Effect of Brewing Time of Vermitea on the Performance and Pest Occurrence of Different Rice Varieties

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Abstract

This study was conducted to investigate the performance of rice varieties effect of vermitea brewed at various durations on lowland rice varieties for two cropping seasons. Nine treatment groups were considered with two experimental factors: Factor A - rice varieties (inbred, black and glutinous rice) and Factor B – brewing time (24 hours, 48 hours, and 72 hours) arranged in Randomized Complete Block Design in three replications. Vermitea was administered through foliar application and gathering of insect pest were done at a weekly interval. Glutinous rice was found superior in most growth and yield parameters. Most of the growth characteristics were varied as affected by the brewing time of vermitea. The different brewing time of vermitea influenced most of the growth characteristics but not the yield contributing characteristics of rice for both seasons. However, brewing to 48 hours produced the highest grain yield (dry season). The growth and yield performance of rice was better during dry season compared to wet season. The number of insect pests was highest in black rice during wet season and in inbred rice during dry season. Brewing vermitea to 24 hours attracted the highest number of insects during wet season. More insect pests were observed in wet season than in dry season. Glutinous rice gave the highest economic returns. Brewing vermitea to 48 hours (wet season) and 24 hours (dry season) are the most profitable. Result suggests that a longer brewing time of vermitea does not promote higher growth and protection against insect pests.

Keywords: cropping season, inbred rice, insect repellant, organic agriculture

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Introduction

When modern rice varieties were introduced in the 1960's, insecticides were one component in a package of technologies of the "Green Revolution" in Asia. However, insecticides are often too expensive for resource-poor farmers to use. Even where farmers can afford insecticides the health hazards may outweigh the economic benefits. Studies in the Philippines have indicated that when the effect on farmers health and subsequent lost days of work, and the adverse effect on the environment are taken into consideration, the productivity increases obtained from the utilization of insecticides are minimal. Due to their cost, toxicity to man and the environment, the secondary pest problems caused such as the resurgence of the brown planthopper, and because of the development of insecticide resistant populations, the recent trend in rice IPM has been toward the integration of insect resistant varieties with the conservation of natural control agents. Although there are cases where the judicious use of selective insecticides in rice is necessary, routine, calendar-based applications in a non-IPM context are no longer recommended (Bautista & Javier, 2005).

Over a long period of time, food production has generally depended on conventional agriculture (CA). Breeders have produced varieties that are adapted to conventional farming practices and high chemical inputs. However, with climate change, issues on hazards brought about by CA to the environment as well as to human health rise (Pimentel et al. 2005). For this reason, the government intended to provide development and promotion of Organic Agriculture in the Philippines through the Organic Act of 2010 or Republic Act 10068, which was approved and signed as a law on April 16, 2010. One of the natural amendments that gained the interest of the researchers is vermicompost and its derivatives such as vermiwash, vermicompost leachate and vermitea or vermicompost tea. In the study of Joshi et al. (2014), vermicompost is described as an excellent soil amendment and a biocontrol agent which make it the best organic fertilizer and more eco-friendly as compared to chemical fertilizers. Vermicompost is an ideal organic manure for better growth and yield of many plants. It can increase the production of crops and prevent them from harmful pests without polluting the environment.

Vermicompost tea is the water extracts of solid vermicomposts from which microorganisms, soluble nutrients, and plant-benefi cial substances are converted into a liquid form. It can be used in a wide range of horticultural and agricultural systems to elicit plant growth and pest and disease management responses through a variety of mechanisms. It can be applied directly to plant foliage. It is also used as a soil drench and has been shown to be effective in relatively small quantities (Edwards et al. 2011). Moreover, compost tea brewing technique (aerobic or anaerobic) extracts and grows populations of beneficial microorganisms (Ingham, 2005; Scheuerell, 2003; Scheuerell, 2002, & Scheuerell, 2003. According to Ingham in 2005, long brewing time will enable greater amounts of soluble material and organism's to be extracted from the compost and into the liquid. The greater the amount of soluble material in the tea, the more food resources there are to grow beneficial bacteria and fungi, and the more nutrients will be available for plants. However, the length of brewing which is most effective in increasing the productivity and repelling insect pests in

rice has not yet established. Hence, this study was conducted to: 1) determine the performance of rice varieties applied with vermitea brewed at different durations in terms of growth, yield and pest occurrence; 2) determine which brewing duration of vermitea will give the best performance to rice in terms of growth, yield, and pest occurrence; 3) compare the performance of rice varieties applied with vermitea brewed at different durations in different growing seasons; and 4) perform cost and return analysis of the different rice varieties and brewing durations of vermitea.

