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EFFECT OF RICE HUSK RESIDUE ON MAIZE IN MINNA, NIGERIA

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ABSTRACT

The experiment was conducted during the 2014 and 2015 cropping seasons to study the effect of the method (surface application and incorporation)and rate of application(0, 10 and 15 tons ha^{-1}) of rice husk-residue on maize plant height and yield indices. Incorporation of rice husk-residue at 15 tons ha^{-1} produced the tallest ($P \leq 0.05$) maize plants and longest maize cobs, but method of application of rice husk-residue had no significant effect on grain yield, stover yield and cob weight. Residue incorporation produced longer cobs than surface application. However, 15 tons ha^{-1} residue application rate resulted in the highest ($P \leq 0.05$) grain yield, cob length and cob weight. The study suggests that incorporation of rice husk-residue rather than surface application as mulch, at 15 tons ha^{-1} will ensure better maize performance in Minna, Nigeria.

KeyWords: Rice husk residue, plant height, maize yield, Nigeria

INTRODUCTION

Maize is staple food crop in Nigeria (IITA, 2006; Enujeke *et al.,* 2013), also an energy source in livestock feed. It is a major raw material in the production of beverages, corn oil, corn syrup and flakes (Adeyemo and Agele, 2010). However, in most Sub-Saharan African countries, maize yield is low (IITA, 2007). Hussaini and Khan (2002) noted that soil fertility status and management practice are among the factors that affect the productivity of maize. Inorganic fertilizers are often commonly applied as source of mineral nutrients required to enhance maize growth with a consequent increase in yield (Akinloye and Olaniyan, 2012). However, these mineral fertilizers are beyond the reach of most farmers because they are quite costly (Agyenim-Boateng*et al.,* 2006). Also, increase in soil acidity, nutrient imbalance and poor soil physical condition result from application of inorganic fertilizers over a long period of time (Ojeniyi, 2012). Under these conditions, it may be necessary to employ management practices that would minimize the cost of maintaining soil fertility, enhance crop growth and increase yields.

Crop residues are applied to the soil as organic amendments, rather than being regarded as agricultural waste (McKinney, 2004).

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They could be left on the soil surface, applied as mulch, burnt or chopped into smaller pieces and incorporated into the soil. Most crop residues unlike rice husk face competition especially as livestock feed and material for construction and fencing (Eze *et al.,* 2014b; Eze *et al.,* 2015b). Rice husk is a milling by-product from rice paddy processing. It is produced in appreciable quantity in rice producing communities worldwide (Giddel and Jivan, 2007). Application of crop residues, either as mulch or by incorporation increase soil productivity, improve crop growth and increase yields (Chiroma *et al*., 2003 & 2005;Eze *et al.,* 2014a and b & 2015b). The high cost of mineral fertilizers and the negative effects on soil physical and chemical properties associated with their use for a prolonged period of time necessitates the application of available, cheap crop residues to improve soil productivity and enhance crop growth and yields. Therefore, the study was taken to determine effect of crop residue management practice on the performance of maize.

MATERIALS AND METHODS

The field study was carried out during the 2014 and 2015 cropping seasons at the Teaching and Research Farm of Federal University of Technology, Minna to determine the effect of method and rate of application of rice husk-residue on maize plant height and yield indices. The experimental site is located on latitude 9^0 31' N and longitude 6^0 26' E with a mean annual rainfall of about 1,300 mm between April and October. The temperature of the study site varies from 24^0C to 33.5^0 C, particularly between March and June.The soils are predominantly sandy in nature and are developed from basement complex. Minna is located in the southern Guinea savanna zone of Nigeria.

A 2 x 3 factorial experiment consisting of two methods of application (surface application and incorporation) and three rates of application of rice husk-residue(0, 10 and 15 tons ha^{-1}) was conducted. The treatments were laid out in a randomized complete block design with each plot size of 4 mx 4 m and replicated four times. The treatment plots were maintained or fixed during the two years of the experiment.

Following the application of rice husk-residue, maize seeds ('Oba super 1' variety) were sown at a spacing of 0.75 x 0.50 m inter-row and intra-row, respectively. Two seedlings per stand were maintained at two weeks after planting (WAP). Recommended fertilizer practices (NPK at 90: 60: 60 kg ha^{-1} and weeding were followed. At physiological maturity (12 WAP), maize cobs were harvested, sun-dried for about two weeks and threshed.

Plant height was measured at seedling emergence, vegetative growth, tasseling and maturity stages following the standard procedures. Yield indices viz., grain yield, stover yield, cob length and cob weight were recorded.

