Microbial Fertilizers For Increasing And Sustaining Rice Production On Organic Area And Area Under Conversion

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Abstract: Two studies were conducted on the use of solid and microbial fertilizers on rice for four cropping seasons (June to October 2010, January to April 2011, June to October 2011 and January to April 2012) at the RM-CARES experimental area, Philippines. One study was conducted in a converted organic area certified organic by the Organic Certification Center of the Philippines (OCCP) and the other one was in an area undergoing conversion for two years. The objectives of the study were to formulate organic fertilizer inputs and test for their efficacy; determine the best solid organic fertilizer; and test the best combination of solid organic fertilizer inputs and microbial nutrient sources for organic aromatic rice production. Two solid organic fertilizers namely vermicompost and RM-CARES organic fertilizer were used in the main plot and six microbial and organic fertilizer teas namely; EM, vermi tea, manure tea, RM-CARES OF tea , EM + vermi tea and EM + RM-CARES OF tea were used in the subplots. Results showed that in both converted and under conversion organic areas, the computed grain yield (t/ha) of CL-1 was significantly influenced by solid organic fertilizer with different microbial and organic fertilizer tea application. Interaction effects of solid fertilizers, vermi-compost and RM-CARES OF in combination with EM + RM-CARES OF tea or EM + vermi tea produced the highest average grain yield of 3.57 t/ha (WS) and 2.94 t/ha (DS) in under conversion area. Similar interaction effects were observed in fully converted organic area obtaining computed yield of 2.26t/ha (WS) and 3.23t/ha (DS) implying that both vermi-compost and RM-CARES organic fertilizers performed best when combined with EM + RM-CARES OF tea or with EM + vermi tea . The application of different microbial and fertilizer tea augmented the nutrients released slowly from solid OF. Hence, it is very important that during the process of conversion, the use of organic fertilizer must be supplemented with foliar sprays such as EM + RM-CARES OF tea or with EM + vermi tea or its equivalent organic foliar fertilizer.

Keywords: under conversion, fully converted, organic fertilizer, foliar fertilizer, vermicompost, microbials

1. INTRODUCTION

The massive program of the Department of Agriculture on organic agriculture helps farmers to be more educated on the importance of organic farming to the soil, people and the environment. Although many have decided to shift to organic farming, many are still hesitant to convert their farms into organic because of the yield reduction incurred during the initial stages of conversion. It is essential therefore, to develop an effective nutrient management approach by tapping available organic resources that can be used to sustain the needed nutrients throughout the growth and development of the crops. Organic inputs like solid organic fertilizers are efficient and effective in replenishing the soil with organic matter or humus being depleted with continued cropping. In addition, plant extracts, manures and teas are also known to suppress plant diseases, promote crop health and increase soil microorganism population and diversity that will improve soil structure, water retention, rooting depth and plant growth.

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Moreover, bio-organics like effective microorganism (EM) has been used with considerable success in improving soil quality and enhancing the growth and yield of crops. Having attained the right proportion by evaluating the ideal combination of solid fertilizers and different organic fertilizer inputs and microbials will ensure farmers' confidence that they will succeed during the conversion period of their farms and thus help in promoting organic farming in the country.

2. MATERIALS AND METHODS

Two studies were conducted at the RM-CARES experimental area. One study was in a fully converted organic area certified by the Organic Certification Center of the Philippines (OCCP) and the other one was in an area undergoing conversion for two years. The aromatic rice variety CL-1 was used in the study. Both study used 722 square meters belonging to Maligaya clay loam which was plowed and harrowed twice by tractor. After thorough land preparation, the experimental area was laid out following the Split plot Design in Randomized Block Design with three replications. Each block was divided into 12 plots measuring 4 x 5 m^2. Distance between block is 1 meter and 0.50 meter between treatments. The treatments evaluated were as follows:

Mainplot – Kind of Solid Organic Fertilizer
- T1 – Vermicompost (4t/ha)
- T2 – RM-CARES Organic fertilizer (4t/ha)