Materials and Methods

This experiment was conducted at the experimental site of the Organic Rice Project of Crop Science Research Development Center (CSRDC) CapSU Burias, Mambusao, Capiz for the wet and dry cropping seasons in 2017. The study used (1) certified PSB 222 (inbred) rice seeds taken from the Bayer Philippines Inc. in Iloilo City, (2) black rice and glutinous rice from CSRDC and (3) vermi tea produced from 2 kg vermicasts added with 30 L water and 1 kg molasses brewed at different times (24, 48, 72 hours) using Rex Vermi Compost Tea Brewer. The vermicasts were supplied by the Organic Project of CSRDC, and the Rex Vermi Compost Tea Brewer was supplied by Felicidad Orchard Organic Farming, General Santos, Philippines. Vermitea was applied through foliar application using a knapsack sprayer at a weekly interval.

The Randomized Complete Block Design (RCBD) with three replications was used in the study. Nine treatment groups were considered with two experimental factors: factor A - rice varieties and factor B – brewing time. The experimental treatments were T1 – inbred: 24 hours, T2 – inbred: 48 hours, T3 – inbred: 72 hours, T4 – black rice: 24 hours, T5 – black rice: 48 hours, T6 – black rice: 72 hours, T7 – glutinous rice: 24 hours, T8 – glutinous rice: 48 hours, T9 – glutinous rice: 72 hours.

The performance of the rice plants was measured in terms of plant height, number of tillers, fresh biomass, and number of days of maturity, number of field grains, percent of field grains, grain yield and 1000 - seed weight. Pest population was determined by swatting of insect net for flying insects and close visual observation for other pests and predators.

The economics of production of the different rice varieties was based on cost and return analysis and in terms of return on investment. All expenses incurred including labor, inputs, and other miscellaneous expenses were properly recorded and were converted into per hectare basis.

All data gathered from this study were analyzed through the IRRISTAR Program using Analysis of Variance of Randomized Complete Block Design (RCBD) and significant means were compared using LSD at 5% and 1% levels of significance.

Results and Discussion

Growth Performance

The growth characteristics of rice varieties applied with vermi tea brewed at various durations across seasons are shown in Table 1.

Table 1. Growth performance of rice varieties applied with vermitea brewed at different durations across seasons.

Growth Parameters	Rice Variety			Brewing Time of Vermitea			Mean
	Inbred	Black	Glutinous	24 hrs	48 hrs	72 hrs	
a.Plant Height (cm)							
Wet Season	100.06b	92.65c	114.70a	103.23	104.09	100.17	102.483b
Dry Season	111.79a	109.86a	107.80b	116.59a	95.48b	117.38a	109.817a
b.Number of Tillers							
Wet Season	11.87	9.78	9.21	10.70	10.70	9.47	10.288b
Dry Season	15.27	13.51	14.10	13.47b	17.64a	11.77b	14.293a
c.Number of Panicles							
Wet Season	8.34	6.69	7.16	7.40	7.74	7.06	7.398b
Dry Season	11.89	11.18	11.15	11.54	13.04	9.64	11.407a
d.Fresh Biomass (g)							
Wet Season	113.35b	89.94c	141.88a	112.48b	122.10a	110.59b	15.057b
Dry Season	179.11a	163.70b	167.03b	189.85a	128.93b	191.06a	169.947a

CV (a) = 5.39%; CV (b) = 16.28%; CV (c) = 17.02%; CV (d) = 20.29%; Means followed by a common letter are not significantly different at the 5% level by LSD; letters in blue indicate vertical mean comparisons while letters in red indicate horizontal mean comparisons.

Growth Performance of Rice Varieties

The growth characteristics of rice in terms of plant height and fresh biomass were significantly varied among rice varieties when applied with vermitea brewed at different durations (Table 1) during wet season. The number of tillers and panicles are comparable in all varieties. Glutinous rice produced the tallest plant (114.70 cm) and heaviest fresh biomass (141.88 g) while black rice produced the shortest plant (92.65 cm) and lightest fresh biomass (89.94).

