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# RESPONSE OF GROUNDNUT YIELD AND NUTRIENT STATUS TO TILLAGE AND WOOD ASH

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## ABSTRACT

The aim of study was to investigate into suitable tillage and liming material for enhanced productivity and quality of groundnut (*Arachis hypogaea L*) in the rainforest area of Nigeria. Six tillage-wood ash treatments: Zero tillage, zero tillage + ash, disc ploughing, disc ploughing, + ash, manual ridging, and manual ridging + ash were studied for their effect on growth, yield, and leaf and seed chemical composition of groundnuts. Manual ridging and plough increase growth and yield parameters of groundnut such as number of branches and flowers, height; pod and seed weight; and leaf and seed P,K, Mg and Ca content compared with zero tillage. Mean seed weight per plant for zero tillage, ploughing and ridging were 33.9, 42.5 and 44.2g respectively. Application of wood ash at 4t/ha to soil increased the growth and yield parameters and leaf and seed N, P, K, Ca and Mg status. Ash increased mean seed weight by 15.5%. Combination of ridging and ash gave highest values of growth and yield parameters as well as leaf and seed P content.

Keywords: Suitable tillage, liming material and mean seed weight

## INTRODUCTION

The frontier of groundnut production is extending from the traditional savanna zone of Nigeria to the rain forest zone. This is in response to the advice of the government aimed at increasing production and export earning. However, there is scarce information on management practices for enhance groundnut in the rain forest ecology. Hence, there is need to revive studies into management practice for enhance productivity of groundnut. This is particularly so with regard to tillage or soil preparation methods, liming and sourcing for calcium which is essential for pod formation (Yayock, 1979). Sourcing for calcium (lime) and nutrient source is necessary for the rainforest zone where soil is largely acidic and deficient in Ca and other nutrient such as K, Mg and P which are essential for groundnut production. (Sesay and Yarmah 1996; Yusuf and Idowu 2001). It is usual to grow groundnut on ridges and ploughed soils although studies on tillage

requirement gave inconclusive result. Adelana and Akintola (1991) found no significant difference in seed yield of groundnut grown by mechanized tillage methods in forest and savanna zone of Nigeria in the humid zone of Sierra Leone. Groundnut is cultivated with or without ridging and there is no definite recommendation (Sesay and Yarmah, 1996). It is known that difference in soil type and microclimate determines crop response to tillage.

There is need to examine the possibility of cultivating groundnut using zero tillage and develop tillage-liming package. Wood ash is suitable as a source of Ca and others secondary and micronutrient and is regarded as a liming material (Obi and Ekperegin 2001; Ojeniyi and Awotolu, 2001; Ojeniyi and Adejobi, 2002). However, its effectiveness as source of Calcium and other nutrients for groundnut has not received research attention. In this work the effect of tillage methods and wood ash on performance and nutrient status of groundnut grown in the rainforest zone of Southwest Nigeria is studied.

## MATERIALS AND METHODS

Field trials to study suitable tillage+ash package for enhanced productivity of groundnut were conducted in 2001 and 2002 at Akure, in the rainforest zone of Southwest Nigeria. The soil at the sites of study is sandy clay loam, and is classified as an oxic Tropudalf (Luvisol) (Adepetu *et al.*, 1979). The initial analysis of surface soil gave 1.34% organic matter, total N of 0.08%, available P of 2.6 mg/kg, exchangeable K of 0.03cmol/kg exchangeable Ca of 0.75 cmol/kg, exchangeable Mg of 0.4cmol/kg. The soil was low in organic matter, N, P, K, P and C (Akinrinde and Obigbesan, 2000).

