

## Rice response to organic residues management on permanent raised bed system in the semi-arid tropics of Eastern Indonesia

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### Abstract

Management of organic residues on heavy clay Vertisols under permanent raised beds could increase crop production. A field experiment was conducted on permanent raised beds from 2001/2002 to 2003/2004 at Kawo in the rainfed agro-ecosystem of Southern Lombok, to evaluate the response of rice (*Oryza sativa*) to management of organic residues. The experiment tested the hypothesis that retained or added organic residues increase the yield of rice grown on Vertisols on permanent raised beds in Southern Lombok. In Yr 2 and Yr 3, but not Yr 1, the yield of rice was significantly higher in treatments with Straw buried to 10 cm depth (TSI) or with Buffalo dung buried to 10 cm depth (TID) than that with Straw removed (TSO) or with Straw mulch (TSM). In Yr 1, there were no significant differences between treatments in yield, or in components of yield (weight of 1000 grains; total dry mass; panicle length). In Yr 2, the yields of rice in TSM and TID were each higher than that in TSI and in TSO. In Yr 3, the yields in TSI and TID were each greater than that in TSO. The yield of rice was up to 17% higher with, than without, organic residues, and rice responded earlier to Buffalo dung buried to 10 cm depth (TID) than to TSI (Straw buried to 10 cm depth). Hence, after 2 or 3 years with organic residues, the data generally support the hypothesis.

### Keywords

Low rainfall, food security, organic matter, furrows

### Introduction

The agricultural production in rice-based (*Oryza sativa*) cropping systems on rainfed Vertisols in the semi-arid tropics of Southern Lombok is often constrained by unreliable water supplied from the erratic low rainfall, plus poor soil management (Ma'shum et al. 2003). Permanent raised beds have been widely reported elsewhere to increase yield of crops compared with that of crops grown on flat land (Van Cooten and Borrell 1999; Ram et al. 2005). Organic residues have often been shown elsewhere to increase the stability of aggregates of Vertisols (see Dalal, Bridge 1996). This in turn has contributed to increased crop yields. Our paper compares yields of rice grown on permanent raised beds under different management of organic residues in rainfed rice cropping systems in Southern Lombok, Eastern Indonesia.

### Materials and methods

A field experiment with permanent raised beds on a Vertisol was set up in a completely randomized design with 3 replicates at Kawo in Southern Lombok, Eastern Indonesia (8° 45' S, 116° 20' E; 18 m above sea level; 1000 to 1400 mm average rainfall), from 2001/2002 to 2003/2004. The experiment tested the hypotheses that retained or added organic residues increase the yield of rice. Plots (each 10 m long and 6 m wide) were separated by border bunds (0.2 m high, 0.5 m wide), with an outer furrow 80 cm wide. Each plot consisted of 4 raised beds, each 1.2 m wide and 0.2 m high. Each year, the treatments applied by hand each year at two weeks before sowing were: Straw removed (TSO), Straw mulch (TSM), Straw buried to 10 cm depth (TSI), and Buffalo dung (10 t/ha) buried to 10 cm depth (TID). Six rows of rice were sown 20 cm apart on the top of each bed with an inter-row spacing of 20 cm (30 plants in 1.5 m quadrant). Superphosphate (36% P<sub>2</sub>O<sub>5</sub>) was applied at 150 kg/ha at sowing at 5 cm

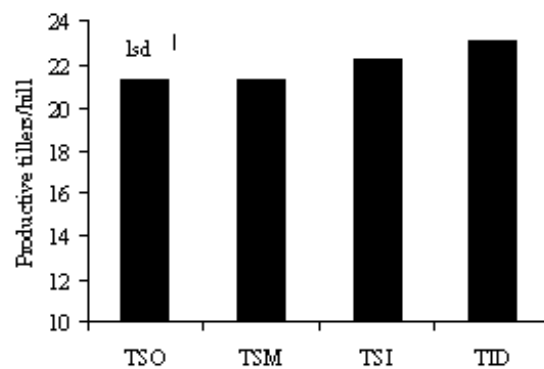
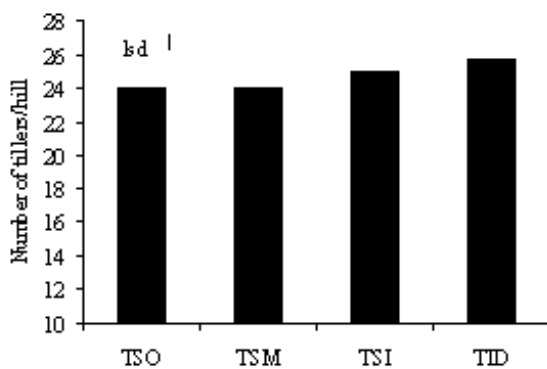
depth. Urea (300 kg/ha) was applied at 30 DAS (days after sowing) and at 55 DAS. Each year, grain yield, and 1000 grain weight, number of tillers per hill, and length of panicle were measured.

## Results and discussion

In Yr 1, there were no significant differences between treatments in yield of rice (Table 1), or in other plant parameters. In Yr 2, the yield of rice in TSM was higher than that in TSI or TSO, but not TID. In Yr 3, the yield was higher TSI and in TID than that in TSO or in TSM. In Yr 3, the yield in TSI and TID were each higher than that in TSO. Hence, after 2 to 3 years, the yield of rice with buried organic residues was up to 17% higher than that without, possibly because, with buried organic residues, nutrients were more easily accessible to roots (data not shown). Buffalo dung buried increased yield earlier than did Straw buried, possibly because buffalo dung had a lower C:N ratio, and so was more decomposable, than was straw. In Yr 3 only, the total number of tillers/hill, and the number of productive tillers/hill were each higher in TID than that in TSO or TSM (Fig. 1; Fig. 2). In Yr 3, there were no differences between treatments in weight of 1000 grains (mean 29 g), total dry mass (mean 6.5 t/ha) or panicle length/hill (mean 23.6 cm). Presumably, the number of panicles/hill and/or the number of grains/panicle (not shown here) contributed to the differences in yield.

Table 1. Yield (t/ha) of rice on permanent raised beds on Vertisols under different management of organic residues at Kawo, Southern Lombok in Yr 1 (2001/2002), Yr 2 (2002/2003) and Yr 3 (2003/2004).

Treatment	2001/2002	2002/2003	2003/2004
TSO	4.5	5.2	4.8
TSM	3.7	5.8	4.9
TSI	4.1	5.3	5.6
TID	4.3	5.6	5.3
LSD <sub>0.05</sub>	Ns	0.3	0.5



**Fig. 1. Total number of tillers/hill of rice in 2003/2004 at Kawo under different management of crop residue.**

**Fig.2. Number of productive tillers/hill of rice in 2003/2004 at Kawo under different management of crop residue.**

### **Conclusion**

After 2 or 3 years, retained or added organic residues (straw, buffalo dung) increase the yield of rainfed rice grown on Vertisols on permanent raised beds in Southern Lombok, Indonesia.

### **Acknowledgement**

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