Plant height and fresh biomass were also significantly different among rice varieties during dry season. Inbred rice obtained the tallest height of plant (111.79 cm) but is comparable to black rice (109.86 cm) while glutinous rice produced the shortest plant (107.80 cm). Inbred rice also recorded the heaviest fresh biomass

(179.11 g) while glutinous and black varieties produced the lightest (167.03 g and 163.70 g, respectively).

Effect of Brewing Time of Vermitea on Growth Performance of Rice

The different brewing durations of vermitea significantly affected the fresh biomass but not the other growth characteristics (plant height, number of tillers and number of panicles) of different rice varieties during wet season. The heaviest fresh biomass (122.10 g) was recorded from plants applied with vermitea brewed for 48 hours. Brewing vermitea for 24 hours and 72 hours gave a comparable weight of fresh biomass of 112.48 g and 110.59 g, respectively.

On dry season trial, plant height, number of tillers and fresh biomass were influenced by different brewing durations of vermitea. The tallest height was obtained from rice plants treated with vermitea brewed for 72 hours (117.38 cm) but was found comparable to plants applied with vermitea brewed for 24 hours (116.59 cm). The shortest height of rice was recorded from plants applied with vermitea brewed for 48 hours (95.48 cm). The highest number of tillers was produced by plants applied with vermitea brewed for 48 hours (17.64) while the lowest was from plants treated with vermitea brewed for 24 hours (13.47) and 72 hours (11.77), respectively. On the other hand, applying vermitea brewed for 72 hours and 24 hours gave the heaviest fresh biomass (191.06 g and 189.85 g, respectively) while treating plants with vermitea brewed for 48 hours gave the lightest fresh biomass (122.10 g).

Growth Performance of Rice in Different Seasons

The different rice varieties exhibited better growth performance in all parameters (plant height:109.82 cm, number of tillers:14.29, number of panicles: 11.41 and fresh biomass: 169.95 g) during dry season compared to wet season (plant height: 102.48 cm, number of tillers: 10.29, number of panicles: 7.40 and fresh biomass: 115.06 g).

Yield Performance

Table 2 presents the yield and yield contributing characteristics of rice varieties applied with vermitea brewed at various durations across seasons.

Table 2. Yield parameters of rice varieties applied with vermitea brewed at various durations across seasons.

Yield Parameters	Rice Variety			Brewing Time of Vermitea			Mean
	Inbred	Black	Glutinous	24 hrs	48 hrs	72 hrs	
a. No. of Filled Grains							
Wet Season	85.62b	83.89b	118.82a	95.96	94.69	97.59	96.10b
Dry Season	118.54a	83.37c	107.49b	115.99	108.74	106.67	106.80a
b.No. of Unfilled Grains							
Wet Season	36.81b	35.49b	48.50a	39.10	39.49	42.2	40.27a
Dry Season	12.85b	28.34a	10.75b	11.10	10.57	10.27	13.98b
c.% of Filled Grains							
Wet Season	69.93	70.27	71.01	71.05	70.57	69.81	70.44b
Dry Season	90.22a	74.63b	90.91a	91.27	91.14	91.22	88.43a
d.1000-Seed Weight (g)							
Wet Season	33.22	31.22	34.56	32.78	33.22	33.00	33.00
Dry Season	27.89c	32.78b	36.89a	31.55	33.22	32.78	32.52
e.Grain Yield (ton /ha)							
Wet Season	3.03	2.95	3.15	2.94	3.63	2.54	3.04b
Dry Season	5.24	5.20	5.35	4.67b	5.14a	3.97c	4.93a

CV (a) = 10.90%; CV (b) = 15.19%; CV (c) = 8.67%; CV (d) = 7.22%; CV (e) = 11.76%; Means followed by a common letter are not significantly different at the 5% level by LSD; letters in blue indicate vertical mean comparisons while letters in red indicate horizontal mean comparisons.

Yield performance of rice varieties

The different rice varieties significantly differed in number of filled grains and number of unfilled grains but not in percentage of filled grains, 1000-seed weight and grain yield when applied with vermitea brewed at various durations during wet season (Table 2). Glutinous rice produced the highest number of filled and unfilled grains (118.82 and 48.50) while inbred (85.62 and 36.81) and black varieties (83.89 and 35.49) produced the lowest. The grain yield was not significantly different among the rice varieties however, glutinous rice gained numerically the highest grain yield (3.15 ton/ha) followed by inbred rice (3.03 ton/ha) and black rice (2.95 ton/ha), respectively.