Subplot – Microbial and Organic Fertilizer Tea
- T1 – EM alone
- T2 – Vermi tea
- T3 – Manure tea
- T4 – RM-CARES OF tea
- T5 – EM + Vermi tea
- T6 – EM + RM-CARES OF tea

Vermicompost and RM-CARES Organic Fertilizer (OF) at the rate of 4 t/ha were applied basally. The chemical analysis of the fertilizer were as follows: Vermicompost – nitrogen (N) = 2.08%; phosphorus (P_2O_5) = 0.60%; potassium (K_2O) = 1.26%; and organic matter (OM) = 3.94% while RM-CARES OF had nitrogen (N) =1.42%; phosphorus (P_2O_5) = 1.39%; potassium (K_2O) = 0.79 %; and organic matter (OM) = 22.71%. EM and teas were sprayed weekly until tillering stage. Hand weeding was employed at 20 days after transplanting (DAT). No insecticide spraying was done throughout the cropping period. Irrigation of the experimental crops was done every other day to maintain 3-5 cm level of water. Harvesting was done when approximately 95 percent of the grains in the panicle have ripened.Data gathered were analyzed using Split plot Design in Randomized Block Design. Comparison among means was done using Duncan's Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

Computed Grain Yield (t/ha) of CL-1 Under Conversion (Four Season Trials)

As presented in Table 1, interaction showed that when vermi-compost was combined with EM + RM-CARES OF tea, it resulted to the highest computed yield of 3.92 t/ha, but failed to show difference from those treatment with EM + vermi tea and manure tea with means of 3.92 and 3.28 t/ha, respectively. On the other hand, RM-CARES OF in combination with EM + vermi tea produced the highest yield comparable with plants fertilized with EM + RM-CARES OF tea and vermi tea. The application of different microbial and fertilizer tea augmented the nutrients released slowly from solid OF. In the process of farm conversion to organic, generally the yield of any crop will decline, due to the reduction in the available major nutrients in the soil that will be supplied by organic fertilizer. Hence, it is very important that during the process of conversion, the use of organic fertilizer must be supplemented with foliar spray such as EM + vermi compost tea or its equivalent organic foliar fertilizer.

Table 1. Computed grain yield (t/ha) of CL-1 adjusted at 14% MC as influenced by solid organic fertilizer with different microbial and organic fertilizer tea application under conversion area (WS 2010).

KIND OF SOLID ORGANIC FERTILIZER	YIELD (t/ha) DIFFERENT MICROBIAL AND ORGANIC FERTILIZER TEA APPLICATION						
	EM Alone	Vermi Tea	Manure Tea	RM-CARES OF Tea	EM + Vermi Tea	EM + RM-CARES OF Tea	A-Mean
Vermi-Compost	2.63 b	2.96 b	3.28 ab	2.92 b	3.74 a	3.92 a	3.24 B
RM-CARES OF	3.62 c	4.56 ab	4.01 bc	4.27 xabc	5.01 a	4.73 ab	4.37 A
B-Mean	3.77 AB	3.76 AB	3.65 B	3.60 B	3.82 AB	4.24 AB	

Means having the same letter within a row are not significantly different at 5% level of significance

The yield in DS 2011 as influenced by kind of solid organic fertilizer with different microbial and organic fertilizer tea application is shown in Table 2. There was no significant difference on the application of solid organic fertilizer but highly significant on the application of different microbial and organic fertilizer tea and significant in their interaction. Highest yield was obtained when vermi-compost was applied with EM + vermi tea (2.65 t/ha) but comparable with vermi-compost in combination with EM + RM-CARES OF tea (2.53 t/ha). Microbial and organic fertilizer tea application as supplement for solid OF in farm undergoing conversion is very vital to minimize abrupt yield loss of crop due to absence of inorganic fertilizer. Since the release of plant nutrients in OF is slow, spraying of organic foliar is important to supplement the nutrients needed by the crops planted in a conventional farm undergoing conversion to organic farm, the fact that nutrients from foliar fertilizer can be readily absorbed by the plants.

Table 2. Computed grain yield (t/ha) of CL-1 adjusted at 14% MC as influenced by solid organic fertilizer with different microbial and organic fertilizer tea application under conversion area (DS 2011).

