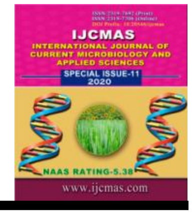
Int.J.Curr.Microbiol.App.Sci (2020) Special Issue-11: 3405-3412

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 Special Issue-11 pp. 3405-3412
Journal homepage: http://www.ijcmas.com



Original Research Article

Study the Effect of Organic Nutrient Management on Major Diseases in Rice (*Oryza sativa* L.)

M. Srinivasarao[1]*, M. Pramanick[2] and Bhanu Priya[3]

[1]Department of Agronomy, Agricultural College, Naira, ANGRAU, A.P, India
[2]Department of Agronomy, BCKV, Mohanpur-741252, Nadia, West Bengal, India
[3]Department of Seed Analyst, Chattishgarh State Seed Testing Laboratory, Chattishgarh, India
*Corresponding author

Keywords

Brown spot, Mustardcake, Rice, Sheath blight and Vermicompost

A B S T R A C T

Rice (*Oryza sativa* L.) is one of the most important staple food for the people of southeast Asia including India, which supplies major source of calories for about 45 per cent of world population, particularly to the people of Asian countries. Organic agriculture and conservation agriculture is developing rapidly and increasing in its acreage. Almost 30.4 million ha area is managed organically by more than 7,00,000 farmers. The global organic land area has increased by almost 1.8 million ha compared to the year of 2005. Present experiment was carried out at BCKV, Kalyani, Nadia, West Bengal during the *Kharif* season of 2013 and 2014 with the objective to study the effect of organic nutrient and plant protection management practices on disease intensity of major diseases in rice. Based on the experimental findings least brown spot disease severity was observed under seed treatment with brahmastra + foliar spray with brahmastra (at 15, 30, 45, 60, 75 DAT) + *Trichoderma harzianum* soil application @ 130 kg ha^{-1}) (P_3) (27.59) and it had statistically not comparable difference with brahmastra seed treatment + *Trichoderma harzianum* application @ 130 kg ha^{-1} (P_2) (29.17) over control (P_4). Least sheath blight incidence was also observed in seed treatment with brahmastra + foliar spray with brahmastra (at 15, 30, 45, 60, 75 DAT) + *Trichoderma harzianum* soil application @ 130 kg ha^{-1}) (P_3) (20.22) without any comparable difference with brahmastra seed treatment + *Trichoderma harzianum* application @ 130 kg ha^{-1} (P_2) (19.93).

Introduction

Rice (*Oryza sativa* L.) is one of the most important staple food for the people of southeast Asia including India, which supplies major source of calories for about 45 per cent of world population, particularly to the people of Asian countries. The production of rice in India has four fold increase from 1950–51 to 2001–02 (Mahunta *et al*., 2017). It is commendable that India has attained self-sufficiency in food for 17% population of the world with merely 2% of the world's land resources (Sarkar, 2005). By the year 2025, the country will face an uphill task of producing 325 million ton food grains to meet the national food and nutrition security demands for a projected population of 1.4 billion (Lungmuana and Angami, 2011). In the quest of more food, the soils have been constantly afflicted with much damaged, steadily degraded and destroyed with profound economic costs. Generally increase in rice production is attributed to release of high yielding varieties and use of higher dose of chemical fertilizers, no doubt have the positive impact on crop growth and yield, but had negative on soil organic matter, soil fertility, earth worm activity and soil micro organism activity. While decline in soil fertility and productivity due to nutritional imbalance has been recognized as one of the most important factors limiting crop yields, the decline in organic C content of the soil could be arrested and the gap between potential and actual yield could be bridged to a large extent, if chemical fertilizers are applied in conjunction with organic manures. Organic agriculture and conservation agriculture is developing rapidly and increasing in its acreage. Almost 30.4 million ha area is managed organically by more than 7,00,000 farmers. The global organic land area has increased by almost 1.8 million ha compared to the year 2005 (Ravichandra *et al.*, 2014). Keeping this background in mind, the present investigation was conducted with the broader objective of assessing the effect of organic nutrients and plant protection management practices on major pest and diseases in rice crop.

