durations (F_c = 24.5542**, 0.01 =< p < .05) of vermitea. Interaction effects (F_c = 24.5542 **, 0.01 =< p < .05) were highly found between the 2 factors (Table 4).

Consistent with the results of the previous parameters, Casino F1 eggplant produced the most number of flowers (both primary and secondary flowers/male flowers as source of pollens for pollination) when sprayed with 20% concentration level of vermitea with 144.92 flowers and not significantly different from those sprayed with 10% and 15% levels which produced 125 and 118 flowers, respectively. The least was obtained by the control treatment with 68.33 flowers. As Hartman and Kester (1997) and Pava (1995) that nitrogen, phosphorus and potassium are essential elements needed by plants in macro level for the reproductive growth of the plants. Potassium is a nutrient element which helps in the translocation of photosynthates to the reproductive organ of the plant causing an early flowering and eventually, producing more number of flowers. As some investigations showed that fresh earthworm casts are several times richer in available nitrogen, available phosphates and available potash than the surrounding topsoil. Worm castings also contain many beneficial bacteria and enzymes needed for the growth of plants (Organic Material Review Institute, 2010).

In Factor B, however, plants sprayed with vermitea and brewed for 2 days produced the most number of flowers with 133.67, while those sprayed with vermitea for 1 day produced the least with only 93.08 flowers. Nevertheless, no significant differences were observed among treatment means. Factor that supports this finding is the optimum time recommended for brewing of vermitea that shorter time may cause to produce anaerobic biofilm, while longer time make the organisms to use up all the foods and sleep and begin to develop anaerobic layers (Rex Compost Tea Brewer, 2010).

Table 4. Average number of flowers produced of eggplant as affected by varying levels and brewing durations of vermitea foliar spray applications.

Factor A *(Levels of Vermitea)*	Factor B *(Brewing Durations)*				Mean (A)
	1 day	2 days	3 days	4 days	
Control (no foliar spray)	-	-	-	-	78.33[d]
5% conc.	104.67[bc]	105.33[b]	102.67[b]	100.67[b]	103.30[c]
10% conc.	102.00[c]	109.33[b]	104.67[b]	102.00[b]	104.50[c]
15% conc.	107.33[b]	124.33[a]	116.00[a]	112.67[a]	115.08[b]
20% conc.	119.67[a]	124.33[a]	117.00[a]	111.67[a]	118.17[a]
Mean (B)	108.42[b]	115.83[a]	110.08[b]	106.75[c]	
F-test: A**, B**, AxB**					
CV: 2.08%					

Means within same column and row followed by common letters are not significantly different at 5% using Tukey Test

Percent Fruit Set. The percent fruit set was significantly affected by the concentration levels (F_c = 432.5793**, 0.01 =< p < .05) of vermitea as well as the brewing duration (F_c = 15.8437**, 0.01 =< p < .05). There were significant interaction effects (F_c = 6.5747 **, 0.01 =< p < .05) observed between the two factors (Table 5).

In Factor A, plants sprayed with 20% levels of vermitea produced 74.72% fruit set, followed by those sprayed with 15% level (67.07%) and 10% level (56.54%). The least was obtained by those in the control treatment which registered 34.72% fruit set. The low percentages of fruit set were primarily due to the more number of flowers which didn't develop into fruits. Contributory to the fruit setting of plants aside from genetic make-ups are the environmental factors that include nutrients, presence of pollinators and climatic conditions (Bautista, 1994). As Pava (1995) reiterated that essential nutrients such as nitrogen, phosphorus and potassium and other macronutrients are responsible for the growth and development of the plants. Nitrogen is essential for greening and growth of the plants, while potassium for the translocation of usable photosynthates for fruit bearing of the plants.