KIND OF SOLID ORGANIC FERTILIZER	YIELD (t/ha) DIFFERENT MICROBIAL AND ORGANIC FERTILIZER TEA APPLICATION						
	EM Alone	Vermi Tea	Manure Tea	RM-CARES OF Tea	EM + Vermi Tea	EM + RM-CARES OF Tea	A-Mean
Vermi-Compost	2.10 def	2.26 bcde	1.99 ef	2.00 de	2.65 a	2.53 ab	2.25
RM-CARES OF	1.94 f	2.12 cdef	2.33 bcd	2.09 def	2.40 abc	2.62 a	2.25
B-Mean	2.02 B	2.19 B	2.16 B	2.04 B	2.52A	2.58 A	

Means having the same letter within a row are not significantly different at 5% level of significance

The yield of CL-1 during WS 2011 was significantly affected by the application of different microbial and organic fertilizer tea but insignificant in the kind of solid organic fertilizer and their interaction (Table 3). Highest yield of 2.85 t/ha was obtained from plants applied with EM + vermi tea, comparable with EM + RM-CARES OF tea.

Table 3. Computed grain yield (t/ha) of CL-1 adjusted at 14% MC as influenced by solid organic fertilizer with different microbial and organic fertilizer tea application under conversion area (WS 2011).

KIND OF SOLID ORGANIC FERTILIZER	YIELD (t/ha) DIFFERENT MICROBIAL AND ORGANIC FERTILIZER TEA APPLICATION						
	EM Alone	Vermi Tea	Manure Tea	RM-CARES OF Tea	EM + Vermi Tea	EM + RM-CARES OF Tea	A-Mean
Vermi-Compost	2.33	2.50	2.53	2.38	2.69	2.61	2.50
RM-CARES OF	2.08	2.12	2.37	2.21	3.02	2.82	2.43
B-Mean	2.20C	2.31C	2.45BC	2.30C	2.85A	2.71AB	

Means having the same letter within a row are not significantly different at 5% level of significance

As shown in Table 4, the highest yield was obtained in plots fertilized with EM + vermi tea with mean of 3.39 t/ha, however, this was comparable with plants in plots fertilized with EM + RM-CARES OF tea and manure tea alone with means of 3.25 t/ha and 3.23 t/ha, respectively. Lowest yield was obtained from plot treated with EM alone (2.45 t/ha) comparable with those plants applied with RM-CARES OF tea, manure tea and vermi tea with means of 2.86 t/ha, 2.82 t/ha and 2.74 t/ha, respectively.

Table 4. Computed grain yield (t/ha) of CL-1 adjusted at 14% MC as influenced by solid organic fertilizer with different microbial and organic fertilizer tea application under conversion area (DS 2012).

KIND OF SOLID ORGANIC FERTILIZER	YIELD (t/ha) DIFFERENT MICROBIAL AND ORGANIC FERTILIZER TEA APPLICATION						A-Mean
	EM Alone	Vermi Tea	Manure Tea	RM-CARES OF Tea	EM + Vermi Tea	EM + RM-CARES OF Tea	
Vermi-Compost	2.72	2.62	3.37	2.87	3.39	3.39	3.06
RM-CARES OF	2.91	2.87	3.10	2.85	3.40	3.11	3.04
B-Mean	2.82 B	2.74 B	3.23 A	2.86 B	3.39 A	3.25 A	

Means having the same letter within a row are not significantly different at 5% level of significance

Computed Grain Yield (t/ha) of CL-1 in Fully Converted Organic Area (Four Season Trials)

The computed grain yield (t/ha) adjusted at 14% MC of Basmati 370 was significantly influenced by solid organic fertilizer with different microbial and organic fertilizer tea application (Table 5). Interaction effects of both solid fertilizers, vermi-compost and RM-CARES OF in combination with EM + RM-CARES OF tea produced the highest grain yield of 2.20 t/ha and 1.99 t/ha implying that both vermi-compost and RM-CARES organic fertilizers performed best when combined with EM + RM-CARES OF tea.

