Straw Composting with Biological Agent Inoculation and Application Biofertilizer to Increase Rice Production with Water Management System

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MAIN CONCERN OF FOOD SECURITY IN INDONESIA ???

- Rice Demand is Increasing Continually due to population growth (The population now is about 240 million and will be closed to 500 million in year of 2050)
- Agricultural land is shrinking due land conversion to non agricultural uses
- Degradation of soil health and quality goes rapidly (mostly belong to the Sick soils)

HEALTHINESS STATUS OF PADDY SOILS INDONESIA



□72 % has the organic carbon (< 2% Org-C) **:** categorized as a Sick Soils **23** % has the organic carbon (2 – 3 % Org-**C): Moderately □**5 % has the organic carbon (> 3 % Org-C) **Belong to healthy** or fertile paddy soils Les et al, 2010

WHAT IS THE SOLUTION ???

BIOFERTILIZER AND STRAW COMPOST MANAGEMENT COMBINED WITH WATER SAVING TECHNOLOGY (SYSTEM OF ORGANIC BASED AEROBIC RICE INTENSIFICATION "SOBARI") TO :

- RESTORE OR REMEDIATE, IMPROVE AND MAINTAIN THE SOILS HEALTH, AND
- INCREASE THE GROWTH AND YIELD OF PADDY RICE IN SUSTAINABLE WAYS

WHAT IS THE MAIN PRODUCT OF RICE CULTIVATION ??

- The main product of RC is Organic Fertilizers in form of straw (straw production is about 1,5 x Grain yield, 2010 = 60 million Ton rice grain yield = 90 MTof straw)
- The farmer burn their fertilizers and buy inorganic fertilizers ??



The benefit and Economic Value of Rice Straw in Indonesia = 90 million ton/year



The Cheap Source for Major Nutrients, especially:

- ✤ Silica (Si) = 300 500 kg/ha
- Potassium K, N, P, Ca, Mg, S
- Organic carbon (as a Fuel for soil ecosystem)
- Burning of Rice straw lead to Nutrient loss, gas emission

Source : Dr. Husnain,2010

WHAT IS A SYSTEM OF ORGANIC BASED AEROBIC RICE INTENSIFICATION (SOBARI) ??

SOBARI is a holistic rice production system by using and integrating the soil biological power, plant, fertilizers and water management by design



Water Supply Management



Maintain the water level about 0 to 1 cm (muddy condition), if the water level goes down to – 5 cm than supply irrigated up to muddy condition (1 to 2 cm). Use the plastics pipe (Diameter : 3 to 4 inch, 30 – 35 cm long) to monitor the water level of paddy field.

- □ Irriagted the paddy field up to 3- 5 cm at the beginning of panicle initiation to flowering stage
- Maintain muddy conditions from flowering stage to milky stage

The objective.....

- to obtain decomposers consortium formulation which can be effective to straw composting and has antagonistic effect for soil pathogens
- to test the effect of biofertilizer inoculants (nitrogen fixation bacteria and phosphate solibilizing bacteria) on rice plants in soil treated with straw that had been inoculated decomposer consortium with water management system.



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- The preliminary research to screening of isolates and formulations consortium decomposers and biological agents carried out in the Laboratory of Soil Biology and and the Laboratory of Phytopathology, Agriculture Faculty, Universitas Padjadjaran.
- The formulation decomposer with biological agent :
 - A : Trichoderma harzianum, Bacillus subtililis, Cytophaga sp. and B. Licheniformis ;
 - B : *B. subtililis, Cytophaga* sp., *B. licheniformis, Streptomyces* sp.)

