APPLICATION OF ORGANIC AMELIORANT AND BIOFERTLIZERS TO INCREASE THE INDUCED SYSTEMIC RESISTANCE AND RICE PRODUCTIVITY IN INDONESIA

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ABSTRACT

The experiments was conducted in Experimental Station of Faculty of Agriculture, University Padjadjaran Bandung (SPLPP) to investigate the effect of composted straw combined with biofertilizers consortia and biocontrol agent to promote the induced systemic resistance for reduce the intensity of disease in paddy. The experiment was arranged as randomized block design consisted of 12 treatments (0, 2,5, 5 and 7,5 ton of composted straw ha^{-1} combined with 400 g of biofertilizers consortia and 400 g inoculant of biocontrol agent) and provided with 3 replication. The experimental results revealed that application of 400 g ha^{-1} of biofertilizer combined with 5 ton ha^{-1}Biomeliorant was able to increase the diseases resistance of paddy and reduce bacterial leaf blight (BLB) diseases caused *Xanthomonas oryzae,* brown spot disease (*Helminthosporium oryzae*), blast disease (*Pyricularia oryzae*) and sheath blight disease (*Rhizoctonia solani*). The inhibition percentage were 63.18%, 51.38%, 58.33% and 47.95% respectively. The highest inhibition percentage about 80.12%. was obtained by the aplication of 400 g ha^{-1} of consortia of biofertlizer-*Trichoderma sp* (CB-T)

Key words: bioameliorant, biofertilizers, biocontrol agent, disease of Paddy

INTRODUCTION

The major rice production problems in Indonesia are soil health and quality degradation and the yield losses up to 35% due to pests and plant pathogens attack. The application of composted straw combined with consortia of biological fertilizers and biocontrol agents are expected to improve the soil health, nutrients, availability, the resistance of rice plant against the major diseases. The application of bioaugmented straw compost combined with consortia of biofertilizers has a great prospect to remediate and improve the soil health and to increase the rice productivity in sustainable ways (Simarmata *et al*., 2013). Induced systemic resistance (ISR) emerged as an important mechanism by which selected plant growth–promoting bacteria and fungi in the rhizosphere prime the whole plant body for enhanced defense against a broad range of pathogens and insect herbivores. The ISR in plants triggered by biological or chemical inducers, which protects nonexposed plant parts against future attack by pathogenic microbes and herbivorous insects (Ku, 1982; Gaind and Nain. 2011).

MATERIAL AND METHODS

1. The experiment was conducted at Experimental Station and Extension for Agriculture Development (SPLPP) of Faculty of Agriculture, University of Padjadjaran Bandung , located about 600 m above sea level. Consortia of decomposer and biocontrol agent (*Streptomyces sp, Cytophaga sp, Bacillus sp*, Pseudomonas sp and *Trichoderma sp*) has been used for in situ aerobically straw 'composting and the biofertilizers consortia containing the isolate of *Azotobacter sp, Azospirilum sp, Pseudomonas sp, Bacillus sp and Acinetobacter* were obtained from soil biology laboratory of Agriculture Faculty of Padjadjaran University Bandung.
2. The composted straw (0, 2.5, 5.0 and 7.5 t ha^{-1}) were deployed one weeks on soil surface of plots (4 m x 5 m) homogeneously before the land cultivation or preparation (incorporating).

Figure 1. Packaging of Biofertilizer + *Trichoderma harzianum* (Left), Biofertilizer packaging (Middle), and Composting paddy straw (Right)

3. The 400 g of biofertilizers consortia inoculants (CB) or 400 g of biocontrol agent (*harzianum*) inoculant was mix with 40 kg of compost and distributed evenly on the rice plots shortly before the transplanting of rice seedling.
4. Two single young seedlings (15 days) was planted with plant spacing about 30 cm x 35 cm in line about 5 cm distance from each others at point of planting cross section (Simarmata *et al*., 2011).
5. The intensity of rice diseases was observed at 7 weeks after transplanting (WAT) using 0-9 scale of the standard evaluation system for rice (IRRI, 2002).

