

## Effect of Sawdust Ash plus Urea on Maize Performance and Nutrient Status

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**Abstract:** Sawdust ash (SDA) is a waste from wood and sawmilling industries. Effect of SDA combined with urea was investigated in plant height, yield and nutrient content of leaves of maize in two experiments in Okene, in the Guinea Savanna zone of Nigeria. Treatments were a) 4 t ha<sup>-1</sup> SDA, b) 250 kg ha<sup>-1</sup> urea, c) 1 t ha<sup>-1</sup> SDA + 187.5 kg ha<sup>-1</sup> urea/d, 2 t ha<sup>-1</sup> + 125 kg ha<sup>-1</sup> urea, e) 3 t ha<sup>-1</sup> SDA + 62.5 kg ha<sup>-1</sup> urea and f, untreated control. The SDA at 4 t ha<sup>-1</sup> increased height of maize insignificantly. The 1 t ha<sup>-1</sup> SDA + 187.5 kg ha<sup>-1</sup> urea gave highest maize yield and leaf N. Compared with untreated control, SDA, combined application of reduced rates of SDA and urea, the urea alone increased leaf N, P, K, Ca and Mg concentrations. Combined application of SDA and urea is a suitable option for maize cultivation.

**Key words:** Sawdust ash, sawmilling, urea, plant height, yield and nutrient content

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### INTRODUCTION

Maize is the third most important grain crop in the Savannah zone of Nigeria, following sorghum and rice, respectively. However, its yield is drastically limited by deficiency of N and P in the soils, low cation exchange capacity and soil acidity. Hence, responses of maize to N and P fertilizers have often been recorded in the guinea Savannah zones of Nigeria (Odieta *et al.*, 2005). However, the high cost of chemical fertilizers and its scarcity has limited its use by farmers. Also the N fertilizers tend to aggravate soil acidity problem (Uyovbisere and Elemo, 2000). These problems necessitate study into locally sourced cheap agro-wastes that could add nutrients such as P, K, Ca and Mg and even act as a lining material when used along with N fertilizer (urea). Sawdust ash (SDA) is waste generated from wood and sawmilling industries. Used alone, it has been found to increase yield of tomato and okra significantly in South-West Nigeria and it also increased okra pod and leaf P, K, Ca and Mg content (Owolabi *et al.*, 2003). It was also found that Sawdust ash increased soil pH, organic matter, P, K, Ca and Mg and fruit yield of pepper (Odedina *et al.*, 2003). In the present study, the effect of SDA and its combined use with urea (U) on performance of maize and leaf nutrient status is studied in the guinea savannah zone of Nigeria. It is expected that the ash would supply cations and other nutrients not supplied by urea thus ensuring reduced use of chemical fertilizer and more balanced plant nutrition in an integrated form (Louise, 2003).

### MATERIALS AND METHODS

#### Field Experiments

Two experiments were conducted between March and December 2004 on two sites (Benin Road and Kabba Road) at Ohiana in Southern Guinea Savannah zone of Nigeria, 10 km from Okene. The soils are clay loam and sandy loam soils. The soil is derived from sandstones and classified as oxisols

(Akintunde *et al.*, 2000). The sites were planted to maize and cassava in previous two years. Land was manually cleared. There were six treatments applied to soil grown to maize. The treatments were:

- (a) untreated control-no urea, no sawdust ash,
- (b) 1 t ha<sup>-1</sup> sawdust ash + 187.5 kg urea ha<sup>-1</sup>,
- (c) 2 t ha<sup>-1</sup> sawdust ash + 125 kg urea ha<sup>-1</sup>,
- (d) 3 t ha<sup>-1</sup> sawdust ash + 62.5 kg urea ha<sup>-1</sup>,
- (e) 4 t ha<sup>-1</sup> sawdust ash and
- (f) 250 kg ha<sup>-1</sup> urea.

Treatments were replicated three times using a randomized complete block design. Each plot (5 m<sup>2</sup>) was planted with maize at 60×60 cm (28000 plant h<sup>-1</sup>). Three weeding were done manually at 3, 6 and 9 weeks after planting.

