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# EFFECT OF ASH AND GOAT DUNG MANURE ON LEAF NUTRIENTS COMPOSITION, GROWTH AND YIELD OF AMARANTHUS

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## ABSTRACT

Three field experiments were conducted to examine the separate and combined effects of wood ash and goat dung manure on leaf nutrients composition, growth and yield of *Amaranthus cruentus* at Akure, Southwest Nigeria. The treatments compared were: no treatment, 2t/ha goat dung, 2t/ha ash + 2t/ha dung, 2t/ha ash + 4t/ha dung, 2t/ha ash + 6t/ha dung, and 2t/ha ash + 8t/ha dung. Application of 2t/ha ash, 8t/ha goat dung, and combined application of ash and different quantities of goat dung to soil increased leaf N, P, K, Ca and Mg contents significantly compared with no treatment. Separate application of 8t/ha dung, and combined application of 2t/ha ash with each of 2, 4, 6 and 8t/ha dung increased number and yield of leaves, leaf area and number of branches significantly compared with no treatment. Ash and goat dung complement each other as to their effects on nutrients contents, growth and yield of amaranthus. Addition of 2t/ha ash to 8t/ha dung increased stem weight and leaf yield by 68 and 54% respectively. Combined application of 2t/ha ash and 8t/ha dung gave 513 and 342% increase in stem weight and leaf yield respectively compared with no treatment.

## INTRODUCTION

Arable soils of tropics get degraded quickly in physical, chemical an biological qualities as a result of continuous cropping. Continuous cropping with persistent use of NPK fertilizer increases soil acidity and physical degradation while crop yield may fall. Some of the fertilizers aggravate nutrients imbalance due to lack of soil testing programme (Ojeniyi, 2000a). A recent study (Ano and Asumugha, 2000) showed lower benefit-cost ratio for chemical fertilizer compared with integrated use of chemical and organic fertilizers or non-use of chemical fertilizers. Hence, farmers have resorted to the use of organic manure. The vegetable farmers in some parts of Nigeria combine ground goat manure with wood ash or apply them separately to soil (Ojeniyi, 2000b). The impact of this practice on nutrients availability and performance of amaranthus *(Amaranthus cruentus)* has not received research attention. Crop production based on the use of biologically derived traditional fertilizers is consistent with the low external input sustainable agriculture advocated for developing countries. This work was carried out to investigate the response of leaf nutrients contents and yield of Amaranthus to separate or combined application goat dung manure and wood ash.

Three experiments were conducted between May 1999 and June 2000 at Akure, Southwest Nigeria on soil having pH in $CaCl_2$ of 6.5, 0.11% total N, 9.5 mg/kg available P and 0.51 cmol exchangeable K. Hence the soil was considered low in N and P and slightly acidic. The date for the three field experiments were May 9 to July 10, 1999; August 6 to October 16, 1999; and June 5 to August 9, 2000. Each experiment was conducted at different sites.

The experiments on amaranthus consisted of 7 manurial treatments, which were replicated three times using a randomized complete block design. Seeds of amaranthus were sown in trays filed with loamy soil in the greenhouse for 2 weeks. Seedlings were transplanted at a spacing of 20 x 15cm to each of the 21 plots, each plot being $4m^2$. The treatments applied to soil by ring method a week after transplanting were:

Control (no treatment)

2t/ha wood ash

8t/ha goat dung

2t/ha ash + 2t/ha goat dung

2t/ha ash + 4t/ha goat dung

2t/ha ash + 6t/ha goat dung

2t/ha ash + 8t/ha goat dung.

The growth parameters determined weekly for 4 weeks after application of treatments were number of leaves and branches, stem girth and leaf area. The fresh weight of stem and leaf were determined at harvest. Five plants were selected per plot for the determinations.

Leaf samples were harvested at flowering, oven dried and ground. Total N was determined using Kjeldahl method. For P, k, Ca and Mg, ground samples were digested with nitric-perchloric – sulphuric acid - mixture (AOAC, 1990). P was determined by molybdenum blue photometer, while Ca and Mg were determined using EDTA titration. The analysis of woodash and goat dung was also done.

The data were subjected to analysis of variance and the means separated using the least significant difference (P = 0.05) and the Duncan multiple range test.

## RESULT AND DISCUSSION

The ash contained 18%C, 1.53% N, 86.0 Mg/Kg P, 9.4% Ca,, 23.0% K, 8.5% Mg and had C:N of 11.5. The equivalent values for goat dung were 20.0%, 2.52, 167.5, 2.9, 10.0 4.5 and 7.9. Therefore, goat dung had higher values of N and P, whereas ash had higher values of Ca, K and Mg. The dung had lesser C:N and it is expected to mineralize faster than wood ash. The goat dung and ash are expected to complement each other in their effects.