Materials and Methods

A field experiment was conducted in model organic farm at "C Block farm" of Bidhan Chandra Krishi Viswavidyalaya, Kalyani, Nadia during the period of *Kharif* 2013 and *Kharif* 2014, under New Alluvial Zone of West Bengal. The field is maintained as completely organic since 2007. The soil of the experimental field was Gangetic alluvium (Entisol) type with sandy clay loam in texture having good water holding capacity and moderate soil fertility status. The experiment was laid out in strip plot design with 24 numbers of treatment combinations replicated thrice, the treatment details includes N_1: Vermi compost @ 60 kg N equivalent ha^{-1} (Basal & Top dressing), N_2: Mustard cake @ 60 kg N equivalent ha^{-1} (Basal & Top dressing), N_3: Vermi compost @ 30 kg N equivalent ha^{-1} (Basal) + Mustard cake @ 30 kg N equivalent ha^{-1} (Top dressing), N_4: Sesbania green manure @ 20 kg N ha^{-1} + Vermicompost (Top dressing) @ 40 kg N ha^{-1} N_5: Sesbania green manure @ 20 kg N ha^{-1} + Mustard cake @ 40 kg N ha^{-1}(top dressing), N_6: Sesbania green manure @ 20 kg N ha^{-1} + Vermicompost @ 20 kg N ha^{-1}+ Mustard cake @ 20 kg N ha^{-1} and plant protection treatments includes P_1: Seed treatment with Brahmastra + Foliar spray with Brahmastra (at 15, 30, 45, 60, 75 DAT), P_2: Seed treatment with Brahmastra + *Trichoderma harzianum* application @ 130 kg ha^{-1}, P_3: P_1 + P_2 (Seed treatment with Brahmastra + Foliar spray with Brahmastra (at 15, 30, 45, 60, 75 DAT) + *Trichoderma harzianum* soil application @ 130 kg ha^{-1}) & P_4: Control. Brahmastra is a product preparing from different natural sources, it can be used as organic source as plant protection measure against pest and disease attack.

Ingredients

Water, Cow dung, Cow urine, Neem leaves, Castor leaves, Calotropis leaves, Custard apple leaves, Pongamia leaves, Bitter gourd leaves, Parthenium leaves.

All these mentioned plant and animal products collected in a container mix it and boiled for 20 - 30 minutes time after that cool it and kept it for 30 days for fermentation. After 30 days filtered solution can be used as seed treatment or foliar spray (Anand, 2006).

Rice cultivar used in the experiment is IET 4786 (Shatabdi). The recommended dose of fertilizer for rice was 60: 30: 30 kg N, P_20_5

and K_2O ha^{-1} respectively. The green manure was sown and incorporated in their respective plots at the time of puddling.

Remaining organic nutrient sources *i.e*., mustard cake and vermicompost were divided in to two parts and applied as basal and top dressing in their respective plots according to treatment combination. The plant protection inputs *i.e., Trichoderma harzianum* mixed with soil as 1:40 ratio according to treatment, and applied in their respective plots after land preparation. The brahmastra product was used as seed treatment and foliar spraying according to their respective treatment plots.

Disease incidence of brown spot (*Helminthosporium oryzae*) was estimated by the percentage of leaf area affected or disease symptoms (small, oval or circular and dark brown spots with light yellow halo around the outer edge) at 30 DAT, 45DAT, 60 DAT and 75 DAT Then, the leaf area affected values (%) were compared with the disease incidence scale (Anonymous, 1996).

Disease severity scale for brown spot

The disease incidence of sheath blight (*Rhizoctonia solani*) was estimated by the percentage of leaf area affected or disease symptoms (oval or ellipsoidal greenish gray lesions, usually 1-3 cm long, on the leaf sheath, lesions on the leaves usually have irregular lesions, often with gray-white centers and brown margins as they grow older) at 30 DAT, 45DAT, 60 DAT and 75 DAT Then, the leaf area affected values (%) were compared with the disease incidence scale (0-5 scale) (Sriram *et al.*, 2000).