Table 5. Computed grain yield (t/ha) of CL-1 adjusted at 14% MC as influenced by solid organic fertilizer with different microbial and organic fertilizer tea application in fully converted organic area (WS 2010).

KIND OF SOLID ORGANIC FERTILIZER	YIELD (t/ha) DIFFERENT MICROBIAL AND ORGANIC FERTILIZER TEA APPLICATION						A-Mean
	EM Alone	Vermi Tea	Manure Tea	RM-CARES OF Tea	EM + Vermi Tea	EM + RM-CARES OF Tea	
Vermi-Compost	1.61 bc	1.51 c	1.51 c	1.63 bc	1.76 b	2.20 a	1.70
RM-CARES OF	1.38 d	1.55 cd	1.92 ab	1.74 bc	1.92 ab	1.99 a	1.75
B-Mean	1.50 D	1.53 D	1.71 BC	1.69 C	1.84 B	2.09 A	

Means having the same letter within a row are not significantly different at 5% level of significance

Similarly in DS 2011, the computed grain yield (t/ha) of CL-1 was significantly influenced by solid organic fertilizer with different microbial and organic fertilizer tea application (Table 6). Comparison among treatment interaction mean showed that plants fertilized with vermi compost tea in combination with EM + RM-CARES OF tea obtained the highest yield at 3.39t/ha. This was comparable with plants fertilized with EM + vermi tea (3.38t/ha) and manure tea alone (3.37t/ha). RM-CARES OF produced the highest yield when combined with EM + RM-CARES OF tea (3.56 t/ha). This could be attributed to the complementation of slow release of nutrients from solid organic fertilizer and the readily available plant nutrients from the different foliar sprays such that within the growth and development of the crop, there is continuous availability of plant nutrients that supported the development of more grains. Also, EM produces bioactive compounds such as vitamins, hormones and enzymes that stimulate plant growth (Higa and Wididana, 1991b).

Table 6. Computed grain yield (t/ha) of CL-1 adjusted at 14% MC as influenced by solid organic fertilizer with different microbial and organic fertilizer tea application in fully converted organic area (DS 2011).

KIND OF SOLID ORGANIC FERTILIZER	YIELD (t/ha) DIFFERENT MICROBIAL AND ORGANIC FERTILIZER TEA APPLICATION						A-Mean
	EM Alone	Vermi Tea	Manure Tea	RM-CARES OF Tea	EM + Vermi Tea	EM + RM-CARES OF Tea	
Vermi-Compost	2.55 c	2.62 bc	3.37 a	2.87 bc	3.38 a	3.39 a	3.03
RM-CARES OF	2.91 cd	2.87 d	3.30 bc	2.85 d	3.22 b	3.56 a	3.12
B-Mean	2.73 B	2.74 B	3.33 A	2.86 B	3.30 A	3.48 A	

Means having the same letter within a row are not significantly different at 5% level of significance

The computed yield (t/ha) of CL-1 at WS 2011 was also significantly affected by the application of solid organic fertilizer and the application of different microbial and organic fertilizer tea (Table 7). Interaction effects showed that plants applied with vermi-compost in combination with EM alone produced the highest grain yield of 2.85 t/ha but comparable with vermi-compost in combination with vermi tea. On the other hand, RM-CARES OF produced the highest yield of 2.91 t/ha when combined with EM + RM-CARES-OF tea, but comparable with RM-CARES OF in combination with EM alone.

Table 7. Computed grain yield (t/ha) of CL-1 adjusted at 14% MC as influenced by solid organic fertilizer with different microbial and organic fertilizer tea application in fully converted organic area (WS 2011).

