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RESPONSE OF MAIZE (Zea mays) TO A LOAMY SAND AMMENDED WITH RICE HUSK AT OBUBRA, SOUTH EASTERN NIGERIA

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ABSTRACT

The scarcity or non-availability of inorganic fertilizer in the third world is a great impediment to achieving increased production of maize today. An alternative to this is to increase soil fertility with readily available and affordable materials. This study was conducted using a Randomised Complete Block Design (RCBD) with the following rates of rice husk to boost soil fertility for improved maize production 0 tha^{-1} (T_1), 16.7 tha^{-1}, (T_2), 33.3 tha^{-1} (T_3), 50.0 tha^{-1} (T_4), 66.7 tha^{-1} (T_5). From result obtained for grain yield for the two years, T_4 gave optimum yield. In 1999 treatments T_1, T_2 and T_3 were not significantly different from each other while in 2000, treatments T_2 and T_3 were significantly ($p<0.05$) different from T_1. Plant heights obtained at three weeks after planting in 1999 showed that T_3, T_4 and T_5 were significantly different ($p<0.05$) followed by treatment T_2 and T_1. The results were the same for treatments T_3, T_4 and T_5 at five weeks after planting while treatments T_1 and T_2 had the same effect. At 7 weeks after planting treatments T_4 and T_5 had the same effect, but were the best followed by treatments T_3, T_2 and T_1 in that order. However, in 2000, treatments T_3, T_4 and T_5 were the best followed by treatments T_1 and T_2. For cob length, the results were not too distinct while treatment effect on cob girth was not significant.

KEY WORDS:Rice husk, organic fertilizer, soil fertility, tropical soil.

INTRODUCTION

Maize is one of the most important cereals in the world alongside wheat and rice. It is grown commercially in almost every part of Nigeria. With the fast growing population of Africa (Amalu (1998), there is a necessity for increased production than before. Maize on the other hand requires very fertile soil for production (Philips, 1977). The scarcity or non-availability of inorganic fertilizer in the third world (Nigeria in particular) is a great impediment to achieving this. . An alternative to this is to increase soil fertility with readily available and affordable organic manure like rice husk. Molongoy and Merckx (1993) reported that high amount of rice husk application increases nitrogen immobilization. This increases rapidly between 7 and 28 days after which the process slows down. The large amount of carbon rich materials increase the microbial population and immobilizes the mineral nitrogen, thereafter part of the microbial population dies and mineral nitrogen increases rapidly.

Bentley (1986) stated that many upland soils of the humid and sub-humid tropics (Oxisols, Ultisols and Alfisols) have low inherent fertility. This is because they are characterised by low activity clay with predominantly kaolinite, iron and aluminium oxides in the clay fraction (Jou and Adams (1986). Since soils of this nature are usually low in phosphorus, they will require the addition of either inorganic or organic fertilizers. The use of organic manure influences soil aggregation and structure, infiltration rates, reduction of erosion, prevention of surface crusting, retention of water, and heat in the soil (Agbim and Adeoye, 1991)

The use of organic material to fertilize tropical soils is of utmost importance because of their (soil) low ECEC. Usually for mineral soils, organic matter accounts for 30 64% of total CEC, and in sandy soils more than 50% of the CEC is attributable to its organic components (Allison, 1965).

Though farmers are aware of the importance of organic matter in raising farm productivity, the total crop residues each year might not be adequate. For example, about 5000kg/ha of stalk is needed to protect the soil against wind or water erosion and 7,000kg/ha need to be incorporated to maintain soil fertility. However, farmers' cereal stalks might never be more than 4,000kg/ha (Van Raay and de Leeuw, 1970). In rice milling environment there abound excess of organic matter in the form of rice husk. Use of litter (waste) upon decay and mineralization add nutrients to the soils (Aisueni, 1991). The use of organic recycling as a fertilizer material is still highly practiced both in Europe and America where inorganic fertilizer is common. The practice of recycling organic waste °had produced significant result in some parts of Nigeria (Sridhar et al, 1991). The objective of this paper was three fold; first to determine the growth response of maize at different weeks after planting to soils fertilized with rice husk. Secondly to determine which rate would maximize yield of maize and thirdly to develop a sustainable method of disposing rice husks in rice milling environments.