The intensity of diseases were calculated using the following formula.

$$I = \sum \left\{ \frac{(nixi)}{NxV} \right\} x100\%$$

Where : I = disease intensity, n = number of plant in each category, i = scales of disease severity, V = The higher scale of disease saverity and N = number of plant observed.

Leaf blight intensity data is used to calculate the Area Under Disease Progress Curve (AUDPC) with the formula (Campbell & Madden , 1990) :

$$AUDPC = \sum_{i}^{n-1} \left[\left(\frac{Y_i + Y_{i+1}}{2} \right) \right] (t_{i+1} - t_i)$$

Information : Y_(i+1) = Data observation of the i+1 T_(i+1) = Time observation to - i+1 Y_i = Data observations 1st observation t_i = Time 1st

Processing of the data obtained by the method of analysis of variance done F test at 5% significance level using the statistical program SPSS (16.0). The difference between the treatment effect in the test using test Duncan Multiple Range Test (DMRT) at the 5% significance level .

RESULTS AND DISCUSSION

The observation of the symptoms and signs of disease in rice plants during research in the field trial obtained five types of diseases are diseases brown spot caused by *Helminthosporium oryzae* , diseases brown spot cramped due to *Cercospora jansanea* , disease sheath blight caused by *Rhizoctonia solani* , blast disease caused by *Pyricularia oryzae* , and bacterial leaf blight disease (crackle) which is caused by the bacterium *Xanthomonas oryzae*.

A. Symptom of Orange leaf blight diseases
B. Symptom of bacterial leaf blight
C. Symptom of narrow brown spot diseases (*Cercospora janseana* Miyake)
D. Symptom of brown spot diseases (*Helminthosporium oryzae*)
E. Symptom of Blast disease (*Pyricularia oryzae*)
F. Symptom of sheat blight disease (*Rhizoctonia solani*)

Table 1. Area Under Disease Progress Curve (AUDPC) and Inhibition Percentage of Brown Spot Disease and Blast Disease on Paddy.

Code	Treatment	Brown spot Disease			Blast Disease		
		AUDPC		Inhibition (%)	AUDPC		Inhibition (%)
A	Control	340,6	g	0	84,0	a	0
B	2.5 ton ha^{-1} CS	228,6	abcd	32,88	53,7	a	36.07
C	5.0 ton ha^{-1} CS	322,0	fg	5,46	83,3	a	0.83
D	7.5 ton ha^{-1} CS	252,0	bcde	26,01	35,0	a	58.33
E	400 g ha^{-1} of CB	298,6	efg	12,33	18,6	a	77.86
F	400 g ha^{-1} of CB + 2.5 ton ha^{-1} CS	280,0	cdefg	17,79	46,7	a	44.40
G	400 g ha^{-1} of CB + 5.0 ton ha^{-1} CS	165,6	a	51,38	35,0	a	58.33
H	400 g ha^{-1} of CB + 7.5 ton ha^{-1} CS	224,0	abc	34,23	74,7	a	11.07
I	400 g ha^{-1} of CB-T	326,6	g	4,09	16,7	a	80.12
J	400 g ha^{-1} of CB-T+ 2.5 ton ha^{-1} CS	261,3	bcdef	23,28	56,0	a	33.33
K	400 g ha^{-1} of CB-T+ 5.0 ton ha^{-1} CS	193,6	ab	43,16	51,33	a	38.89
L	400 g ha^{-1} of CB-T+ 7.5 ton ha^{-1} CS	294,0	defg	13,68	63,0	a	25.00

Table 2. Area Under Disease Progress Curve (AUDPC) and Inhibition Percentage of Orange leaf blight Disease and Sheat blight Disease on Paddy.