KIND OF SOLID ORGANIC FERTILIZER	YIELD (t/ha) DIFFERENT MICROBIAL AND ORGANIC FERTILIZER TEA APPLICATION						
	EM Alone	Vermi Tea	Manure Tea	RM-CARES OF Tea	EM + Vermi Tea	EM + RM-CARES OF Tea	A-Mean
Vermi-Compost	2.85 a	2.81 ab	2.62 b	2.62 b	2.58 b	2.29 c	2.63
RM-CARES OF	2.83 a	2.28 d	2.41 cd	2.59 c	2.41 cd	2.91 a	2.57
B-Mean	2.84 A	2.55 B	2.51 B	2.60 B	2.49 B	2.59 B	

Means having the same letter within a row are not significantly different at 5% level of significance

As reflected in Table 8, EM + vermi tea obtained the highest yield during WS 2012 with 3.38 t/ha but comparable with EM + RM-CARES OF tea. An increase of 16.15% and 16.55% was obtained when EM was combined with vermi over the sole application of EM (2.91 t/ha) and vermi tea alone (2.90 t/ha). This indicates that microbial like EM performed best when combined with different organic fertilizer tea application.

Table 8. Computed grain yield (t/ha) of CL-1 adjusted at 14% MC as influenced by solid organic fertilizer with different microbial and organic fertilizer tea application in fully converted organic area (WS 2012).

KIND OF SOLID ORGANIC FERTILIZER	YIELD (t/ha) DIFFERENT MICROBIAL AND ORGANIC FERTILIZER TEA APPLICATION						
	EM Alone	Vermi Tea	Manure Tea	RM-CARES OF Tea	EM + Vermi Tea	EM + RM-CARES OF Tea	A-Mean
Vermi-Compost	2.97	2.92	2.87	2.92	3.36	3.07	3.03
RM-CARES OF	2.85	2.87	2.84	2.87	3.40	3.25	3.01
B-Mean	2.91B	2.90B	2.86B	2.90B	3.38A	3.19A	

Means having the same letter within a row are not significantly different at 5% level of significance

Summary of the Yield of the Two Best Performing Treatments Under Conversion and Fully Converted Organic Area

In under conversion area, highest yield was recorded in WS 2010 from RM-CARES organic fertilizer in combination with the EM + Vermi tea with 5.01 t/ha (Table 9 and Figure 1). The high yield could be possibly attributed to the residual effect of the previous inorganic fertilizer applied in the area since it was the first cropping season of the conversion period. However, the yield was reduced to 108.7 % during the next cropping season (DS 2011) but an increasing trend in the yield was observed in the succeeding cropping seasons.

Table 9. Summary of the average yield of CL-1 during the conduct of the experiment.

Status of the Area	Solid OF	Microbial and Organic Fertilizer tea Application	Computed Yield (t/ha)				Average Yield (t/ha)	
			WS 2010	DS 2011	WS 2011	DS 2012	WS 2010/ 2011	DS 2011/ 2012
Under conversion	Vermi-compost	EM + vermi tea	3.74	2.65	2.69	3.39	3.22	3.02
		EM + RM-CARES OF tea	3.92	2.53	2.61	3.39	3.27	2.96
	RM-CARES OF	EM + vermi tea	5.01	2.40	3.02	3.40	4.02	2.90
		EM + RM-CARES OF tea	4.73	2.62	2.82	3.11	3.78	2.87
						Ave	**3.57**	**2.94**
Fully converted	Vermi-compost	EM + vermi tea	1.76	3.38	2.58	3.36	2.17	2.98
		EM + RM-CARES OF tea	2.20	3.39	2.29	3.07	2.25	3.23
	RM-CARES OF	EM + vermi tea	1.92	3.22	2.41	3.40	2.17	3.31
		EM + RM-CARES OF tea	1.99	3.56	2.91	3.25	2.45	3.41
						Ave	**2.26**	**3.23**

