# EFFECTS OF TILLAGE METHODS AND TILLAGE DEPTHS ON PRODUCTIVITY OF GINGER IN TWO AGRO ECOLOGICAL ZONES OF NIGERIA

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## ABSTRACT

*A field study carried out to determine appropriate tillage methods and tillage depth for ginger production in two agro ecological zones of Nigeria is reported. The ecological zones are derived Savannah and the Rain Forest. Three tillage treatments namely, ploughing once, ploughing and harrowing once and no tillage were conducted at depths of 0cm (for the no till), 5 cm, 10 cm and 15 cm. The fields were mapped using the Latin Squared (LS) design arrangement. The tillage operation in the derive Savannah zone was carried out using a 41 kW Ford tractor, 1 meter width disc plough and a three meter width disc harrow. In the Rain forest zone, a 65 kW tractor MF make, 1meter width disc plough and a three meter width disc harrow were used. Ginger rhizomes, UGC 1 variety, were used. The seeds were conditioned by cutting into small sets of about 25 kg each. The cuttings were done in such a way that each set had at least one to two viable buds. The sets were carefully placed inside holes of 5 cm deep at a spacing of 15 cm by 20 cm (row by column) and covered with soil. There were 240 seedlings per plot. Altogether, the plant population per site was 11,760. Forty eight stands were selected at random and carefully harvested in each plot 9 months after planting. The harvested products were weighed using electronic weighing machine. Results show that in the two zones, ploughing at 15 cm depth and then harrowing gave the highest yield and the least yield was obtained in the plot treated with no tillage. The field data were subjected to statistical analysis using the ANOVA model. Results show significant difference between the parameters at 1% level of significance. The means of the treatments were compared using the Least Significant Difference (LSD) test. Results show that there are differences between the means of the treatments for all the parameters in the two zones.*

**KEYWORDS:** Tillage, Depths, Ginger, Productivity

## 1. INTRODUCTION

Tillage is a post bush clearing physical manipulation of the soil aimed at modifying the soil structure (Ojeniyi, 1997). In other words, tillage is the process of modifying the state of the soil by mechanical means in order to provide conditions that are favourable to root penetration, and hence overall crop performance while preventing the deterioration of the land through soil compaction, soil loss, nutrient loss or erosion (Anazodo, 1986; Adama and Ujah, 2009). The presence of hard pans and high density of weeds in tropical soils including Nigeria make it imperative that some form of mechanical manipulation (tillage) should be done on the soils before planting to soften the hard pans for easy penetration of the roots and to reduce the incidence of weeds. The delicate nature of the soils also calls for careful handling to reduce compaction, structural damage and increased erosion. One of the objectives of the Agricultural Transformation Agenda was to promote the responsible use of land, water and other natural resources to create a vibrant agricultural sector (FMARD, 2016).

Ginger is an important raw material in food, beverages, tobacco, cosmetic and pharmaceutical manufacturing industries. Ginger is not native to Nigeria but believed to have been introduced into Nigeria in the 1920s from South East Asia. Nigeria produces large quantities of ginger and ranks third to China and India as the World's largest producers. The greatest production comes from Kaduna state where Kachia, Kubacha, Kwoi and Kafanchan are the major areas of production (Echendu, 2008).

Researchers have been conducting and/or sponsoring research in ginger production and processing, all aimed at increasing production and adding values to the product. A number of tillage studies had been done for different crops and in soils. Some these of studies include determination of the effects of tillage on soil physical and chemical properties and yield of ginger. The work was done by Agbede, and Adekiya, 2018.The tillage methods examined were zero tillage, manual ridging, manual mounding, ploughing plus harrowing and ploughing plus harrowing twice. Chaudhary and Monalisha, 2017 carried out experiment to determine the effect of conservation tillage and crop residue management on soil physical properties and crop productivity of wheat. Adama**,** and Maduabuchi, 2014 determined the effects of tillage methods on some soil properties in a clayey loam soil in Umudike environment The properties determined are Physical properties and cone index. Also, Agbe, et al. (2015) carried out a study to determine the response of cowpea and soyabean to tillage practices on a alfosol in Markurdi. And in 2015, Manua et al. (2015) studied the performance of different geometrical tillage blades under indoor soil bin conditions. Ojeniyi and Adebisi, 2015 investigated tillage mulch package for enhanced productivity of sweet potato on soil physical properties and crop performance.