In June 2001 and 2002, six tillage+ash manure treatments were established, and replicated three times. The treatments were:

(a) Zero tillage (in which paraquat 1.1dimethy 4,4 bipyridilium) was sprayed at 2L/ha two week before planting). Wood ash was later applied in ring form (ZTA).
(b) Zero tillage without wood ash, (ZT)
(c) Disc ploughing followed by application of wood ash (DPA)
(d) Disc ploughing without ash (DP)
(e) Manual ridging followed by application of wood ash (MRA)
(f) Manual ridging alone (MR)

Two seeds of groundnut were planted per stand a week after land preparation and thinning to one plant was done 14 days after planting. Manual weeding was generally done 40 days after planting. Each plot was $18m^2$ with plants spaced at 0.3x0.6m. Wood ash was applied in ring form to plant at thinning at the rate of 4t/ha, which was recommended for maize (Oladejo and Ojeniyi, 1988). Twelve plants were selected per plot for periodic determination of growth parameters such a number of branches, plant height and number of flowers. At 120 days after planting, harvest was done and plant weight, fresh pod weight and seed weight were recorded.

## LEAF AND SEED ANALYSIS

At harvest leaf and seed samples were collected on treatment basis and chemically analysed. Samples were oven-dried for 24 hrs at 70°C and milled. They were extracted using nitric-perchloric acid mixture (Tel, 1984). N was determined using Kjedahl method, P was determined using molybdenum blue colorimetry, K was determined using flame photometer, and Ca and Mg by atomic absorption.

## RESULT

Table 1 shows response of growth parameters of groundnut to soil preparation method and ash application. Soil preparation in forms of ploughing and ridging increased plant height, number of branches and flowers.

Irrespective of ash manure treatment, mean plant height and number of groundnut branches increased in the order of zero tillage, manual ridging and ploughing. Zero tillage also gave least number of branches.

**Table 1: Effect of soil preparation and wood ash on growth of groundnut**

| Treatment | Whole Plant Weight (cm) | No of Branches | No of Flowers |
|---|---|---|---|
| ZTA | 32.4 | 6.8 | 6.8 |
| ZT | 28.7 | 6.0 | 5.6 |
| PDA | 37.6 | 8.7 | 8.8 |
| DP | 40.0 | 7.7 | 9.0 |
| MRA | 36.2 | 9.9 | 9.9 |
| MR | 31.4 | 6.7 | 7.5 |
| LSD (0.05) | 8.0 | 0.8 | 8.5 |

Legend: ZTA = Zero tillage plus ash MRA = Manual ridging plus ash

ZT = Zero tillage without ash MR = Manual ridging alone

DPA = Disc ploughing plus ash

DP = Disc ploughing alone

Application of wood ash to soil increased growth parameters such as plant height, number of branches and flowers especially in zero tillage and ploughed plots. Irrespective of soil preparation method, mean plant height values for no-ash and ash application were 35.4 and 33.4 cm, respectively. The values of number of branches were 8.5 and 6.8, and were 8.5 and 7.4 for number of flowers.

Table 2 and 3 respectively contains chemical analysis data on groundnut leaf and seed respectively. It is shown that tillage in form of ploughing and ridging enhance uptake of P as shown by leaf and seed analysis. Also seed K, Mg leaf and N and Ca were enhanced by tillage irrespective of ash treatment.

Without ash application, Table 2 shows that leaf P increased in the order of zero tillage, ploughing and ridging in 2001 and 2002. Also seed P increased in the same order in 2001 as shown in Table 3 and ridging gave highest seed P in 2002. Application of wood ash to soil increased nutrient availability to groundnut. Table 2

shows that ash treatment tended to increase leaf N, P, K, Ca and Mg status especially in zero tillage and ridged soils. In ploughed soils, ash increased leaf Ca and Mg. Table 2 shows that ash improved seed N, P, K, and Mg status. For example, the leaf N for ash treatment and no ash were 2.80 and 2.75% respectively; the values for leaf P were 0.30 and 0.27, for leaf K, 3.7 and 3.5, for Ca, 0.50 and 0.44 and for Mg they were 0.82 and 0.49 for seed, mean leaf N were 5.8 and 3.8% for ash and no ash respectively; they were 0.37 and 0.25% for leaf P, 0.34 and 0.27% for leaf K and 0.36 and 0.28% for leaf Mg. Therefore, the availability of N, P, K, Ca and Mg to groundnut plant was enhanced by application of wood ash to soil.