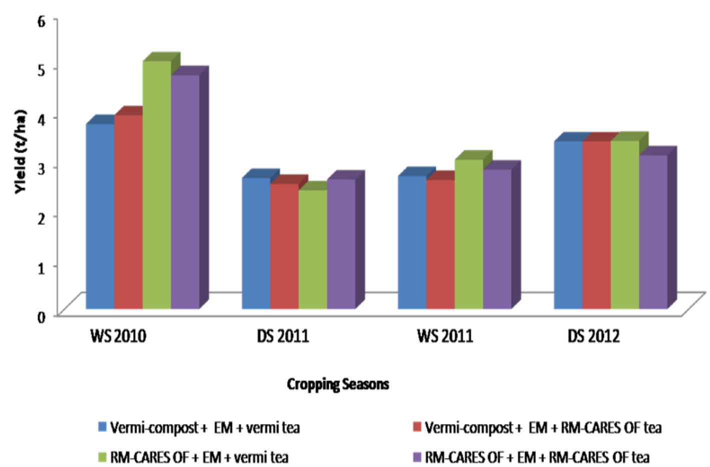

Fig 1. Computed yield of CL-1 in four cropping seasons under conversion area

In fully converted area, highest yield was obtained in DS 2011 from plants applied with RM-CARES OF in combination with EM + RM-CARES OF tea with 3.56 t/ha (Table 10 and Figure 2). Regardless of the treatments, it can be observed that yields of the four trials were higher in dry seasons than wet seasons. During WS, the average yield was 2.26 t/ha or 42.92% lower than the average yield in DS (3.23 t/ha). The lower yield in WS was because of the frequent rainfall that interfered with the growth and development of CL-1.

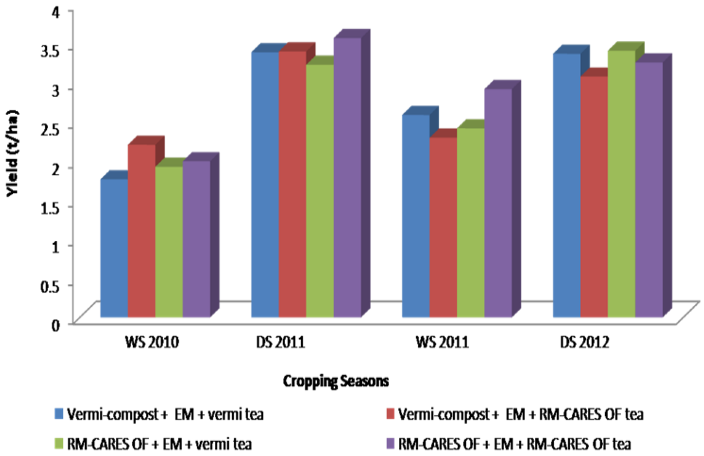

Fig 2. Computed yield of CL-1 in four cropping seasons under conversion area

The average yield of organic CL-1 both in under conversion (WS-3.57 t/ha; DS-2.94t/ha) and fully converted areas (WS-2.26t/ha; 3.23 t/ha) was almost equal with the conventional yield of India (origin of CL-1) at 2.0-3.0 tons/ha (http://agropedia.iitk.ac). According to the organic surveys obtained by Lee (1992), yields for most surveyed crops would likely decline under organic production methods with yield generally reported as 5 to 10 percent lower per acre than the conventional system. However, she mentioned that this might be only true at the beginning of the adoption period but this would improve later (Dabbert and Madden, 1986). Thus, supplementation in the form of organic foliar fertilizer is of prime importance since EM consists of mixed cultures of beneficial and naturally-occurring microorganisms that can be applied as inoculants to increase the microbial diversity of soils and plants. Research has shown that the inoculation of EM cultures to the soil/plant ecosystem can improve soil quality, soil health, and the growth, yield, and quality of crops (Higa and Wididana, 1991b). Also, teas provide organic nutrients like sugars and amino acids, plus organic chelating agents (humic and fulvic acids) that carry extracted micronutrients (e.g, iron, zinc, manganese and copper) to plants. Micronutrients are the building blocks of plant enzymes, vitamins and hormones that can increase plant disease-resistance, vigor and hardiness of the plants (Merril and McKeon, 1998).

Changes in Soil Properties of the Experimental Field of Fully Converted Organic and Under Conversion Area

The most important benefit from organic farming is the healing of the soil from the negative effect of chemical fertilizers and pesticides that later will result to a productive plant habitat. As shown by the positive yield increase of rice, application of organic fertilizer markedly improved the soil properties such as available P, exchangeable K, organic matter and pH both for fully converted and under conversion areas after two cropping seasons. In under conversion area, an increase of 0.52% for available P, 15.38 % in exchangeable K, 35.24% in organic matter and 1.83% in pH was attained (Table 10). The same trend was observed in fully converted area where an increase of 50% available P, 15.38% exchangeable K, 8% organic matter and 2.17% pH was obtained. This result is supported by the findings of Reganold (1989) that long-term organic farming increased the available P, K, Ca and OM compared to conventional practices. However, since rice is a nitrogen requiring plant, the total N (%) of the soil failed to increase.