On dry season production all yield contributing parameters were different in rice varieties but not in grain yield. The highest number of filled grains was produced by inbred variety (118.54), highest number of unfilled grains by black rice (28.34), highest percentage of filled grains by glutinous (90.91) and inbred rice (90.22) and heaviest 1000-seed weight by glutinous rice (36.89 g). The lowest number of filled grains was produced by black variety (83.37), lowest number of unfilled grains by inbred and glutinous rice (12.85 and 10.75, respectively), lowest percentage of filled grains by black rice (74.63) and lightest 1000-seed weight by inbred rice (27.89 g).

Numerically, glutinous rice produced the highest grain yield of 5.35 ton/ha followed by inbred rice with 5.24 ton/ha and the lowest grain yield was obtained from black rice with 5.20 ton/ha.

Effect of Brewing Time of Vermitea on Yield Performance of Rice

The different brewing time of vermitea did not significantly influence the yield and yield contributing parameters of the rice varieties on wet season. However, numerical results show that brewing vermitea at 72 hours produced the highest number of filled and unfilled grains (97.59 and 42.20, respectively). Furthermore, brewing vermitea at 24 hours obtained the highest percentage of filled grains (71.05) and brewing at 48 hours yielded the heaviest 1000-seed weight (33.22 g). The highest grain yield of 3.63 ton/ha was produced by application of vermitea brewed to 48 hours, followed by 2.94 ton/ha (24 hours) and 2.54 ton/ha (72 hours).

Similarly, experiment during dry season did not affect the yield parameters of rice varieties except for the number of filled grains. The highest number of filled grains (115.99) was recorded from application of vermitea brewed for 24 hours while the lowest was obtained from brewing for 48 hrs and 72 hrs (108.74 and 106.67, respectively). Numerically, applying vermitea brewed for 24 hours produced the highest number of unfilled grains (11.10) and percentage of filled grains (91.27). Moreover, brewing vermitea to 48 hrs yielded the heaviest 1000-seed weight (33.22 g) and highest grain yield (5.14 ton/ha). The lightest 1000-seed weight (31.55 g) was obtained from application of vermitea brewed for 24 hrs while the lowest yield (3.97 ton/ha) was from brewing at 72 hrs.

Yield Performance of Rice in Different Seasons

Except in 1000-seed weight, the yield performance of rice varieties are significantly better during dry season with 106.80 filled grains, 13.98 unfilled grains, 88.43 percent filled grains and 4.93 ton/ha grain yield than during wet season with 96.10 filled grains, 40.27 unfilled grains, 70.44 percent filled grains and 3.04 ton/ha grain yield.

The highest number of insect pests was recorded in black rice at 89.20 while the lowest was observed in inbred and glutinous varieties at 67.53 and 64.97, respectively during wet season (Table 3). On dry season, the number of insect pests was greatest in inbred variety (57.56) followed by glutinous rice (50.89) and least in black rice (45.67). Brewing vermitea to 24 hrs attracted most insect pests with 82.73 while brewing to 72 hrs and 48 hrs had the least with 70.50 and 68.47, respectively. Result further shows that more insect pests occur during wet season (73.90) than during wet season (51.37).

Pest Occurence on Rice Varieties Applied with Vermitea Brewed at Different Durations

Table 3. Pest occurence on rice varieties applied with vermi tea brewed at different

durations.

Pest Occurence	Rice Variety			Brewing Time of Vermitea			Mean
	Inbred	Black	Glutinous	24 hrs	48 hrs	72 hrs	
Number of Insect Pests							
Wet Season	67.53b	89.20a	64.97b	82.73a	68.47b	70.50b	73.90a
Dry Season	57.56a	45.67c	50.89b	51.11	50.33	52.67	51.37b

CV (a) = 11.50%; Means followed by a common letter are not significantly different at the 5% level by LSD; letters in blue indicate vertical mean comparisons while letters in red indicate horizontal mean comparisons.

Economic Analysis

Table 4. Cost and return of rice varieties applied with vermi tea brewed at different durations.

