CONTROL OF RICE BLAST (*Magnaporthe grisea*) DISEASE USING VARIOUS ORGANIC MANURES

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ABSTRACT

A research on the effects of organic manures on the incidence and severity of rice blast (Magnaporthe grisea) on rice, was carried out at the Teaching and Research farm of the School of Agriculture and Agricultural Technology, Federal University of Technology, Owerri, Imo state in April, 2011. The upland rice varieties used were OFADA 9 (local variety), NERICA 1, NERICA 3, NERICA 10. The experiment was laid out in a completely randomized design (CRD) with three replications. The treatments were poultry droppings, cattle dung, pig slurry and control. Data on plant height and leaf blast severity were collected at 30, 40, 50 and 60 days after sowing per plot per Treatment. At 50 days after sowing (booting stage), the highest plant height was recorded on plants treated with poultry dropping (73cm) and cattle dung (65cm) which was significantly (p>0.05) different from pig slurry (44cm) and control (43cm) while the interaction effect showed that OFADA 9 (85cm) which received poultry droppings recorded the highest plant height which was significantly (p>0.05) different from cattle dung on NERICA 3. The severity was assessed by visual observation and scoring the percentage leaf area/plot affected by blast disease lesions. Results showed that pots treated with pig slurry recorded least blast incidence and severity (9 %) in the experiment than other treatments, followed by poultry dropping (12 %) and control (19 %) while cattle dung (23 %) gave significantly (p>0.05) higher blast incidence and severity on the plant leaf with best effect noticed on NERICA 10, NERICA 3, NERICA 1 and OFADA 9.

Keywords: Rice blast, organic manures, incidence, severity, varieties.

INTRODUCTION

Rice (*Oryza sativa*) is a cereal foodstuff which forms an important part of the diet of over 2.7 billion people worldwide and as such is a staple food (ICAR, 2006). World production of rice has risen steadily from about 600 million tons of paddy in 2007 with Africa producing 23 million tons of paddy and Nigeria contributing 0.72% (4 million tons paddy) to it (FA0, 2008). Ighalo and Remison (1995) reported that application of soil enriching fertilizer is necessary to increase yield per rice plant and that low yield in rice production is due to lack of inadequate use of fertilizer. Rice has the potential to improve nutrition as it supply almost 60% of the dietary energy and protein deprived from plants (ICAR, 2006), boost food security, foster rural development and support sustainable land care (NRC, 1996). Major Rice diseases include Rice Ragged stunt, sheath Blight and Tungro. Worldwide, rice blast caused by the filamentous fungus *Magnaporthe grisea* (Hebert) Barr. (ana-morph, *Pyricularia grisea* Sacc.), which is one of the most economically devastating crop diseases

(Valent and Chumley, 1994) in most rice growing and producing areas of the world (Ou, 1985), attacks at all stages of the crop and symptoms appear on leaves and nodes (Seebold *et al*., 2004). The extent of damage caused by the disease is by measuring incidence and severity which depend on factors like physiological race of the pathogen; rice varieties employed, cultural practices and the prevailing environmental factors (Ou, 1985 ; Singh and Bhatt, 1986). Organic manure used for agriculture may be classified into the following categories: crop residues, green manure, poultry manure, municipal refuse, wastes from the extraction of vegetable oil common compost, mushroom compost, cattle manure, hog and residues from processing animal products (Hsieh and Hsieh 1989). The use of compost as a biological approach have received much attention due to its ability to suppress soil borne and foliar plant diseases. Disease suppressive properties of compost amendments are well known and the spectrum of pathogens and diseases that can be effectively managed by compost amendments has been well documented (De Ceuster *et al*., 1999; Hoitink *et al*., 2001; Litterick *et al*., 2004; Noble and Coventry, 2005; Chen and Nelson, 2008; Richter *et.al*., 2011a; Richter *et.al*., 2011b).Haruna and Abubakar, (2009) reported that soil amendments such as poultry, neem leaf (*Azadirachta indica*) and cow dung based compost showed significantly reduced disease incidence and severity of *Fusarium* wilt of tomato; and also poultry manure specifically produced higher yield than other soil amendment. The application of manure to soil provides potential benefits including improving the fertility, structure, water holding capacity of soil, increasing soil organic matter and reducing the amount of synthetic fertilizer needed for crop production (Blay *et al.,* 2002). Organic composted manures such as poultry, cow dung etc are rich amendments that promote plant growth and can suppress plant diseases. However, the inconsistency of disease suppression prevents rural resource-poor farmers from fully harnessing the potential benefits. This has led to a great need for scientifically based research to increase the efficacy and consistency of using different composted manure types to enhance disease suppression in organic vegetable and crop production. The objective of this research was to rank the efficacy of the different organic manure types for the control of blast disease on rice and determine the rice variety that is more resistant to rice blast disease.