In Factor B, two days of brewing had made eggplant to develop flowers into more fruits with 75.19% and is not significantly different from those brewed at 3 days with 65.69% , but statistically different from the rest of the brewing durations. The least was obtained by those plants sprayed with vermitea and brewed for one day with 45.25%. This implies that two days period of brewing of vermitea is more effective than one, three and four days of brewing. This shows further that one day period of brewing does not extract much beneficial organisms from compost, compared to two days. Three and four days period of brewing were long enough that no more soluble food resource and nutrients present in water as bacteria may increase by 100 to 500 times as a result of brewing process. That the longer the brewing time, the more soluble materials were extracted or the more food for the beneficial bacteria and fungi (Rex Compost Tea Brewer, 2010). Therefore, more nutrients will be available to the plants. However, there should be optimal time for tea production to attain balance between extraction and growth of organisms. Short brewing may cause a tendency to produce anaerobic biofilm. Longer brewing time will make organisms to use up all their food and go to sleep and/or may colonize the surface of containers and begin to develop anaerobic layers on the container walls.

Table 5. Average percent (%) fruit set of eggplant as affected by varying levels and brewing durations of vermitea foliar spray applications.

Factor A *(Levels of Vermitea)*	Factor B *(Brewing Durations)*				Mean (A)
	1 day	2 days	3 days	4 days	
Control (no foliar spray)	-	-	-	-	34.72[e]
5% conc.	41.33[d]	48.67[d]	47.67[d]	43.33[d]	45.25[d]
10% conc.	50.67[c]	56.67[c]	55.67[c]	53.33[c]	54.08[c]
15% conc.	57.33[b]	63.00[b]	60.00[b]	60.00[b]	60.08[b]
20% conc.	71.00[a]	74.00[a]	69.33[a]	66.00[a]	70.08[a]
Mean (B)	55.08[b]	60.58[a]	58.17[a]	55.67[b]	
F-test: A**, B**, AxB**					
CV: 3.03%					

Means within same column and row followed by a common letter is not significantly different at 5% using Tukey Test

Length and Diameter of Fruits. Both the length and diameter of fruits of eggplants were greatly influenced by the levels (*d.f. = 3;* F_c = 40.9912**, p = < .01 for the length; F_c = 33.5011**, p =p < .01, for the diameter) and brewing durations (*d.f. = 3;* F_c = 4.8133 **, p = < .01 for length; F_c = 4.2561*, 0.01 =< p < .05 for diameter) of vermitea. Significant interaction effects were significantly observed between the two factors on the length (*d.f. = 9;* F_c = 2.6443*, 0.01 =< p < .05) of the fruits

(Table 6), but not on their diameter (*d.f. = 9;* Fc = 1.4363^{ns} , p = < .05) (Table 7).

Table 6. Average length of fruits (cm) of eggplant as affected by varying levels and brewing durations of vermitea foliar spray applications.

Factor A *(Levels of Vermitea)*	Factor B *(Brewing Durations)*				Mean (A)
	1 day	2 days	3 days	4 days	
Control (no foliar spray)	-	-	-	-	14.46^{c}
5% conc.	15.90^{b}	16.33^{c}	14.73^{c}	14.63^{b}	15.40^{c}
10% conc.	15.17^{b}	16.70^{bc}	15.90^{bc}	16.33^{ab}	16.02^{c}
15% conc.	17.03^{b}	19.00^{ab}	17.90^{ab}	17.27^{a}	17.80^{b}
20% conc.	20.63^{a}	22.33^{a}	18.63^{a}	18.43^{a}	20.01^{a}
Mean (B)	17.18^{b}	18.59^{a}	16.79^{b}	16.67^{b}	
F-test: A**, B**, AxB*					
CV: 1.46%					

Means of same column and row followed by common letters are not significantly different at 5% using Tukey Test.

Eggplants sprayed with 20% concentration level of vermitea and brewed for two days produced the longest (22.33 cm) and the largest (3.63 cm) fruits. The shortest and the smallest fruits were obtained from those which were not sprayed with any vermitea at 14.46 cm and 2.46 cm, respectively. The higher the concentration level of vermitea, the longer and the larger the fruits were produced; while brewing vermitea not shorter and beyond two days gave shorter and smaller fruits (Rex Compost Tea Brewer, 2010).

Table 7. Average diameter of fruits (cm) of eggplant as affected by varying levels and brewing durations of vermitea foliar spray applications.