**Table 2: Response of yield components of groundnut to tillage and wood ash**

| Treatment (G) | WHOLE PLANTS WEIGHT (KG) | | POD WEIGHT/PLANT (G) | | SEED WEIGHT/PLANT | |
|---|---|---|---|---|---|---|
| | 2001 | 2002 | 2001 | 2002 | 2001 | 2002 |
| ZTA | 1.60 | 1.68 | 76.0 | 72.3 | 33.0 | 39.0 |
| ZT | 0.70 | 1.42 | 74.1 | 71.5 | 31.5 | 32.0 |
| PDA | 1.66 | 1.72 | 86.6 | 80.1 | 44.6 | 43.9 |
| DP | 1.32 | 1.62 | 75.1 | 71.7 | 42.9 | 38.7 |
| MRA | 1.73 | 1.98 | 87.6 | 86.9 | 47.6 | 50.5 |
| MR | 1.70 | 1.42 | 80.6 | 78.3 | 43.6 | 35.2 |
| LSD (0.05) | 0.20 | 0.12 | 8.5 | 5.9 | 13.0 | 10.5 |

Table 3: **Effect of tillage and wood ash on chemical composition of groundnut Leaf**

| Treatment | N% | | P% | | K% | | Ca% | | Mg% | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2001 | 2002 | 2001 | 2002 | 2001 | 2002 | 2001 | 2002 | 2001 | 2002 |
| ZTA | 3.1 | 3.0 | 0.25 | 0.26 | 4.1 | 3.9 | 0.48 | 0.48 | 0.86 | 0.87 |
| ZT | 2.1 | 2.3 | 0.25 | 0.22 | 3.5 | 3.7 | 0.42 | 0.43 | 0.26 | 0.56 |
| PDA | 2.5 | 2.2 | 0.25 | 0.03 | 3.2 | 2.9 | 0.52 | 0.50 | 0.72 | 0.71 |
| DP | 2.7 | 3.3 | 0.27 | 0.34 | 3.7 | 3.7 | 0.14 | 0.46 | 0.29 | 0.56 |
| MRA | 3.1 | 2.9 | 0.33 | 0.41 | 4.8 | 3.4 | 0.52 | 0.54 | 0.96 | 0.77 |
| MR | 2.3 | 3.8 | 0.25 | 0.30 | 3.4 | 3.2 | 0.40 | 0.47 | 0.67 | 0.98 |

Table 4 presents data on yield components of groundnut in response to tillage and ash treatments. It is shown that ploughing and ridging improve plant pod and seed weight in 2001 and 2002 compared with zero tillage. Irrespective of ash treatment and year, mean plant weight recorded for zero tillage, ploughing and ridging were 1.35, 1.58, 1.71 Kg respectively; the values for pod weight per plant were 73.4; 78.4 and 83.4g and were 33.9; 42.5 and 44.2g for seed weight per plant. Ploughing and ridging increased seed weight by 25 and 30% respectively. Irrespective of tillage treatment and year, wood ash also increased the yield components. The mean plant weight for ash

And no ash were 1.73 and 1.36kg respectively; the values for pod weight were 81.6 and 75.2g, and they were 43.1 and 37.3 for seed weight. Therefore, tillage and wood ash application improved growth and yield of groundnut. Compared with zero tillage, ploughing and manual ridging increased mean seed weight by 25.4 and 30.4% respectively. Ash increased mean seed weight by 15.5%. It is implied that manual ridging and ploughing respectively increased seed yield more than wood ash applied to soil at 6t/ha. Among the six combined tillage and wood ash treatments , (zero tillage plus ash, zero tillage, ploughing plus ash, ploughing, manual ridging plus ash and ridging alone), the ridging plus ash treatment gave the highest number of branches and flowers (Table 1), plant weight, pod and seed weight (Table 2), leaf and seed P status and relatively high leaf Ca and leaf and seed Mg content. (Table 3 and 4). In 2001 seed weight given by ridging plus ash was significantly higher (P=0.05) than that of zero tillage plus ash. In 2002 seed weight given by ridging plus ash was significantly higher than any other combined or simple treatments.