RESULTS

Screening of decomposer with biological agent on quality of straw compost

Formulation* and	C-org (%)	N (%)	C/N	CEC (c mol/kg)
period of composting	Walkley & Black	Kjeldahl	C/IN	NH ₄ Acetat pH 7
1 week				
Control	24.08	0.46	52	36.74
A Formulation	32.63	0.59	55	37.18
B Formulation	27.63	0.55	50	36.06
2 weeks				
Control	23.47	0.48	49	34.09
A Formulation	31.00	0.61	51	36.76
B Formulation	26.78	0.59	45	35.89
3 weeks				
Control	21.45	0.49	44	32.14
A Formulation	30.25	0.64	47	33.89
B Formulation	25.41	0.63	40	32.14
4 weeks				
Control	20.37	0.50	41	30.22
A Formulation	27.26	0.67	41	32.46
B Formulation	23.57	0.65	36	29.30

*formulation A : Trichoderma harzianum, Bacillus subtililis, Cytophaga sp. and B. Licheniformis formulation B : B. subtililis, Cytophaga sp., B. licheniformis, Streptomyces sp.



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- The field experiment with water management system was using the split plot design with three replications
- The main plot was the dose of straw compost + biofertilizer consists of 8 factors (0 t/ha to 7,5 t/ha without and plus biofertilizer 400 g/ha).
- The subplot was doses of a inorganik fertilizer N, P and K consists of 5 factors (100%, 90%, 80%, 70% and 60% of recommendations doses).



Compost Preparation

Composting straw was using a consortium decomposers (Formulation B) : *Baccilus subtilis*, *Cythopaga* sp, and *Streptomyces* sp with incubation period of 2 weeks

Biofertilizer Application

Biofertilizer applications have been diluted given 2 stages. The first stage was application in the nursery field with a dose of 50 g/m2, given the spread just before sowing. The second stage is given on cropping land







Methods









RESULTS

Straw compost + biofertilizers - (J)	Inorganic fertilizer					
	$0 t ha^{-1} + 0 g ha^{-1}$	6,59 b*	6,48 d	6,35 c	6,07 b	5,99 b
	(e)	(d)	(c)	(b)	(a)	
0 t ha ⁻¹ + 400 g ha ⁻¹	6,77 d	6,44 c	5,87 a	6,21 c	5,59 a	
	(e)	(d)	(b)	(c)	(a)	
2,5 t ha ⁻¹ + 0 g ha ⁻¹	6,82 e	6,18 a	6,40 d	5,91 a	5,57 a	
	(e)	(c)	(d)	(b)	(a)	
2,5 t ha ⁻¹ + 400 g ha ⁻¹	6,66 c	6,24 b	6,17 b	6,49 g	6,17 d	
	(d)	(b)	(a)	(c)	(a)	
5,0 t ha ⁻¹ + 0 g ha ⁻¹	6,29 a	6,63 e	6,48 e	6,24 d	6,12 c	
	(c)	(e)	(d)	(b)	(a)	
5,0 t ha ⁻¹ + 400 g ha ⁻¹	6,83 e	6,62 e	7,20 g	6,36 e	6,63 f	
	(c)	(b)	(d)	(a)	(b)	
7,5 t ha ⁻¹ + 0 g ha ⁻¹	6,88 f	6,61 e	6,32 c	6,45 f	6,41 e	
	(e)	(d)	(a)	(c)	(b)	
7,5 t ha ⁻¹ + 400 g ha ⁻¹	6,88 f	6,90 f	6,99 f	6,56 h	5,99 b	
	(c)	(c)	(d)	(b)	(a)	

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Flooding rice 10 – 20 tilllers/clump

60 – 80 produvtive

CONCLUSIONS



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- Decomposer is important for straw composting to improve quality and short period composting.
- Application of 5 t ha⁻¹ compost straw + 400 g ha⁻¹ biofertilizer and inorganic fertilizer (80% N, P and K doses recommendations) with water management system could increase the yield of rice to 7.20 kg plot⁻¹ is equivalent to 6.35 t ha⁻¹ (increasing 13,3%).

CONCLUSIONS



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 Biofertilizers and straw compost with water management system are designed to (a) promote and to increase the biological activity of beneficial organism in rhizosphere, (b) remediate, improve and maintain the health of paddy soils and (c) increase the productivity of paddy rice in sustainable ways, (c) promote efficient and eco-friendly paddy soil cultivation and (d) reduce the inorganic fertilizers application significantly.

Thank You

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In situ Composting of Rice Straw

The composing and decomposer inoculation on straw pile (heaps)

The covering of straw pile

Without Covering 4 weeks

2-3 weeks

Ready to use