All these studies and many more were carried out on crops not including ginger. Also the authors are not aware of any such studies carried out in soils of Umudike or on soils of the derived Savannah zone of Nigeria where root crops are the main food crop. These are fundamental gaps.

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The objective of this study was therefore to determine the effects of tillage methods and tillage depths on productivity of ginger in two agro ecological zones of Nigeria and thus recommend appropriate tillage package for ginger production in the zones of Nigeria.

## 2. MATERIALS AND METHODS

### 2.1 The Project Area

2.1.1 The derived Savannah zone.

The derived Savannah ecological zone lies on $5^0$55 and $7^0$08 North of Equator and $6^0$ 35 and $7^0$ 55 East of Greenwich Meridian. .It is in the transition zone between the Guinea Savannah in the north and the Rain forest in the south (Ofomata, 1975). The mean annual minimum temperature is between $24^0$ C and $27^0$ C (Muonanu, 1975; NIMET, 2012) while the maximum is between $33^0$ C and $36^0$ C (NIMET, 2011). The soil retains moderate moisture to sustain trees and grasses all through the year. The vegetation has formations of remarkable diversity (Figures 1). At one end, on close examination, about sixty percent of the plant species of the lowland of rain forest are observed though sharply narrowing to the northern Savannah section of the zone. At the wetter part, that is the southern part of the zone, close or semi close forests take up a good portion (Idachaba etal; 1991; Aneke, 1991)

2.1.2 The Rain Forest zone

The Rain Forest zone lies on Greenwich meridian and roughly within the band of Latitude$6^0$ 7' North of Equator. The rainfall distribution is between 1500 mm and 2500 mm range (Okwuobi, 1976; Idachaba *et al*; 1991; Aneke, 1991). The zone is characterized by tropical forest with tall trees.

### 2.2 Site Selection and Bush Clearing Operation

The project site in the derived Savannah zone was located at Ako Nike in Enugu East Local Government Area of Enugu state. Ako Nike is about 25 km away from Enugu-Ugwuogo - Opi road. For the Rain forest zone, the project site was at the Eastern farm of Michael Okpara University of Agriculture, Umudike, Abia State. At Ako Nike, the site needed some form of clearing as there were many trees and tick vegetation. A bulldozer was procured and used to clear the area at close supervision by experts. In Umudike site, post emergence herbicide was used to clear the grasses before field mapping.

### 2.3 Field Mapping and Experimental Design

In each location, the site was mapped into plots with each plot measuring 6m m by 10 m (0.006 ha). The Latin Squared (LS) design was used. There were seven treatments with seven replications. Altogether there were 49 plots in each zone. The treatments were disc ploughing once at depths of 5cm (P5), 10 cm (P10) and 15 cm (P15) then disc ploughing once and harrowing at depths of 5cm (P5H), 10 cm(P10H) and 15 cm (P15H) and no tillage (NT). The tillage treatments were assigned to the plots at random.

### 2.4 Tillage and Spraying

The tillage operation in the derived Savannah zone was carried out using a 41 kW Ford tractor, 1 meter width disc plough and a three meter width disc harrow. In the Rain forest zone, a 65 kW tractor MF make, 1meter width disc plough and a three meter width disc harrow were used. The fields were sprayed with primestra pre emergence herbicide before planting at a rate of 0.0 18 litres per plot. The planting operation was carried out manually.