Disease severity scale for sheath blight of rice

Percentage disease severity was calculated by the formula given by McKinney (1923).

$$\text{Disease severity (\%)} = \frac{\text{Total sum of numerical ratings}}{\text{Total number of leaves observed}} \times \frac{100}{\text{Maximum disease score}}$$

Results and Discussion

Brown spot disease incidence was observed at different growth stages of rice, *viz*., 30, 45, 60 and 75 days after transplanting (DAT) and disease severity was increased progressively with increase in the age of the crop and reached their maximum values at 75 DAT. It was significantly influenced with organic plant protection management treatments in both the years of study (Table 1) at all growth stages except 30 DAT. At 30 DAT no significant difference was observed among the organic plant protection treatments. From the pooled data of the both the years the least brown spot disease severity was observed under the treatment P_3 and it had statistically not comparable difference with P_2 and the maximum brown spot disease severity was observed under the treatment P_4 at remaining all growth stages by recorded the values of 11.99, 14.51 and 27.59 under the treatment P_3, 13.25, 15.88 and 29.17 under the treatment P_2 and the higher values of 21.73, 23.76 and 40.49 under the treatment P_4 at 45, 60 and 75 DAT respectively. The percentage of reduction in disease severity over P_4 (control) was followed as 44.8%, 38.9% and 31.8 % under P_3 and 39%, 33% and 27.9% under P_2 at 45, 60 and 75 DAT respectively. The interaction effect of organic nutrient and plant protection treatments was not significantly influenced on the brown spot disease severity at all growth stages throughout the experiment (Table 3) though by the pooled data the values range from 11.78- 17.90 under the treatments N_4P_2 and N_1P_1 respectively at 30 DAT, and 10.54, 12.55 and 25.67 under the treatment N_6P_3 to

24.21, 25.32 and 42.91 under the treatment N_3P_4 at 45, 60 and 75 DAT respectively.

Sheath blight of rice was attacked during 1st year of experimentation but during 2nd year, did not find any sheath blight symptoms. Sheath blight disease severity was increased progressively with increase in the age of the crop and reached their maximum values at 75 DAT. It was significantly influenced with organic plant protection management treatments (Table 2) at all growth stages.

The lowest sheath blight disease severity was observed under the treatment P_3 by recorded the values of 12.08, 10.63, 14.73 and 19.93 and it was statistically at par with the treatment P_2 with recorded the values of 12.78, 11.10, 15.58 and 20.22 at 30, 45, 60 and 75 DAT respectively. At all growth stages the highest sheath blight disease severity was observed under the treatment P_4 (19.96, 20.04, 22.81 and 31.10 at 30, 45, 60 and 75 DAT respectively). The percentage reduction in disease severity at 75 DAT was followed as 36% and 35% under the treatments P_3 and P_2 respectively over the P_4 (control). The interaction effect of organic nutrient and plant protection treatments was not significantly influenced on the sheath blight disease severity at all growth stages throughout the experiment though the values range from 9.21, 9.64, 10.87 and 19.84 under the treatment N_3P_3 to 20.45, 20.76, 23.30 and 31.28 under the treatment N_6P_4 at 30, 45, 60 and 75 DAT respectively.

These results were supported by Bhagawati (2005), they found that *Trichoderma harzianum* and *Trichoderma viride* when added to soil in the presence of *Rhizoctonia solani* could suppress infection of sheath blight in rice. Similar results were reported by Rahman (2007) and Joshi *et al.,* (2007).