MATERIALS AND METHODS

The experiment was conducted between April and July 2011, at the teaching and research farm of the School of Agriculture and Agricultural Technology, Federal University of Technology, Owerri, (FUTO) Imo state. The University is located between latitudes 5°23'N and 5°24'N; and longitudes 5°59'E and 6°58'E. It is situated in the tropical rainforest zone of south eastern Nigeria. The mean annual rainfall is about 2,500 mm and spans from April to November. The rice seeds were sourced from International Institute for Tropical Agriculture (IITA) Ibadan. The varieties used were OFADA 9 (local), NERICA 1, NERICA 3 and NERICA 10. Treatments evaluated comprised three organic composted manure sources and control and four varieties of rice. These were variously combined to give sixteen treatment combinations and laid in complete randomized design (CRD) with three replications. The treatments were poultry droppings (A), pig slurry (B), cattle dung (C) and the control (zero manure) (D). .Rice *(Oryza sativa* L.) plants were grown in (48) plastic pots of 25 cm in height filled with local field soil and placed on the piece of land area cleared. The manure types which were the treatments were properly dried, treated, randomly applied to the respective pots and thoroughly incorporated into the pots filled with soil ten days before sowing. The control pot did not receive any manure. Each treatment had 3 kg of each manure source in each pot, with three replicate pots of 8 - 10 rice plants per pot. The treatments, poultry droppings and pig slurry were collected from FUTO Farm while, cattle dung from Mami market, Obinze. Chemical analysis of the organic manure types were also carried out at the laboratory of the Department of Soil Science and Technology before its application. The soil pH was determined using the method of Hendershot et al., (1993); total organic carbon was determined by Walkley and Black's method (Nelson and Sommers, 1982); exchangeable bases were determined by the method of Association of Official Analytical Chemists (AOAC, 1970); total nitrogen (N) was estimated using microKejeldahl method (Bremner and Mulvaney, 1982) and the available phosphorus was measured colourimetrically by Bray (II) method (Olsen and Sommers). After germination, weeding was carried out as at when due. Data on plant germination were collected by counting after ten days of sowing and recorded as 85 % germination. Plant heights were measured using a meter rule. The measurements were taken at 20, 30, 40 and 50 days after sowing. Height was measured from the ground level to the last fully opened leaves. The five plants were measured at random from each pot and the average was calculated from five measured values. Leaf blast incidence was determined by assessing the percentage of plant with the above ground symptoms. A plant having any evidence of blast per pot per replicate was counted and recorded as infected at 30, 40, 50 and 60 days after sowing. The percentage damage was determined by dividing the leaf blast affected plants by the total number of plants per pot and multiplied by 100, that is,

$$\text{Disease incidence} = \frac{\text{Number of plants infected} \times 100}{\text{Total number of plant/pot}}$$