Factor A *(Levels of Vermitea)*	Factor B *(Brewing Durations)*				Mean (A)
	1 day	2 days	3 days	4 days	
Control (no foliar spray)	-	-	-	-	2.46^{d}
5% conc.	2.60	2.70	2.63	2.47	2.60^{c}
10% conc.	2.73	2.77	2.77	2.70	2.74^{c}
15% conc.	2.97	3.00	3.00	2.80	2.94^{b}
20% conc.	3.30	3.63	3.20	3.00	3.28^{a}
Mean (B)	2.90^{b}	3.02^{a}	2.90^{b}	2.74^{b}	
F-test: A**, B*, AxB^{ns}					
CV: 6.13%					

Means within same column and row followed by a letter is not significantly different at 5% using Tukey Test.

Total Fruit Yield. Consistent with the results of the earlier growth and yield parameters, the total fruit yield of eggplant per hectare was likewise significantly influenced by the levels (*d.f. = 3;* F_c = 231.7934**, p = < .01) and brewing durations (*d.f. = 3;* F_c = 5.4648 **, p = < .01) of vermitea (Table 8). Highly significant interaction effects were noted between the two factors (*d.f. = 9;* F_c = 6.3224 **, p = < .01).

The combination of 20% concentration level of vermitea and two days brewing duration gave the highest fruit yield of eggplant with 9.53 tons/ha. Among the levels of vermitea, it showed 20% level obtaining the highest yield (9.11 tons/ha), and in the brewing durations, it revealed 2 days brewing with 8.49 tons/ha. The lowest yield was obtained from the treatment which was not applied with any foliar spray (5.86 tons/ha). The influential effects of vermitea as well as the optimum time duration of brewing were among the factors contributory to higher yields of eggplant (Rex Compost Tea Brewer, 2010). Besides, vermicast or worm casting enhances yield of crops (Organic Material Review Institute, 2010).

Table 8. Average fruit yield (tons/ha) of eggplant as affected by varying levels and brewing durations of vermitea foliar spray applications.

Factor A *(Levels of Vermitea)*	Factor B *(Brewing Durations)*				Mean (A)
	1 day	2 days	3 days	4 days	
Control (no foliar spray)	-	-	-	-	4.86[e]
5% conc.	6.90[d]	7.60[c]	7.40[c]	7.20[c]	7.28[d]
10% conc.	7.83[c]	8.37[b]	8.17[b]	8.10[b]	8.12[c]
15% conc.	8.30[b]	8.47[b]	8.50[b]	8.20[b]	8.37[b]
20% conc.	8.97[a]	9.53[a]	9.03[a]	8.90[a]	9.11[a]
Mean (B)	8.00[b]	8.49[a]	8.28[ab]	8.10[b]	
F-test: A**, B**, AxB**					
CV: 2.09%					

Means of same column and row followed by common letters are not significantly different at 5% using Tukey Test.

***Cost and Return Analysis*.** The cost and return analysis is shown in Table 9. Based from the total fruit yield per hectare, the 20% concentration level of vermitea obtained the highest return on investment (ROI) with 225.36%, with brewing duration at two days (198.94%). The lowest ROI was obtained in the control treatment (no foliar application) with 143%, and those sprayed with vermitea and brewed for one day at 185.71%. Even though treatments with increasing brewing durations had increasing expenses, however, higher net returns were likewise observed from those treatments with high gross sales.

Table 9. Cost and return analysis (US $) of eggplant per hectare as influenced by varying levels and brewing durations of vermitea foliar spray applications.

FACTORS		GROSS SALES (US $)	EXPENSES (US $)	NET RETURNS (US $)	ROI (%)
Levels of Vermitea (A)	Control (no foliar application)	2,641.30	1,086.96	1,554.35	143.00
	5% concentration	3,956.52	1,521.74	2,434.78	160.00
	10% concentration	4,413.04	1,521.74	2,891.30	190.00
	15% concentration	4,548.91	1,521.74	3,027.17	198.93
	20% concentration	4,951.09	1,521.74	3,429.35	225.36
Brewing Duration of Vermitea (B)	One day	4,347.83	1,521.74	2,826.09	185.71
	Two days	4,614.13	1,543.48	3,070.65	198.94
	Three days	4,500.00	1,565.22	2,934.78	187.50
	Four days	4,402.17	1,586.96	3,032.61	191.03

US $ 0.5319/kg = farm gate price per kilogram (US $ 1 = PhP 46.00)

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