**Table 4: Effect of tillage and wood ash on chemical composition of groundnut seed**

| Treatment | N% | | P% | | K% | | Ca% | | Mg% | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2001 | 2002 | 2001 | 2002 | 2001 | 2002 | 2001 | 2002 | 2001 | 2002 |
| ZTA | 5.3 | 9.6 | 0.27 | 0.41 | 0.36 | 0.30 | 0.06 | 0.07 | 0.36 | 0.30 |
| ZT | 5.0 | 5.1 | 0.19 | 0.30 | 0.20 | 0.28 | 0.06 | 0.04 | 0.20 | 0.28 |
| PDA | 5.9 | 5.9 | 0.39 | 0.36 | 0.42 | 0.34 | 0.07 | 0.07 | 0.42 | 0.34 |
| DP | 2.9 | 3.5 | 0.25 | 0.25 | 0.34 | 0.20 | 0.05 | 0.05 | 0.34 | 0.20 |
| MRA | 5.9 | 5.9 | 0.36 | 0.44 | 0.32 | 0.30 | 0.07 | 0.03 | 0.42 | 0.30 |
| MR | 3.1 | 3.2 | 0.36 | 0.39 | 0.28 | 0.30 | 0.03 | 0.032 | 0.36 | 0.30 |

# DISCUSSION

It was found that manual ridging and ploughing compared with zero tillage increased growth and yield parameters of groundnut such as number of branches and flowers, plant height and pod and seed weight. The tillage treatment also enhanced uptake of P, K, Mg and Ca as indicated by leaf and seed analysis. The improved performance of groundnut attributed to manual ridging and ploughing can be deduced to reduced soil bulk density and increased loosening of soil. (Adekiya and Ojeniyi, 2002) which should have enhanced aeration and availability of oxygen in soil. The latter conditions are known to enhance N-fixation, which is known to depend on aerobic respiration (Osundina, 1998). Also, tillage should have enhanced root growth and uptake of nutrients, especially P which is less mobile in soil. Groundnut is also known to require P (Sesay and Yarmah, 1996).

The finding that, wood ash increased growth and yield parameters of groundnut and leaf and seed N, P, K and Ca, and Mg content is related to the previous finding that wood ash is an effective source of plant nutrients such as N, P, K, Ca and Mg. (Obi, 2000, Obi and Ekperegin 2001; Ojeniyi and Adejobi, 2002 Reuler and Janssen, 1996) and has not been found to be effective as fertilizer for vegetables (Ogbalu, 1999 and Ojeniyi *et al.*, 2001, Ojeniyi and Adejobi 2002), cassava (Nyobe, 1998) and nutrient (N, P, K, Mg) uptake and yield in rice (Reuler and Janssen, 1996). Groundnut is known to responds to application of Ca, because is

removes large amount of Ca from soil. For seeding to take place, the hungry "pegs" requires supply of Ca, (Woife and Kipps, 1953).

Application of K fertilizer was shown to increase N, S and P content of seed and protein content of groundnut (Kayode, 1987). Salako (1988) indicated that Ca, and K are required for germination, establishment and proper leaf development of groundnut respectively. Apart from being a source of Ca and liming material (Obi and Ekperegin, 2001), wood ash is affirmed to have fertilizing effect on groundnut, being also a source of P, K and Mg.

Among the combined tillage plus ash treatments, manual ridging plus ash application gave best performance and leaf and seed P status. In a study comparing Mechanized tillage with manual tillage method, (Ojeniyi, *et al.*, 1999; Ojeniyi and Adekayode, 1999; Adekiya and Ojeniyi, 2002) found that ridging gave the least soil bulk density, and they are the poorest soils. The enhanced porosity attributable to manual ridging should have enhanced root growth and uptake of soil mobile P which is essential for growth, nodule formation and N fixation in legumes (Osundina, 1998).

## CONCLUSION

Performance and nutrient content of groundnut could be enhanced significantly on acidic soils of the rainforest zone by ridging or ploughing and addition of wood ash to soil, the performance of groundnut was most enhanced by wood ash application to soil at 4t/ha. The ash served as a source of nutrients and liming material.

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