Leaf blast in upland rice reached maximum disease severity at 25 to 40 days after seeding and gradually decreases as resistance of the newly formed leaves increases with age (Filippi and Prabhu, 1997b). Data on leaf blast severity was collected also at 30, 40, 50 and 60 days after sowing per plot per Treatment. The severity was assessed by visual observation and scoring the percentage leaf area/plot affected by blast disease lesions. These were read on the scale (0-9) of the Standard Evaluation System designed by International Rice Research Institute (IRRI, 1996). After the trial, plant samples were randomly collected from the experimental site according to the organic manure treatments and infected leaf parts taken for identification of the causal organism. Disease pathogen identification was determined using a growth medium Potato Dextrose Agar (PDA). The infected plant part was inoculated, covered and tied with polyethylene to prevent contamination and put in the sterilized incubator with culture plate well labeled and observed after three days for disease growth, after which sub-culturing was done to get a pure culture of the pathogen and incubated for two days. All data collected were subjected to analysis of variance (ANOVA) according to the procedure for a complete randomized design as outlined by Steel and Torrie (1980). Test for significant difference among treatment means was performed using least significant difference at 5% level of probability.Blast severity was estimated using the visual observation and scoring according to the format described by IRRI standard evaluation system scale for rice (IRRI system, 1996) (Table 1).After the trial, plant samples were randomly collected from the experimental site according to the organic manure treatments and the infected leaf parts taken were for identification of the causal organism. Disease pathogen identification was determined using a growth medium Potato Dextrose Agar (PDA). The infected plant part was inoculated, covered and tied with polyethylene to prevent contamination and put in the sterilized incubator with culture plate well labeled and observed after three days for disease growth, after which sub-culturing was done to get a pure culture of the pathogen and incubated for two days. All data collected were subjected to analysis of variance (ANOVA) according to the procedure for a complete randomized design as outlined by Steel and Torrie (1980). Test for significant difference among treatment means was performed using least significant difference at 5% level of probability.

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Result and Discussion

Result on organic manure composition showed that poultry droppings were high in nitrogen content, phosphorus, potassium and other essential nutrients among all other manures in terms of nutrient content (Table 2). The result showed that at 20 days after sowing (sprouting stage), the pots treated with Cattle dung and Poultry droppings had the highest mean plant height (28cm), followed by Control (23 cm) and Pig slurry (18 cm) (Table 3). At 30 days after sowing (tillering stage), the pots treated with cattle dung (50 cm) recorded highest mean plant height followed by poultry droppings (46 cm), control (34 cm) and pig slurry (28 cm) (Table 3). At 40 days after sowing (elongation stage), the highest plant height was recorded on plants treated with poultry dropping (62 cm) followed by cattle dung (57 cm), pig slurry (41 cm) and control (38 cm) while the interaction effect shows that OFADA 9 (68 cm) that received poultry dropping recorded the highest height , followed by poultry dropping on NERICA 10 (65 cm), Cattle dung on NERICA 3 (63 cm), Cattle dung on NERICA 10 (62 cm), (Table 3). At 50 days after sowing (booting stage), the highest plant height was recorded on plants treated with poultry dropping (73 cm) and cattle dung (65 cm) which was significantly ($p>0.05$) different from pig slurry (44 cm) and control (43 cm) while the interaction effect showed that OFADA 9 (85 cm) which received poultry droppings recorded the highest plant height which was significantly ($p>0.05$) different from cattle dung on NERICA 3, (Table 3). However, no germination was noticed on pots planted with OFADA 9 where pig slurry was applied. Leaf blast incidence was determined by counting the number of leaves infected. The percentage leaf damage was determined by dividing the blast affected plants by the total number of plants per pot and multiplied by 100. Result on Leaf blast incidence at 30 days (Table 4) showed that that there was no significant ($p>0.05$) difference among the treatments and interaction effect even though the blast disease incidence was very low in other manure

Table 1: Scale used for rating of blast disease.

Scale	Description	Host Behavior
0	No lesion observed	Highly Resistant
1	Small brown specks of pin point size	Resistant
2	Small roundish to slightly elongated, necrotic gray spots, about 1-2 mm in diameter, with a distinct brown margin. Lesions are mostly found on the lower leaves	Moderately Resistant
3	Lesion type same as in 2, but significant number of lesions on the upper leaves	Moderately Resistant
4	Typical susceptible blast lesions, 3 mm or longer infecting less than 4% of leaf area	Moderately Susceptible
5	Typical susceptible blast lesions of 3mm or longer infecting 4-10% of the leaf area	Moderately Susceptible
6	Typical susceptible blast lesions of 3 mm or longer infecting 11-25% of the leaf area	Susceptible
7	Typical susceptible blast lesions of 3 mm or longer infecting 26-50% of the leaf area	Susceptible
8	Typical susceptible blast lesions of 3 mm or longer infecting 51-75% of the leaf area many leaves are dead	Highly Susceptible
9	Typical susceptible blast lesions of 3 mm or longer infecting more than 75% leaf area affected	Highly Susceptible