Five plants were selected per plot for determination of growth parameters at 100% silking. Plant growth at 120 cm level and height were taken. At harvest, the ear and cob weight were air-dried gram weight were taken.

#### Leaf Analysis

At 9 weeks after treatment application, ear leaf samples collected from plots were air-dried and ground. Total N was determined by kjeldahl method. For P, K, Ca and Mg samples were digested using nitric-perchloric-sulphuric acid mixture and determined as described for soil.

#### Statistical Analysis

The SPSS for window 10 was used for analysis of variance. Means were compared using the least significant difference at 95% level of probability.

### RESULTS AND DISCUSSION

At 4, 6 and 7 weeks after treatment application (WAT), sawdust ash (SDA), urea fertilizer (U) and combined application of reduced levels of SDA and urea (U) increased maize height (Table 1).

The increased were not significant at site 1 (Benin Road) at 4 WAT. Aside from the latter, the 1 t ha<sup>-1</sup> SDA + 287.5 kg ha<sup>-1</sup> U increased height consistently at both sites (Benin Road and Kabba Road, Site 2). The two other combinations: 2 t ha<sup>-1</sup> SDA + 125 kg ha<sup>-1</sup> U and 3 t ha<sup>-1</sup> SDA + 62.5 kg ha<sup>-1</sup> U increased plant height at site 2, 6 and 7 WAT. At site 2 at 6 and 7 WAT, combined application of SDA and urea of reduced levels increased plant height compared with SDA and urea and SDA gave least values. The overall values of mean plant height gave similar impression. Therefore, the presence of urea alone or combined with SDA enhanced maize growth and urea had better effect in combination with SDA. This could be due to immobilization of Nitrogen and its gradual

Table 1: Effect of sawdust ash (SDA) and urea (U) on height of maize plant

Treatments	4 WAT		6 WAT		7 WAT
	Site 1	Site 2	Site 1	Site 2	Site 2
Control	103.2	64.7	156.9	96.7	120.5
4 t ha <sup>-1</sup> SDA	125.9	74.9	190.9	108.3	136.5
250 kg ha <sup>-1</sup> U	136.1	84.0	203.7	128.8	143.9
1 t ha <sup>-1</sup> SDA + 187.5 g ha <sup>-1</sup> U	127.9	103.4	201.3	139.1	150.7
2 t ha <sup>-1</sup> SDA + 125 kg ha <sup>-1</sup> U	127.4	92.6	208.3	133.3	150.3
3 t ha <sup>-1</sup> SDA + 62.5 kg ha <sup>-1</sup> U	122.7	93.0	189.4	132.5	156.3
LSD (0.05)	NS	28.7	39.7	33.7	23.4

WAT = No. of Weeks After Treatment application; NS = Non Significant

release by microorganisms acting on the carbonaceous sawdust ash. Sawdust is known to have very high C:N ratio of 300 to 500 (Olayinka and Adebayo, 1989). The integrated use of urea and sawdust ash is also expected to enhance release of nutrients from SDA due to enhanced microbial action and reduce the C:N ratio of the soil environment (Olayinka and Adebayo, 1989). While combined use of SDA and urea could temporarily immobilize N for longer effect, use of urea alone would have exposed it to leaching and volatile loss thereby reducing its impact.

Table 2 shows that compared with the untreated control, SDA, urea and the combinations of other reduced levels increased maize cob and grain weight. The yield parameters tended to increase in the order: control < SDA < 3 t ha<sup>-1</sup> SDA + 62.5 kg ha<sup>-1</sup> U, 2 t ha<sup>-1</sup> SDA + 125 kg ha<sup>-1</sup> U < 250 kg ha<sup>-1</sup> U < 1 t ha<sup>-1</sup> SDA + 187.5 kg ha<sup>-1</sup> U. Therefore the latter treatment gave the highest maize cob and grain yields which were significantly higher than those for the control and it was followed by 250 kg ha<sup>-1</sup> U. The two treatments however gave similar yields. It is also shown that the three combinations of SDA and urea gave similar yield compared to urea alone and could therefore substitute for urea fertilizer.