Compared with no treatment, application of ash and goat dung increased nutrients composition of amaranthus (Table 1). There were significant increases in leaf N, P, K, Ca and Mg contents in case of second crop, and the increases in leaf N, P and K were significant in case of the first crop.

Addition of goat dung to ash tended to increase leaf N and P contents compared with ash alone, especially if ash was combined with 4, 6 and 8t/ha goat dung. This attests to the finding that goat dung contains more N and P compared with ash. Addition of 2t/Ha ash to 8t/ha goat dung increased leaf N, P, K, Ca and Mg.

Separate application of ash and goat dung increased growth parameters of amaranthus such as number of leaves, leaf area, number of branches and stem girth compared with no treatment (Table 2). The increases due to application of 2t/ha ash were not significant. The increases in number of leaves and leaf area due to application of 8t/ha goat dung significant (P = 0.05). Also additio

goat dung treatments to ash increased plant height, number of leaves, leaf area, number of branches and stem girth compared with ash alone. Addition of ash to 8t/ha dung increased plant height, number of leaves, leaf area and number of branches. It increased plant height, number of leaves and leaf area by 28, 51 and 63% respectively compared with goat dung alone.

Separate application of ash and goat dung increased stem weight (Table 3) and leaf yield (Table 4). The mean fresh stem weight for the no treatment, 2t/ha ash, 8t/ha goat dung, 2t/ha ash + 2t/ha dung, 2t/ha ash + 4t/ha dung, 2t/ha ash + 6t/ha goat dung, 2t/ha ash + 8t/ha dung were 15.4, 18.7, 68.3, 38.8, 42.8, 43.3 and 114.7g respectively. The equivalent values for leaf yield were 12.9, 19.2, 55.2, 30.0, 40.7, 40.8 and 84.8g.

Addition of goat dung to ash increased stem yield and leaf yield compared with ash alone. The increases were significant in case of the stem yield of the third crop (Table 3) and leaf yield of the first and third crops (Table 4). The values of stem yield and leaf yield tended to increase with amount of goat dung. Therefore, application of 2t/ha ash to 8t/ha goat dung gave the highest values of stem yield and leaf yield. Overall, it gave 513 and 342% increases in stem yield and leaf yield respectively compared with 2t/ha ash.

Addition of ash to goat dung increased stem yield and leaf yield compared with goat dung alone. Compared with 8t/ha goat dung, addition of 2t/ha ash to 8t/ha dung increased stem yield of the third crop significantly. In case of leaf yield, the increases in the values for first and third crops were significant. Overall, addition of ash to goat manure increased stem yield and leaf yield by 68 and 54% respectively. The finding that ash and goat manure increased yield and leaf N, P, K, Ca and Mg contents of amaranthus indicates that these materials are sources of the nutrients. The increases in leaf N and P and yield of amaranthus due to application of goat dung manure is consistent with the fact that goat dung is a better source of N and P compared with ash. The fact that application of wood ash increased leaf K, Ca and Mg is consistent with the observation that ash is a better source of the cations than goat dung. Therefore, ash and goat dung complemented each other as to their effects on leaf nutrients contents and yield.

Another advantage that might have been derived from application of ash was increase in the pH of the acidic soil as a result of increased availability of cations such as K, Ca and Mg (Oladejo and Ojeniyi, 1998).

## CONCLUSION

It is concluded that ash and goat dung are suitable manures for amaranthus and that combined application of the two types of manure to soil gave better increases in growth, yield and nutrient contents of amaranthus compared with application of either of the manures.

Table 1: Response of Leaf Nutrients Contents of First (1) And Second (2) Crops of Amaranthus Goat Dung (D) Manure and Woodash (A)

| | N% | | P% | | K% | | Ca% | | Mg% | |
|---|---|---|---|---|---|---|---|---|---|---|
| Treatment | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 |
| No treatment | 3.2 | 2.0 | 0.14 | 0.15 | 1.2 | 1.0 | 0.24 | 0.20 | 0.05 | 0.06 |
| 2t/ha A | 5.0 | 4.9 | 0.38 | 0.46 | 2.6 | 3.7 | 0.28 | 0.39 | 0.07 | 0.16 |
| 8t/ha D | 5.6 | 5.4 | 0.44 | 0.52 | 2.2 | 3.6 | 0.26 | 0.35 | 0.07 | 0.13 |
| 2t/ha A + 2t/ha D | 5.9 | 5.5 | 0.36 | 0.45 | 2.2 | 3.8 | 0.26 | 0.40 | 0.08 | 0.18 |
| 2t/ha A + 4t/ha D | 6.3 | 6.1 | 0.34 | 0.51 | 2.6 | 4.4 | 0.33 | 0.42 | 0.08 | 0.15 |
| 2t/ha A + 6t/ha D | 5.4 | 5.5 | 0.44 | 0.49 | 2.5 | 3.6 | 0.23 | 0.38 | 0.06 | 0.10 |
| 2t/ha A + 8t/ha D | 5.9 | 6.6 | 0.57 | 0.58 | 3.3 | 3.8 | 0.28 | 0.49 | 0.12 | 0.29 |
| LSD (0.05) | Ns | 2.3 | 0.08 | 0.18 | 0.4 | 0.9 | NS | 0.08 | NS | 0.06 |