Entries with consistent rating between 4 and 6 with overall average not higher than 5.5, may have a good level of quantitative resistance.

cattle dung recorded lowest disease incidence. Result on Leaf blast incidence at 40 days (Table 4) indicated that there was no significant ($p>0.05$) difference among the treatment even though 4 % disease incidence which is lowest was observed in plants treated with cattle dung, low incidence was recorded on other manures used as pig slurry recorded 6 %,poultry and control recorded 7 %. At 50 days after sowing, highest disease incidence was recorded on pots treated with cattle dung (23 %), control (19 %), poultry droppings (12 %) and pig slurry (9 %), (Table 4). At the 60 days after sowing disease incidence

Table 2: Nutrient Composition of the Organic Manures used.

Manures	Poultry Manure	Pig Slurry	Cattle dung
Nitrogen (%)	1.38	0.36	0.32
pH in water	7.98	6.94	5.53
Organic carbon (%)	30.82	25.72	22.79
Potassium (Meq/100g)	2.75	0.87	0.81
Calcium (Meq/100g)	4.30	3.72	2.98
Magnesium (Meq/100g)	5.38	3.96	3.00
Phosphorus (ppm/100g)	-	-	-

was highest on NERICA 3 (48%), NERICA 1 (47 %) NERICA 10 (41 %) while OFADA 9 (21 %) recorded the lowest incidence which is significantly different from other varieties while the organic manure cattle dung (67 %) recorded highest incidence followed by control and Poultry dropping (32 %) while pig slurry recorded lowest disease incidence, (Table 4). It was observed that at 30 days after sowing (Table 5) there was no significant ($p>0.05$) difference recorded among treatments even though pots treated with poultry dropping, pig slurry and cattle dung were moderately susceptible, the control pot was highly resistant. Result on Leaf blast disease severity at 40 days (Table 5) showed that the pots treated with cattle dung had the highest severity (10%), followed by Control (8%), Poultry dropping (6%) and Pig Slurry (5%) in Table 5. There was no significant (p>0.05) difference among the treatment. Using scoring read on the scale (0-9) with standard Evaluation System designed by (IRRI, 1996) (Table 1). Table 5 indicated that pots treated with organic manures and control were all moderately susceptible. Results from 50 days after sowing (Table 5) showed that pots treated with pig slurry (9%) was moderately susceptible followed by poultry dropping (12%), control (20%) and cattle dung (26%) were susceptible to the disease. According to standard evaluation scale (1996), rating not higher than 5.5 may have a high level of resistance. Therefore the disease occurs less at the pots treated with pig slurry, poultry dropping and control and cattle dung at ratings of 4, 6, 6 and 7 respectively. Result from this experiment showed that organic manure on plant height showed that at the sprouting and tillering stages, the pots treated with cattle dung and poultry droppings had the highest plant height, followed by control and pig slurry. While at elongation and booting stages, the highest plant height was recorded on plants treated with poultry droppings followed by cattle dung which was significantly (p>0.05) different from pig slurry and control while the interaction effect shows that OFADA 9 that

Table 3: Effect of different manure types on Plant Height (cm) of Rice at 20, 30, 40 and 50 Days after sowing)

Treatments	20 DAS	30 DAS	40 DAS	50 DAS
1 X A	29	55	68	85
1 X B	0	0	0	0
1 X C	22	40	43	46
1 X D	27	42	47	56
2 X A	26	42	58	69
2 X B	25	39	60	64
2 X C	32	55	62	70
2 X D	23	32	36	40
3 X A	28	42	56	66
3 X B	28	43	59	63
3 X C	32	54	63	74
3 X D	21	32	34	36
4 X A	29	46	65	72
4 X B	20	30	44	49
4 X C	27	51	59	71
4 X D	21	29	34	43
$LSD_{0.05}$	11.64	17.43	20.98	22.95

1 - OFADA 9 , 2 - NERICA 1, 3 – NERICA 3 , 4 – NERICA 10; A - Poultry dropping, B – Pig Slurr, C – Cattle dung, D - Control

received poultry dropping recorded the highest height, followed by poultry dropping on NERICA 10, Cattle dung on NERICA 3, Cattle dung on NERICA 10 (Table 4). It was also observed that pots treated with pig slurry on OFADA 9 in all replications did not germinate. Leaf blast incidence at 30 and 40 days showed no significant (p>0.05) difference among the treatment even though 4% disease incidence which is lowest was observed in plants treated with cattle dung, low incidence was recorded on other manures used as pig slurry recorded 6%, poultry and control recorded 7%. However, at elongation stage (Table 5), highest disease incidence was recorded on pots treated with cattle dung (23%), control (19%), poultry droppings (12%) and pig slurry (9%).