Code	Treatment	Orange leaf blight Disease			Sheat blight Disease		
		AUDPC		Inhibition (%)	AUDPC		Inhibition (%)
A	Control	86,3	a	0	154,0	d	0
B	2.5 ton ha^{-1} CS	56,0	a	35,11	63,0	a	59,09
C	5.0 ton ha^{-1} CS	72,3	a	16,22	109,7	abcd	28,77
D	7.5 ton ha^{-1} CS	51,3	a	40,56	142,3	cd	7,60
E	400 g ha^{-1} of CB	65,33	a	24,30	149,3	d	3,05
F	400 g ha^{-1} of CB + 2.5 ton ha^{-1} CS	74,6	a	13,56	91,0	abc	40,91
G	400 g ha^{-1} of CB + 5.0 ton ha^{-1} CS	63,0	a	27,00	72,3	ab	53,05
H	400 g ha^{-1} of CB + 7.5 ton ha^{-1} CS	56,0	a	35,11	142,3	cd	7,60
I	400 g ha^{-1} of CB-T	60,6	a	29,78	126,0	bcd	18,18
J	400 g ha^{-1} of CB-T+ 2.5 ton ha^{-1} CS	63,0	a	27,00	100,3	abcd	34,87
K	400 g ha^{-1} of CB-T+ 5.0 ton ha^{-1} CS	74,6	a	13,56	56,7	a	63,18
L	400 g ha^{-1} of CB-T+ 7.5 ton ha^{-1} CS	58,3	a	32,44	135,3	cd	12,14

Table 3. Area Under Disease Progress Curve (AUDPC) and Inhibition Percentage of Sheat Blight Disease and Naroow Brown Spot Disease on Paddy.

Code	Treatment	Sheat blight disease			Narrow brown spot Disease		
		AUDPC		Inhibition (%)	AUDPC		Inhibition (%)
A	Control	170,3	a	0	340,6	g	0
B	2.5 ton ha^{-1} CS	163,3	a	4,17	228,6	abcd	32,88
C	5.0 ton ha^{-1} CS	137,7	a	19,19	322,0	fg	5,46
D	7.5 ton ha^{-1} CS	156,3	a	8,27	252,0	bcde	26,01
E	400 g ha^{-1} of CB	151,67	a	10,99	298,6	efg	12,33
F	400 g ha^{-1} of CB + 2.5 ton ha^{-1} CS	137,7	a	19,19	280,0	cdefg	17,79
G	400 g ha^{-1} of CB + 5.0 ton ha^{-1} CS	88,7	a	47,95	165,6	a	51,38
H	400 g ha^{-1} of CB + 7.5 ton ha^{-1} CS	165,7	a	2,76	224,0	abc	34,23
I	400 g ha^{-1} of CB-T	151,7	a	10,97	326,6	g	4,09
J	400 g ha^{-1} of CB-T+ 2.5 ton ha^{-1} CS	158,7	a	6,87	261,3	bcdef	23,28
K	400 g ha^{-1} of CB-T+ 5.0 ton ha^{-1} CS	163,3	a	4,17	193,6	ab	43,16
L	400 g ha^{-1} of CB-T+ 7.5 ton ha^{-1} CS	133	a	21,95	294,0	defg	13,68

Description : The average number marked the same letter in each column showed no significantly different according Duncans multiple range test at 5 %
CS : compost straw (bioameliorant)

CONCLUSSION DAN REMARKS

1. Application of 400 g ha^{-1} of biofertilizer combined with 5 ton ha^{-1} biomeliorant was able to increase the resistance of rice against the major rice disease and reduce bacterial leaf blight (BLB) diseases caused *Xanthomonas oryzae,* brown spot disease (*Helminthosporium oryzae*), blast disease (*Pyricularia oryzae*) and sheath blight disease (*Rhizoctonia solani*). The inhibition percentage were 63.18%, 51.38%, 58.33% and 47.95% respectively.
2. The highest of inbition rate (about 80.12%) was obtained by the aplication of 400 g ha^{-1} of consortia of biofertilizers combined with biocontrol agent *Trichoderma sp* (CB-T).

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