Table 10. Analyses of the soil used in the fully converted organic area and under conversion before planting (WS 2010) and after harvest (DS 2012).

CHEMICAL PROPERTY	METHOD OF ANALYSIS	UNDER CONVERSION		FULLY CONVERTED		INCREASE/ DECREASE OF SOIL PROPERTIES FROM 2010-2012	
		Before Planting (2010)	After Harvest (2012)	Before Planting (2010)	After Harvest (2012)	Under Conversion	Fully Converted
Total N (%)	Kjeldahl	0.13	0.08	0.10	0.08	-0.05 (62.5%)	-0.02 (20%)
Available P (ppm)	Bray No. 2	22.88	23.00	14.00	21.00	+0.12 (0.52%)	+7.00 (50%)
Exch. K (ppm)	Flame Photometer	120.00	130.00	130.00	150.0	+10.00 (8.33%)	+20.00 (15.38%)
Org. Matter (%)	Walkey-Black	1.22	1.65	1.50	1.62	+0.43 (35.24%)	+0.12 (8.00%)
Soil pH	Potentio-metric	5.45	5.55	5.52	5.66	+0.10 (1.83%)	+0.12 (2.17%)

Figure in parentheses represent percent increase/decrease; + = increase; -- = decrease

Occurrence of Insect Pest, Beneficial Insects and Diseases in the Experimental Field Under Conversion and Fully Converted Organic Area

Whorl maggot, stemborer and green leaf hopper (GLH) were the insect pests monitored in both areas. However, minimal number of whorl maggot and stemborer were recorded except for GLH where it was found to be higher during the dry season than wet season (14-35 per 20 sample plants) but not able to cause economic damage to the plants. During wet season, GLH ranged only from 5-22 per 20 sample plants. The frequent spraying of different microbial and fertilizer teas application suppressed their growth and development. Research findings of Sangatanan et al. (1997) found that susceptibility of plants to insect was reduced when organic sources of nutrients were used. Also, the frequent rainfall during the wet season prevented the population build-up of the insect. In addition, the once a week spraying of hot pepper extract also interfered their growth and development. The study conducted by Gudeva et.al showed that oleoresin from hot pepper (*Capsicum annuum*) ssp. microcarpum L. and its dilution 1:20 are the most efficient as a biopesticide against green peach aphid *Myrus persicae Sultz*. However, beneficial insects such as spider and lady bird beetle were also found present in the area while rice blast and bacterial leaf blight (BLB) were the common diseases observed during wet season. To control the incidence of diseases, acapulco extract was sprayed in the area.

Table 11. Average population of insect pests and beneficial insects at different observation periods per 20 sample plants in in under conversion and fully converted areas (2010-2012).

STATUS	OBSERVATION PERIODS (DAT)	GLH		SPIDER		LADY BIRD BEETLE	
		WS (2010/ 2011)	DS (2011/ 2012)	WS (2010/ 2011)	DS (2011/ 2012)	WS (2010/ 2011)	DS (2011/ 2012)
Fully converted organic area	30	5	14	3	7	2	6
	45	22	35	8	14	4	11
	60	19	28	5	9	2	5
Under conversion area	30	16	23	4	11	6	9
	45	17	27	7	14	8	5
	60	9	17	7	8	4	7

4. CONCLUSION

Solid fertilizers like vermi-compost or RM-CARES OF performed best when combined with EM + Vermi tea or EM + RM-CARES OF tea since the application of different microbial and fertilizer tea augmented the nutrients released slowly from solid OF. Hence, it is very important that during the process of conversion, the use of solid organic fertilizer must be supplemented with foliar sprays such as EM + RM-CARES OF tea or with EM + Vermi tea or its equivalent organic foliar fertilizer.

5. ACKNOWLEDGMENT

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