MATERIALS AND METHODS

The research work was sited at Cross River University of Technology, Obubra Campus, Cross River State, Nigeria in 1999 and 2000. Mean annual rainfall of the area ranges between 2250mm and 2500m and mean annual temperature between 21°C and 29°C (CRADP, 1992). Rice husk was used as organic manure. Planting was done on ridges at a distance of 75cm by 25cm. The experiment was laid using Randomised Complete Block Design (RCBD). Five treatments were used namely, 0 tha^{-1} (T_1), 16.7 tha^{-1} (T_2); 33.3 tha^{-1} (T_3); 50.0 tha^{-1} (T_4); and 66.7 tha^{-1} (T_5). Each subplot measured 4m by 4m. There were four replicates giving a total of 20 subplots. Germination percentage was 95% at 7 days after sowing. Weeding was done manually at 4 and 8 weeks after planting (WAP). Plant height was recorded from 3 WAP. Harvesting was done 14 WAP. In the first year before planting, a composite soil sample was collected from the site, shade dried and sieved through a 2mm

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mesh and analysed for the following properties: particle size analysis as described by Day (1965) using Bouyocos hydrometer with sodium hexametaphosphate as dispersant; soil reaction (pH) was determined in 1:2.5 soil: water ratio using glass electrode. Organic carbon was determined by the Walkley and Black method (Jackson, 1969; Allison, 1973); available phosphorus by the Bray No.1 method (Bray and Kurtz, 1945); while nitrogen by method described by Bremner and Mulvaney (1982). Exchangeable Bases (Ca, Mg, K and Na) were determined using Chapman (1965) method. The rice husk used was analysed for same properties except particle size analysis.

Table 1: Some Physical and chemical properties of the soil and rice husk used in the Research:

Property	Soil	Rice Husk
Sand (%)	88.6	-
Silt (%)	7.4	-
Clay (%)	4.0	-
Soil reaction (H_2O)	5.62	6.10
Organic carbon (%)	0.54	32.0
Total nitrogen (%)	0.05	2.72
Available phosphorus (mg kg^{-1})	11.75	99.12
Exchangeable bases		
a. Calcium (cmol kg^{-1})	1.4	0.4
b. Magnesium (cmol kg^{-1})	0.8	0.6
c. Potassium (cmol kg^{-1})	0.36	1.02
d. Sodium (cmol kg^{-1})	0.11	0.11
Exchange acidity (cmol kg^{-1})	0.16	4.48
Base saturation (%)	94.3	32.2
Effective cation exchange capacity (cmol kg^{-1})	2.83	6.61

Table 2: Plant height (cm) at different stages of growth, mean length and girth of maize cob and grain yield after harvest.

Rice husk tha^{-1}	3WAP	5WAP	7WAP	LENGTH OF COB (cm)	COB GIRTH (cm)	YIELD Kgha^{-1}
1999						
0.0	15.4c	65.8b	69.2c	9.8c	9.6	123
16.7	21.9b	91.8b	107.2b	11.8ab	8.4	229
33.3	27.4a	119.9a	126.0b	10.6bc	9.0	268
50.0	29.5a	124.3a	145.3a	12.8a	9.7	627
66.7	27.6a	126.3a	140.7a	13.6a	11.1	941
LSD	3.6	27.0	24.8	2.5	NS	350.2
2000						
0.0	13.8c	66.3b	70.1c	11.6b	8.5	137.5
16.7	20.4b	89.8b	109.0b	13.5a	7.6	312.5
33.3	28.3a	121.1a	114.7b	12.4a	8.2	354.2
50.0	31.2a	125.5a	147.5a	14.6a	8.6	770.8
66.7	29.0a	124.9a	143.0a	15.4a	10.3	875.0
LSD	3.1	25.2	26.0	2.7	N.S	361.5

WAP = Weeks after planting
NS = Not significant

RESULTS AND DISCUSSION

Laboratory results

The analytical results for the soil (0-15cm) and rice husk are shown in Table 1. The soil texture was a loamy sand with pH indicating acidity, and low values for the following properties; organic carbon, total nitrogen, calcium, magnesium, sodium and effective cation exchange capacity. Available phosphorus and potassium values were medium while base saturation was high (Udo and Ogunwale, 1986).