Economic Parameters	Rice Variety			Brewing Time of Vermitea			Mean
	Inbred	Black	Glutinous	24 hrs	48 hrs	72 hrs	
Cost of Production, Php/ha							
Wet Season	23,418.11	18,978.11	18,852.11	20,358.51	20,416.11	20,473.71	20,416.11
Dry Season	23,332.18	18,892.18	18,766.18	21,327.68	21,530.18	21,732.68	20,930.18
Gross Income, Php/ha							
Wet Season	51,510	50,150	53,550	49,980	61,710.00	43,180.00	51,680.00
Dry Season	89,080	88,400	90,950	79,390.00	87,380.00	67,490.00	89,448.33
Net Income, Php/ha							
Wet Season	28,091.89	31,171.89	34,697.89	29,621.49	41,293.89	22,706.29	31,263.89
Dry Season	65,747.82	69,507.82	72,183.82	92,062.32	45,959.82	65,647.32	68,518.15
ROI, %							
Wet Season	119.96	164.25	184.05	145.50	202.26	110.90	154.49
Dry Season	281.79	367.92	384.65	431.66	213.47	302.07	330.26

Cost and Return Analysis of Rice Varieties

Cost and return of rice production using vermitea brewed at different durations is presented in Table 4. The cheapest production cost per hectare was incurred by glutinous rice (Php18,852.11 and Php18,766.18), black rice follows (Php 18,978.11 and Php18,892.18), and the inbred variety (Php23,418.11 and Php23,332.18) during the wet and dry seasons incurred the highest cost. The costs of production incurred for the three varieties using vermitea both during dry and wet season are considerably lower than the average total costs of Php49,745/ha for non-

irrigated palay as reported by the Philippine Statistics Authority (2017).

The highest gross income per hectare was also recorded from glutinous rice both in the wet and dry seasons (Php53,550.00 and Php90,950.00, respectively) followed by the inbred variety (Php51,510.00 and Php89,080.00) and black rice (Php50,150.00 and Php88,400.00).

The gross earnings of glutinous rice has led to gain the highest net income per hectare of Php34,697.89 during the wet season and Php72,183.82 during the dry season. The lowest net income per hectare was earned from inbred rice for both seasons (Php28,091.89:wet season and Php65,747.82:dry season).

Likewise, the highest net returns were noted from glutinous rice with 184.05%/ha and 384.65%/ha while the lowest was obtained from inbred variety with 119.96%/ha and 281.79%/ha during wet season and dry season, respectively.

Cost and Return Analysis of Vermitea Brewed at Different Durations

Brewing vermitea to 24 hours recorded the lowest production cost of Php20,358.51/ha during the wet and Php21,327.68/ha during the dry season. Brewing vermitea to 48 hours and 72 hours incurred a bit higher cost with Php20,416.11/ha and Php20,473.71/ha, respectively during wet season and Php21,530.18/ha and Php21,732.68/ha, respectively during dry season. The trend is attributed to the additional cost for the use of equipment and labor employed while the vermitea is brewed longer.

The gross income per hectare was highest at 48 hours brewing time of vermitea followed by 24 hours and 72 hours with Php61,710.00, Php49,980.00, and Php21,732.68, respectively.

Moreover, the highest net income per hectare was recorded from brewing vermitea to 48 hours with Php41,293.89 (wet season) and 24 hours with Php92,062.32 (dry season). The earnings resulted to highest returns on investment for the two brewing durations of vermitea. The 48 hours brewing time obtained 202.26%/ha (wet season) while 24 hours brewing duration earned 431.66%/ha (dry season).

Conclusions

Glutinous rice was found superior in most growth and yield parameters and numerically recorded the highest grain yield. The effect of different brewing time of vermitea significantly varied on the growth characteristics. The different brewing time of vermitea did not influence the yield contributing characteristics of rice for both seasons but brewing to 48 hours produced the highest grain yield during the dry season. Majority of growth and yield characteristics of rice were recorded higher during dry season compared to wet season. The number of insect pests was highest in black rice during wet season and in inbred rice during dry season. Brewing vermitea

to 24 hours attracted the highest number of insects during wet season. Lesser insect pests were noted during the dry season compared during the wet season. Glutinous rice gave the highest economic returns in both wet and dry season of production. Brewing vermitea to 48 hours and 24 hours are the most profitable during wet season and dry season, respectively.

Recommendations

Based on the results of the study it is recommended to plant glutinous rice for better agronomic performance and economic returns. Brew vermitea to 48 hours during wet season and for 24 hours during dry season for higher returns. Avoid planting black rice during wet season and inbred rice during dry season when these varieties are more attractive to insect pests. The study was conducted in short term and several factors may have contributed to the results of the study. Thus, it is further recommended to conduct the study in different environment before making inference.

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