Table.1

Scale	Severity (leaf area affected)
0	No incidence
1	Affected leaf area less than 1%
2	1-3% of the leaf area affected
3	4-5% of the leaf area affected
4	6-10% of the leaf area affected
5	11-15% of the leaf area affected
6	16-25% of the leaf area affected
7	26-50% of the leaf area affected
8	51-75% of the leaf area affected
9	Affected leaf area above 76%

Table.2

Scale	Severity (leaf area affected)
0	No incidence
1	Affected leaf sheath less than 5%
2	6-10% of the leaf sheath affected
3	11-25% of the leaf sheath affected
4	26-50% of the leaf sheath affected
5	More than 50% of the leaf sheath affected

Table.3 Effect of organic nutrient and plant protection management treatments on brown spot disease severity in rice

Treatments	30 DAS			45 DAS			60 DAS			75 DAS		
	2013	2014	Pooled	2013	2014	Pooled	2013	2014	Pooled	2013	2014	Pooled
P_1	17.04	16.70	16.87	19.19	16.06	17.62	19.82	20.69	20.25	37.71	33.03	35.37
P_2	13.83	14.22	14.02	14.67	11.82	13.25	15.58	16.19	15.88	29.82	28.51	29.17
P_3	14.79	16.23	15.51	13.02	10.97	11.99	14.73	14.29	14.51	28.31	26.86	27.59
P_4	16.84	15.35	16.09	24.41	19.05	21.73	22.81	24.70	23.76	42.73	38.25	40.49
SEm (±)	0.49	0.62	0.98	0.74	0.48	1.08	0.48	0.46	0.81	0.19	0.74	0.93
CD at 5%	NS	NS	NS	2.56	1.65	3.73	1.65	1.59	2.81	0.64	2.56	3.23

Table.4 Effect of organic nutrient and plant protection management treatments on sheath blight disease severity in rice

Treatments	30 DAT	45 DAT	60 DAT	75 DAT
P_1	16.97	14.59	19.82	28.83
P_2	12.78	11.10	15.58	20.22
P_3	12.08	10.63	14.73	19.93
P_4	19.96	20.04	22.81	31.10
SEm (±)	1.38	0.79	1.22	1.43
CD at 5%	4.12	2.36	3.66	4.26

Treatment details: $\mathbf{N_1}$**:** Vermi compost @ 60 kg N equivalent ha^{-1}, $\mathbf{N_2}$**:** Mustard cake @ 60 kg N equivalent ha^{-1}, $\mathbf{N_3}$**:** Vermi compost @ 30 kg N equivalent ha^{-1} + Mustard cake @ 30 kg N equivalent ha^{-1}, **N4:** Sesbania green manure @ 20 kg N equivalent ha^{-1} + Vermicompost @ 40 kg N equivalent ha^{-1}, $\mathbf{N_5}$**:** Sesbania green manure @ 20 kg N equivalent ha^{-1} + Mustard cake @ 40 kg equivalent N ha^{-1}, $\mathbf{N_6}$**:** Sesbania green manure @ 20 kg N equivalent ha^{-1} + Vermicompost @ 20 kg N equivalent ha^{-1}+ Mustard cake @ 20 kg N equivalent ha^{-1}; $\mathbf{P_1}$**:** Seed treatment with Brahmastra + Foliar spray with Brahmastra (at 15, 30, 45, 60, 75DAT), $\mathbf{P_2}$**:** Seed treatment with Brahmastra + Trichoderma harzianum soil application @ 130 kg ha^{-1}, & $\mathbf{P_3}$**:** P_1 + P_2 & $\mathbf{P_4}$**:** Control

Table.5 Effect of organic nutrient and protection management practices on different pest and diseases of rice