Chemical characteristics of the rice husk show that it was slightly acidic, high in organic carbon, total nitrogen and available phosphorus; low in calcium, magnesium, sodium and high in potassium, while effective cation exchange capacity was low although it was near medium.

Plant Height

Table 2 shows plant height at three, five and seven weeks after planting for the two years. Plant height increased up to seven weeks after planting and thereafter measurement stopped. In 1999 and 2000 treatments receiving between 33.3 66.7tha^{-1} of rice husk amendment produced same effect on the maize growth at three WAP. At this stage of growth applying no rice husk causes the plants to lag behind compared to the application of 16.7 tha^{-1} whose growth rate is less than subsequent increasing treatment. At 5 WAP the growth rate pattern slightly changed and treatments receiving 0 tha^{-1} and 16.7 tha^{-1} were ranked together while those receiving between 33.3 tha^{-1} and 66.7 tha^{-1} were not significantly different from each other for both years. In 1999 and 2000 at 7 WAP the pattern of growth earlier observed at 3 WAP resurfaced in that T_1 recorded the shortest height. Consequently T_4 and T_5; and T_2 and T_3; were ranked together and the various heights were significantly different (in three categories) from each indicating the influence of the amendment on the maize growth. The general observation was that plant height increased rapidly and leaf colour remained green for all plots treated with rice husk unlike the zero treatments.

Length of maize cobs

Table 2 shows length of maize cobs after harvesting as influenced by different rates of rice husk applied for the two years. The rates of rice husk showed slight significant difference only at $p<0.05$. The treatment that received 66.7 tha^{-1} of rice husk had the highest mean length of 13.60cm closely followed by plants that received 50.0 tha^{-1}, 16.7 tha^{-1} with length of 12.8cm and 11.8cm respectively in 1999. Plants that received 33.3 tha-1 had a mean length of 10.6cm whereas the control treatment recorded the least cob length of 9.80cm in the same year. Though the least length in 2000 was from the zero treatment, the length for that year was generally higher compared with the previous year. However, very pronounced effect was not exerted by the different rates but significantly different from the zero treatment.

Girth of maize cobs

Table 2 shows the mean girth of maize cobs after harvesting. Although the result showed no significant difference, plant that received 66.7 tha^{-1} of rice husk, recorded the highest mean girth of 11.10cm closely followed by plants that received 50.0 tha^{-1} with 9.70cm in 1999. Plants that received 16.7 tha^{-1} recorded the least girth. Similar results were recorded for the year 2000. It could be concluded that husk application as organic manure had no effect on maize girth.

Maize yield

Application of rice husk as organic manure to the soil significantly affects the yield of maize as shown in table 2 for the two years. In 1999 treatment receiving 66.7 tha^{-1} had the highest maize yield of 941kg/ha followed by treatment receiving 50.0 tha^{-1} with the yield of 627kg/ha. These two yields were significantly different from the remaining yields obtained by applying 33.3tha^{-1} of rice husk and below. And the yields from amongst these three were not significantly different from each other. *In* 2000 the result followed same pattern with the last two treatments not significantly different from each other. However, they were significantly different from other treatments from 33.3t/ha and below. Like in 1999, these other treatments were equally not significantly different from each other. The observation here was that the greater the treatment, the greater the rate of growth and yield till an optimum was reached at 50 tha^{-1}. this result is expected going by the report of Mulongoy and Meckx (1993) and Cooke (1986). Though the growth rates of the plants were very encouraging, the yields were affected by intermittent droughts that occurred in the area during kernel formation in the two years. Consequently, yields were generally lower than the African average of 1700kg/ha (Onwueme and Sinha, 1999).

CONCLUSION

These results demonstrate rice husk as a source of organic manure that has the potential of increasing corn yield and vegetative growth for livestock feed. The high organic carbon, total nitrogen and other content of rice husk also reveal its potential as a source of high quality organic manure. For purpose of vegetative growth, the application rate of 33.3 tha^{-1} will be more suitable while the rate of 50 tha^{-1} will be applicable for the purpose of maximum yield attainment. Consequently, rice husk could better be disposed from milling environments by using it as organic fertilizer on crop farms.

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