TABLE 2: Response of Growth Parameters of Amaranthus to Goat Dung Manure (D) and Wood ash (A)

| Treatment | Mean Plant Height (cm) | Mean Number of Leaves/Plant | Number of Branches | Stem Girth |
|---|---|---|---|---|
| No treatment | 31.3 | 26 | 7 | 2.8 |
| 2t/ha A | 31.2 | 36 | 8 | 3.7 |
| 8t/ha D | 65.7 | 70 | 19 | 6.0 |
| 2t/ha A + 2t/ha D | 60.7 | 68 | 14 | 5.3 |
| 2t/ha A + 4t/ha D | 48.1 | 76 | 15 | 5.3 |
| 2t/ha A + 6t/ha D | 53.4 | 73 | 16 | 4.3 |
| 2t/ha A + 8t/ha D | 91.0 | 106 | 20 | 6.2 |
| LSD (0.05) | 38.0 | 28.5 | 7.3 | NS |

TABLE 3: Response of Stem Yield (G) of Amaranthus to Goat Dung (D) Manure and Wood ash (A)

| Treatment | First Crop | Second Crop | Third Crop |
|---|---|---|---|
| No treatment | $14.0^{a}$ | $10.7^{c}$ | $21.6^{a}$ |
| 2t/ha A | $14.7^{a}$ | $25.3^{c}$ | $16.0^{a}$ |
| 8t/ha D | $80.3^{bc}$ | $77.5^{ab}$ | $47.0^{c}$ |
| 2t/ha A + 2t/ha D | $37.0^{ab}$ | $43.5^{bc}$ | $36.0^{bc}$ |
| 2t/ha A + 4t/ha D | $44.3^{abc}$ | $46.0^{bc}$ | $38.0^{bc}$ |
| 2t/ha A + 6t/ha D | $48.7^{abc}$ | $52.2^{bc}$ | $29.0^{ab}$ |
| 2t/ha A + 8t/ha | $99.7^{c}$ | $90.0^{a}$ | $154.4^{d}$ |

Means followed by the same letters in a column are not significantly different.

TABLE 4: Response of Leaf Yield (G) of Amaranthus to Goat Dung (D) Manure and Wood ash (A)

| Treatment | First Crop | Second Crop | Third Crop |
|---|---|---|---|
| No treatment | $14.0^{a}$ | $7.3^{a}$ | $13.3^{a}$ |
| 2t/ha A | $14.7^{a}$ | $26.6^{ab}$ | $16.2^{a}$ |
| 8t/ha D | $80.3^{bc}$ | $54.2^{b}$ | $31.0^{b}$ |
| 2t/ha A + 2t/ha D | $37.0^{ab}$ | $30.2^{ab}$ | $22.8^{b}$ |
| 2t/ha A + 4t/ha D | $44.3^{abc}$ | $48.2^{b}$ | $29.6^{b}$ |
| 2t/ha A + 6t/ha D | $48.7^{abc}$ | 42.2b | $31.5^{b}$ |
| 2t/ha A + 8t/ha | $99.7^{c}$ | $77.2^{c}$ | $77.5^{d}$ |

Means followed by the same letters in a column are not significantly different.

## REFERENCES


Ano, A. O. and Asumugha, G. N. 2000. On-farm Testing of Sustainable Soil Management Technology for Cassava Production on an Ultisol in Southeastern Nigeria. Paper presented at 34th Annual Conference of Agricultural Society of Nigeria, Bauchi. Abstracts p7.

AOAC, 1970. Official Methods of Analysis. 11th Ed. Assoc. Anal. Chemists Washington, D. C.

Ojeniyi, S. O. 2000a. Effect of Goat Manure on Soil Nutrients Contents and Okra Yield in a Rainforest Area of Nigeria. Applied Tropical Agriculture 5, 20 – 23.

Ojeniyi, S. O. 2000b. Soil Fertility Management and Plant Nutrient Sources in Nigeria. Paper presented at 30th Annual Conference of Agricultural Society of Nigeria, Bauchi. Abstracts p35.

Oladejo, B. T. and Ojeniyi, S. O. 1998. Effect of Woodash on Soil Nutrients Contents and Maize. Proceedings 25th Annual Conference of Soil Science Society of Nigeria. Bauchi (in press).