Treatments	Brown Spot (%)			Sheath blight (%)
	2013	2014	Pooled	2013
N1P1	37.40	36.49	36.95	30.77
N1P2	28.93	30.79	29.86	20.67
N1P3	27.63	28.90	28.26	20.17
N1P4	42.80	43.03	42.91	32.64
N2P1	38.17	33.19	35.68	28.10
N2P2	31.73	27.13	29.43	18.60
N2P3	28.30	25.14	26.72	18.72
N2P4	41.70	40.28	40.99	31.29
N3P1	36.60	33.09	34.85	28.69
N3P2	26.17	29.53	27.85	20.17
N3P3	24.03	28.06	26.05	19.84
N3P4	42.83	37.76	40.30	31.20
N4P1	36.93	31.70	34.32	27.60
N4P2	31.57	26.99	29.28	19.34
N4P3	30.77	28.06	29.41	19.69
N4P4	42.03	36.86	39.45	30.85
N5P1	38.80	31.53	35.17	28.43
N5P2	33.53	29.86	31.70	20.00
N5P3	32.93	25.86	29.40	22.01
N5P4	43.27	34.64	38.95	29.34
N6P1	38.37	32.18	35.27	29.37
N6P2	27.00	26.80	26.90	19.20
N6P3	26.20	25.15	25.67	20.94
N6P4	43.73	36.95	40.34	31.28
SEm(±)NXP	1.21	1.60	2.15	0.839
SEm(±)PXN	0.89	1.51	1.78	0.771
CD NXP	3.680	NS	NS	2.514
CD PXN	2.600	NS	NS	2.327

Table.6 Correlations Matrix of grain yield and yield attributes, plant uptake N, P, K, leaf folder insect incidence and brown spot disease severity

Treatments	uptake N	uptake P	uptake K	Brown spot disease severity	No. leaf folders hill^{-1}	No. effective tillers m^{-2}	No. filled grains panicle^{-1}	Grain yield
uptake N	1.000							
uptake P	0.97**	1.000						
uptake K	0.955**	0.965**	1.000					
Brown spot disease severity	-0.621**	-0.582	-0.574	1.000				
No. leaf folders hill^{-1}	-0.897**	-0.868**	-0.868**	0.385	1.000			
No. effective tillers m^{-2}	0.984**	0.978**	0.955**	-0.627**	-0.909**	1.000		
No. filled grains panicle^{-1}	0.984**	0.969**	0.976**	-0.623**	-0.906**	0.981**	1.000	
Grain yield	0.965**	0.975**	0.995**	-0.559**	-0.878**	0.964**	0.981**	1.000

** Correlation is significant at 0.01 level (2-tailed)
* Correlation is significant at 0.05 level (2-tailed)

Trichoderma are present in all soil and they are the most cultural fungi. *Trichoderma* species are strongly antagonistic to other phytopathogenic fungi. They produce hydrolytic enzymes which are believed to play an important role in the parasitism of phytopathogenic fungi. The diffusion of these enzymes dissolves cell fragments of host cells. These cell fragments in turn induce the production of further enzymes and trigger a cascade of physiological changes, stimulating rapid and directed growth of *Trichoderma* sp. (Zeilinger *et al.*, 1999). The effectiveness of *Trichoderma* in biocontrol could be attributed to the production of chitinase (Srinivasan, 1991). Biological control is an innovative, cost effective and ecofriendly approach. *Trichoderma spp* is known for its mycoparasitic and antagonistic mechanism for the control of fungal disease (Manimegalai *et al.*, 2011). The antagonistic properties of different species of *Trichoderma* against different pathogens have also been reported Madhanraj *et al.*, (2010).

Correlation matrix of grain yield and yield attributes, uptake N, P, K by rice plant and leaf folder insect and brown spot of rice disease are presented in self supporting table 4 listed that all yield attributes and uptake nutrients (N, P and K) were significantly close and contribute positively to the grain yield of rice. Among all the yield attributes, effective tillers m^{-2} and filled grains (%) were sufficiently positive (r = +0.984) in relation with the grain yield of rice. Whereas the leaf folder insect and brown spot disease showed significant variation but negatively contributes to the grain yield. Similar statement was recorded by Sharma *et al.*, 2009; Sangeetha *et al.*, (2013), they observed that all the yield attributes were positively linked with the grain yield of rice.