The untreated control and SDA, respectively had least values of leaf nutrient contents especially with regard to N and P (Table 3). The observation that the untreated control had least values of leaf N, P, K, Ca and Mg suggests that SDA, urea and their combinations increased nutrient availability to maize. However, only the increases in leaf N and K were significant (p < 0.05). Compared with the untreated control, 1 t ha<sup>-1</sup> SDA + 187.5 kg ha<sup>-1</sup> U increased leaf N significantly, while urea and 2 t ha<sup>-1</sup> SDA + 125 kg ha<sup>-1</sup> U increased leaf K significantly. As in case of yield, the three combinations of SDA and urea gave similar leaf N, P, K Ca and Mg concentrations. It is suggested that availability of these nutrients to maize, especially in case of N dictated maize yield. Hence 1 t ha<sup>-1</sup> SDA + 187.5 kg ha<sup>-1</sup> U which gave highest leaf N had highest maize yield and mean value of plant height. Maize is known to have a high N requirement on savanna soils (Akintunde *et al.*, 2000).

The finding that SDA used alone or combined with urea enhanced nutrient availability to maize and its growth and yield is consistent with data on analysis of SDA as given by Odedina *et al.* (2003). The data were 0.27% N, 0.01% P, 5.8% K, 1.5% Ca and 4.08 Mg. Owolabi *et al.* (2003) gave values of 1.16% N, 0.04% available P, 2.8% K, 0.07% Mg and 0.35% Ca. Composition of sawdust ash would vary depending on type of wood and burning intensity. It is ascertained that SDA is a source of nutrients.

Table 2: Effect of sawdust ash (SDA) and urea (U) on maize yield

Treatments	Cob weight/5 plants (kg)		Grain weight/5 plants (kg)	
	Site 1	Site 2	Site 1	Site 2
Control	0.45	0.26	0.31	0.16
4 t ha <sup>-1</sup> SDA	0.73	0.28	0.54	0.17
250 kg ha <sup>-1</sup> U	0.87	0.40	0.65	0.26
1 t ha <sup>-1</sup> SDA + 187.5 g ha <sup>-1</sup> U	1.01	0.44	0.73	0.28
2 t ha <sup>-1</sup> SDA + 125 kg ha <sup>-1</sup> U	0.81	0.39	0.60	0.24
3 t ha <sup>-1</sup> SDA + 62.5 kg ha <sup>-1</sup> U	0.73	0.36	0.55	0.25
LSD (0.05)	0.43	0.16	0.33	0.11

Table 3: Effect of sawdust ash (SDA) and urea (U) on nutrients at Okenne (Nigeria)\*

Treatments	N%	P%	K%	Ca%	Mg%
Control	1.48	0.042	2.38	0.16	0.062
4 t ha <sup>-1</sup> SDA	1.66	0.066	2.46	0.17	0.074
250 kg ha <sup>-1</sup> U	1.80	0.065	3.21	0.17	0.071
1 t ha <sup>-1</sup> SDA + 187.5 g ha <sup>-1</sup> U	2.33	0.064	2.79	0.17	0.067
2 t ha <sup>-1</sup> SDA + 125 kg ha <sup>-1</sup> U	1.86	0.063	2.91	0.18	0.075
3 t ha <sup>-1</sup> SDA + 62.5 kg ha <sup>-1</sup> U	1.54	0.054	2.73	0.19	0.077
LSD (0.05)	0.82	NS	0.52	NS	NS

\* Mean data for the two sites; NS = Non Significant

## CONCLUSIONS

Sawdust ash combined with urea could be utilized as source of nutrients especially N and K in maize production. Its use would enhance growth and yield. The effect of the combined application of the ash with urea on soil chemical properties would be studied for some time. Meanwhile it is recommend for use at 1 t ha<sup>-1</sup> combined with reduced level of urea (187.5 kg ha<sup>-1</sup>).

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