Table 4: Effect of different manures types on Disease incidence (%) of Rice at 30, 40, 50 and 60 Days after sowing)

Treatments	30 DAS	40 DAS	50 DAS	60 DAS
1 X A	3	5	14	28
1 X B		-	-	-
1 X C	3	11	17	33
1 X D	3	3	14	22
2 X A	0	5	5	31
2 X B	0	22	25	47
2 X C	0	0	25	78
2 X D	0	5	16	31
3 X A	0	8	14	39
3 X B	0	0	8	30
3 X C	0	0	22	78
3 X D	3	17	19	45
4 X A	6	8	14	31
4 X B	6	0	3	25
4 X C	0	5	28	67
4 X D	0	3	28	32
$LSD_{0.05}$	NS	NS	15.67	26.27

1 - OFADA 9 , 2 - NERICA 1, 3 – NERICA 3 , 4 – NERICA 10; A - Poultry dropping, B – Pig Slurry C – Cattle dung, D - Control

At the 60 days after sowing disease incidence was highest on NERICA 3 (48%), NERICA 1 (47%) NERICA 10 (41%) while OFADA 9 (21%) recorded the lowest incidence which is significantly ($p>0.05$) different from other varieties. The cattle dung (67%) recorded highest incidence followed by control and poultry droppings (32%) while pig slurry recorded lowest disease incidence. Lowest disease severity was observed in pots treated with pig slurry, with a rating of 5 followed by poultry dropping, control and cattle dung. According to standard evaluation scale (1996), the rating not higher than 5.5 may have a high level of resistance. Therefore the disease occurred less on the pots treated with pig slurry followed by poultry dropping, control and cattle dung, with pig slurry having less score indicating lowest disease severity. The superiority of pig slurry to the other sources of organic manure may be attributed to balanced and gradual release of plant nutrients and increased nutrient uptake to support growth.

Table 5: Effect of different manures types on Disease severity (%) of Rice at 30, 40, 50 and 60 Days after sowing)

Treatments	30 DAS	40 DAS	50 DAS	60 DAS
1 X A	3	9	7	13
1 X B		-	-	-
1 X C	6	7	18	20
1 X D	0	7	14	18
2 X A	3	7	10	11
2 X B	7	9	11	12
2 X C	0	20	23	24
2 X D	0	10	22	22
3 X A	0	6	15	10
3 X B	0	3	13	14
3 X C	0	7	28	32

3 X D	3	7	7	20
4 X A	0	3	11	12
4 X B	0	6	15	8
4 X C	0	7	27	29
4 X D	0	7	10	20
$LSD_{0.05}$	NS	NS	11.41	13.52

1 - OFADA 9 , 2 - NERICA 1, 3 – NERICA 3 , 4 – NERICA 10; A - Poultry dropping, B – Pig Slurry, C – Cattle dung, D - Control

CONCLUSION

This study shows that among the organic sources, poultry dropping had the greatest effect on the growth development of the crop with plants growing in this source of nutrient producing greater height followed by cattle dung, control and pig slurry. Also the use of organic manure for the control of rice blast recorded lowest incidence and severity on pig slurry followed by poultry dropping, control and cattle dung with best effect noticed on NERICA 10, NERICA 3 and NERICA 1 while on OFADA 9 no germination was noticed on pots where pig slurry was applied. This is in line with the findings of Hoitink and Boehm, (1999) who also conducted research studies which showed that compost-mediated manure control foliar diseases and specific microorganisms in the rhizosphere of plants and can reduce the severity of diseases on the entire plant.. Therefore, it is necessary that further research should be carried out on controlling the rice blast disease using organic manures.

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