Data collected was subjected to statistical analysis (Analysis of variance, ANOVA) at 0.05 level of probability using Statistix 8.0 software (Statistix, 2010). Duncan's multiple range test was employed for mean separation where significant differences between means were found.

RESULTS AND DISCUSSION

Application of crop residue had significant effect on plant height at seedling emergence, vegetative growth, tasseling and maturity stages (Table 1). Incorporation of rice husk resulted in significantly ($P \leq 0.05$) taller maize plants than

surface application during all the growth stages. Also, application of 15 tons ha^{-1} of rice husk produced the tallest maize plants. These observations were found to be consistent throughout the growing season and in the two-year study period (2014 and 2015). Incorporation of rice husk increased plant height considerably ($P \leq 0.05$) by a range of between 6% and 10 %, while its application at 15 tons ha^{-1} increased the height of plants by a range of between 10%and 33 %. Kumar and Goh (2000) noted that the benefits that accrue when crop residues are incorporated in the soil include replenishment of soil organic matter, faster mineralization to release essential nutrients for enhancement of crop growth and increase in yields.

Method of application of crop residue (rice husk) had no significant influence on grain yield, stover yield and cob weight of maize. However, it significantly affected the length of cobs

Table 1. Effect of method and rate of application of rice husk-residue on plant height (cm) of maize

Crop growth stages				
Treatment	**Seedling emergence**	**Vegetative growth**	**Tasseling**	**Maturity**
Application method (A)				
Surface	33.7b	112.8b	181.8b	178.6
bIncorporation	37.5a	126.2a	193.3a	194.2a
SE±	1.4	4.1	3.4	5.4
Application rate (B)				
0 t ha^{-1}	30.7c	94.0c	169.9c	173.3b
10 t ha^{-1}	35.7b	125.4b	191.8b	191.9a
15 t ha^{-1}	40.4a	139.2a	201.1a	194.0a
SE±	1.8	5.0	4.2	6.7
Interaction				
A x B	NS	NS	NS	NS

Means with different letter(s) on the same column are significantly (P d" 0.05) different at 0.05 level of probability; NS: Not significant

(Table 2). Incorporation of crop residue as soil organic amendment produced significantly ($P \leq 0.05$) longer cobs compared with surface application of residue, although the better crop growth and longer cobs that resulted from residue incorporation in this study did not translate to significantly higher grain and stover yields. It must be noted however, that incorporation of rice husk has the potential to improve crop yield judging from the fact that this

Table 2. Effect of method and rate of application of rice husk residue on yield parameters of maize

Grain yield Treatment	Stover (kg ha^{-1})	yield (kg ha^{-1})	Cob length (cm)	Cob weight (g/4 m^2)
Application method (A)				
Surface	5,166a	9,630a	14.0a	1,225a
Incorporation	5,712a	10,365a	14.4a	1,299a
SE±	352	671	0.33	61
Application rate (B)				
0 t ha^{-1}	4,261b	9,414a	13.2b	1,065b
10 t ha^{-1}	5,647a	9,893a	14.4a	1,323a
15 t ha^{-1}	6,409a	10,685a	14.9a	1.397a
SE±	431	822	0.4	75
Interaction				
A x B	NS	NS	NS	NS

Means with different letter(s) on the same column are significantly different at 0.05 level of probability
NS: Not significant

treatment produced significantly taller plants and longer cobs. Rate of application of crop residue had significant effect on maize yield parameters (Table 2). Application of 15 tons ha^{-1} of residue produced highest ($P \leq 0.05$) grain yield, cob length and cob weight compared with 0 and 10 tons ha^{-1} application rates. Fifteen tons ha^{-1} application rate increased grain yield by over 50% more than no application and by over 20% over 10 tons ha^{-1} application. It also increased cob length and cob weight by about 25% and 40 %, respectively. The better performance arising from returning crop residue to the soil is attributed to improvement of soil properties and supply of nutrients through mineralization of the applied crop residues (Abbasi *et al.,* 2009; Eze *et al.,* 2014a and b & Eze *et al.,*2015a & b). Thus, crop residues are not agricultural wastes, because these have unlimited potential for improving soil productivity and crop performance.

CONCLUSION

Rice husk incorporation produced tallest plants and longer cobs than surface application.Rice husk residue application at 15 tons ha^{-1} resulted in the tallest plants, highest grain yield and cob weiht, and longest cobs. Therefore, incorporation of rice husk-residue rather than surface application as mulch at 15 tons ha^{-1} is recommended for the enhancement of maize performance in Minna, Nigeria.

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