Based on the experimental findings least brown spot disease severity was observed under seed treatment with brahmastra + foliar spray with brahmastra (at 15, 30, 45, 60, 75 DAT) + *Trichoderma harzianum* soil application @ 130 kg ha^{-1}) (P_3) (27.59) and it had statistically not comparable difference with brahmastra seed treatment + *Trichoderma harzianum* application @ 130 kg ha^{-1} (P_2) (29.17) over control (P_4). Least sheath blight incidence was also observed in seed treatment with brahmastra + foliar spray with brahmastra (at 15, 30, 45, 60, 75 DAT) + *Trichoderma harzianum* soil application @ 130 kg ha^{-1}) (P_3) (20.22) without any comparable difference with brahmastra seed treatment + *Trichoderma harzianum* application @ 130 kg ha^{-1} (P_2) (19.93).

References

Anand S 2006. Natural pesticides, In: Subash Palekarara Shoonya Bandavalada Naisargika Krushi (Local language), 8th Ed, Published by Agni Prakashana, Banglore (India), pp. 91- 92.

Anonymous 1996. Standard evaluation system for Rice. International Rice Research Institute, Los Banos, Laguna, Philippines.

Lungmuana and Angami T 2011. Organic manures for efficiency of phosphorus mineralization, soil quality and food security. Agrobios Newsletter 10 (6): 31-32.

Madhanraj P, Ambikapathy V and Panneerselvam A 2010. Biological control of banana wilt caused by *Fusarium solani* (Mart.) Sacc. International Journal of Applied Biology and Pharmaceutical Technology 1 (3): 1032- 1039.

Mahunta R, Barik A K and Roul P K 2017. Residual Effect of Organic Nutrient Management in Aromatic Rice on Growth & Productivity of Greengram. IOSR Journal of Agriculture and Veternary Science 10 (3 II): 36-39

Manimegalai V, Ambikapathy V and Panneerselvam A 2011. Biological control of paddy brown spot caused by *Bipolaris Oryzae* (Breda de Haan). European Journal of Experimental Biology 1 (4) :24-28.

McKinney H H 1923. A new system of grading plant diseases. Journal of Agricultural Sciences 26: 195-218.

Ravichandra Y P, Sreenivas A G, Prabhuraj A, Hiremath G M, Rachappa V and Vendan K T 2014. Management of insect-pests of paddy by organic approaches. *J. of Biological Control*, 28(3): 166-176.

Sangeetha, S. P., Balakrishnan, A. and Devasenapathy, P. 2013. Influence of Organic Manures on Yield and Quality of Rice (*Oryza sativa* L.) and Blackgram (*Vigna mungo* L.) in Rice-Blackgram Cropping Sequence. American Journal of Plant Sciences 4: 1151-1157.

Sarkar A K 2005. Managing natural resources for increasing agricultural production in Eastern India, 23rd Professor J. N. Mukherjee - ISSS Foundation Lecture. Journal of the Indian Society of Soil Science 54: 435-447.

Sharma, R., Dahiya, S., Rathee, A., Singh, D., Nandal, J. K. and Malik, R. K. 2009. Effect of INM on growth, yield, economics and soil fertility in rice-wheat cropping system. Indian Journal of Fertilisers 5 (3) : 31-34.

Srinivasan, M. C. 1991. *Proc.Natl.Sem.Rec.Adv.Pl.Pathol*., University of pune, Pune.

Sriram, S., Raguchander, T., Babu, S., Nandakumar, R., Shanmugam, V., Vidhyasekaran, P., Balasubramanian, P. and Samiyappan, R. 2000. Inactivation of phytotoxin produced by the rice sheath blight pathogen, *Rhizoctonia solani*. Canadian Journal of Microbiology 46 : 520-524.

Zeilinger, S., Galhaup, C., Payer, K., Woo, S.L., Mach, R.L., Fekete, C., Lorito, M. and Kubicek, C.P. 1999. Chitinase gene expression during mycoparasitic interaction of *Trichoderma harzianum* with its host. Fungal Genetics and Biology 26 :131-140.