Poultry manure-based composting with rice straw and saw dust for lowland rice production in the forest zone of Ghana

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INTRODUCTION

Rice consumption in Ghana has outnumbered production, triggering large importation of the commodity to satisfy demand (MoFA, 2009). Because of poor soil fertility, rice yields are generally low (Buri *et al*., 2009; Issaka *et al*., 1997). Increasing rice production requires the implementation of improved agronomic and structural practices. While improved rice varieties are presently cultivated, appropriate water/soil management and fertilizer affordability are required to ensure high yields. The availability of large amounts of rice straw, saw dust, and poultry manure (Issaka *et al*., 2011) in the Ashanti Region provides an opportunity to improve the productive capacities of soil in this region. These materials have been shown to be effective in increasing rice yield, especially when combined with mineral fertilizer (Buri *et al*., 2004). Improving soil fertility necessitates the identification of cheaper alternatives that can be used solely or in combination with mineral fertilizer. In this study, both on-station and on-farm studies were conducted using these organic materials, and the findings are reported herein.

MATERIALS AND METHODS

In 2012, compost was prepared from poultry manure (PM) mixed with either rice straw (RS) or saw dust (SD) at a ratio of 1:1. An on-station trial was conducted to compare the effect of these materials with that of the application of PM alone. Another on-farm trial was conducted in 2011 where RS, PM, and char from SD (2 $t \cdot ha^{-1}$) were used as sole organic materials. In addition, these materials were combined with PM (1:1) and mineral fertilizer.

RESULTS AND DISCUSSION

Effects of the application rate of organic matter on grain yield and yield components are shown in Table 1. Application of 2.0 $t \cdot ha^{-1}$ organic matter significantly improved panicles$\cdot plant^{-1}$ and panicles$\cdot m^{-2}$, resulting in significantly higher grain yield than that when 1.0 $t \cdot ha^{-1}$ organic

matter was applied. Availability of more nutrients when organic matter is applied at 2.0 t·ha^{-1} largely explains the observed results. Generally, the application of organic matter (1.0 or 2.0 t·ha^{-1}) provided significantly higher grain yield than that when organic matter was not applied.

Table 1 Effect of the rate of application of organic matter on yield components and grain yield

Organic matter (t·ha^{-1})	Plant height (cm)	No. of stand ·m^{-2}	No. of panicles ·plant^{-1}	No. of panicles ·m^{-2}	Stover yield (t·ha^{-1})	Grain yield (t·ha^{-1})
0.0	129.6a	24.6a	2.0c	148c	4.5c	3.4c
1.0	129.6a	24.6a	2.4b	168b	5.4b	4.5b
2.0	129.2a	24.6a	2.8a	188a	6.2a	5.3a

Organic materials: poultry manure, rice straw compost and saw dust compost
Within a column, values followed by the same letters are not significantly different by a margin of the standard error.

Table 2 Effect of sources of organic materials on yield components and grain yield

Organic matter (OM)	Plant height (cm)	No. of stand ·m^{-2}	No. of panicles ·plant^{-1}	No. of panicles ·m^{-2}	Stover yield (t·ha^{-1})	Grain yield (t·ha^{-1})
No-OM	129.6a	24.6a	2.0c	148c	4.5c	3.4c
PM + RScomp	129.3a	24.5a	3.1a	200a	6.6a	5.8a
PM + SDcomp	129.5a	24.6a	3.1a	199a	6.6a	5.7a
PM	130.1a	24.6a	2.9a	194a	6.6a	5.7a

Materials applied at 2.0 t/ha
No-OM: no organic matter was applied; PM + RScomp: poultry manure + rice straw compost; PM + SDcomp: poultry manure + saw dust compost; and PM: poultry manure. Within a column, values followed by the same letters are not significantly different by a margin of the standard error.

PM alone and in combination with RS compost or SD compost showed similar grain yield (Table 2). Composting RS or SD with PM improved the quality of the compost, and hence supplied similar amounts of nutrients. Since RS and SD are relatively cheaper sources of organic materials, more of these materials can be used to cultivate larger areas.

Interaction of sources and rates of organic materials

When organic materials were applied at a higher rate (2 t·ha^{-1}), rice grain yield increased significantly (Figure 1). Increasing the rate of application refers to the increase in the amount of nutrients, especially N, available to plants. All the three organic materials with fertilizer showed similar grain yields ranging from 4.2 t·ha^{-1} to more than 7.0 t·ha^{-1}. Application of 30 kg N·ha^{-1} resulted in significantly increased grain yield for all the treatments (Figure 1). This finding indicates the need to integrate organic materials with mineral fertilizer for better performance. At 1.0 t·ha^{-1} and without fertilizer application, all the organic materials provided comparable grain yield as that of fertilizer application of 30 kg N·ha^{-1}.

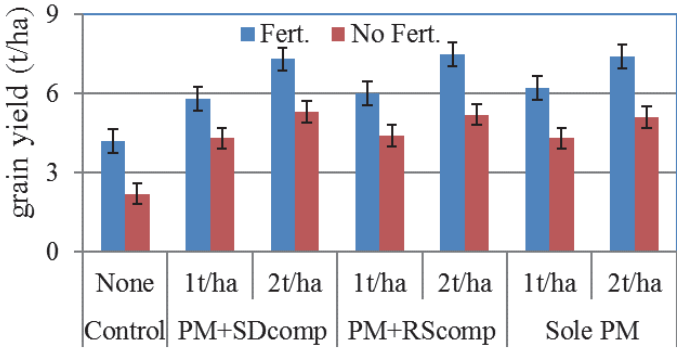

Figure 1 Effect of sources and rates of organic materials on rice grain yield. Fert: Fertilizer applied a 30 kg N·ha^{-1}

Effect of source of organic materials and their combinations

PM alone (2 t·ha^{-1}) and in combination with either RS or char from SD showed similar grain yields that were significantly higher than those obtained when RS or char from SD were applied alone (Figure 2). PM has better quality than RS or char from SD; this could be the reason for the differences in their effectiveness.

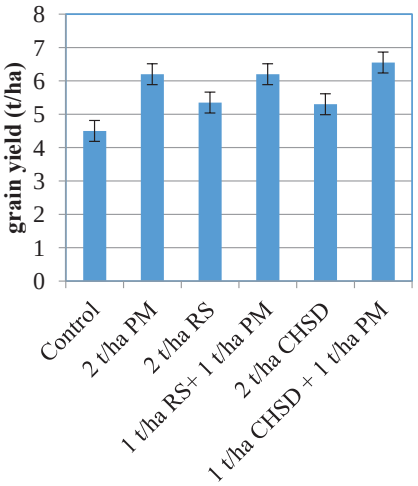

Figure 2 Effect of sources and combinations of organic materials on grain yield

CONCLUSIONS

Integrating organic materials with mineral fertilizer yields better results than those when organic minerals are applied alone. Composting PM with either RS of SD yielded similar results as those after the application of PM alone. Combing relatively rich PM with RS or charred SD enhances rice yield. Compost applied at 2.0 t·ha^{-1} also improves rice yield.

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