### 2.5 Procurement and Conditioning of the Seedlings

Ginger rhizomes were procured from the National Root Crops Research Institute, Umudike. The variety planted was the UGC 1 (yellow ginger). The seeds were conditioned by cutting into small sets of about 25 kg each. The cuttings were done in such a way that each set had at least one to two viable buds.

### 2.6 Planting Operation, Fertilizer and Weed Control Applications

The sets were carefully placed inside holes of about 5 cm deep and covered with soil. The spacing was 15 cm by 20 cm (row by column). There were 240 seedlings per plot. Altogether the plant population per site was

11,760. NPK 15:15:15 compound fertilizer was applied at a rate of 1.8 kg/plot after planting and top dressed with Urea 13 weeks after planting at the rate 0.72kg/plot. The plots were kept free of weeds by weeding twice. The weeds were removed manually.

### 2.7 Harvesting and Yield Measurement

Harvesting in both sites was done 9 months after planting. Forty eight stands were selected at random and harvested in each plot. During the harvests, care was taken to minimize damages and other losses. The harvested products were weighed using electronic weighing machine.

## 3. RESULTS AND DISCUSSION

### 3.1 Ginger yield in the derived Savannah zone

The yield performance of ginger at varying depths and tillage methods in the derived Savannah zone of Nigeria were shown in Figure 1. From the Figure, ploughing at 15 cm depth and then harrowing gave the highest yield. The least yield was obtained in the plot treated with no tillage. Ploughing at 15 cm depth and harrowing increased yield by10033.73kg/ha (64.03%), 8969.14kg/ha (57.24%) and 6870.00kg/ha (43.84%) against no tillage, ploughing at 5 cm depth and ploughing at 5 cm depth plus harrowing respectively. Among the plots ploughed without harrowing, a negligible yield difference was recorded. The plots ploughed at 15 cm depth recorded an increase of 501.71 kg/ha (6.97%) more than the plot ploughed and harrowed at 5 cm depth.

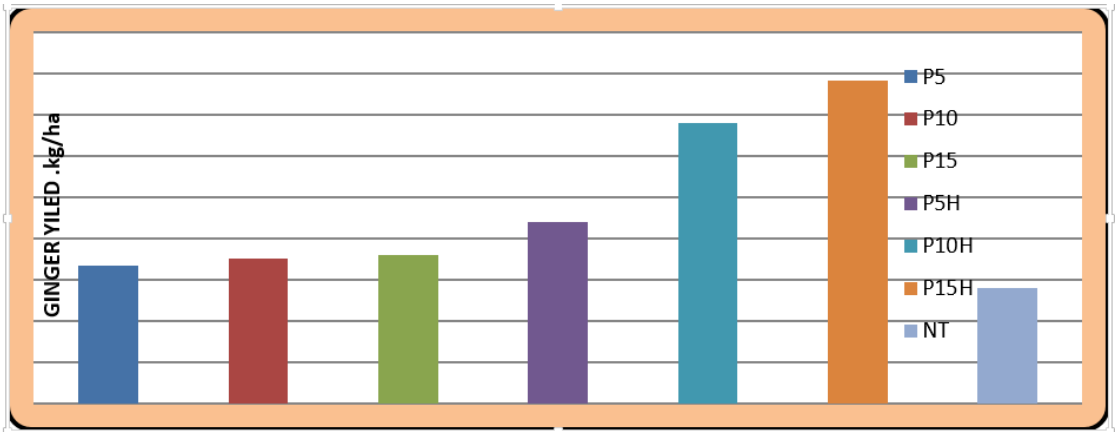


Fig. 1. Ginger Yield (kg/ha) for Different Tillage Methods and Tillage Depths in the Derived Savannah Zone

Keynote: P5 = Ploughing at 5 cm depth, P10 = Ploughing at 10 cm depth, P15 = Ploughing at 15 cm depth, P5H = Ploughing at 5 cm depth plus harrowing, P10H = Ploughing at 10 cm depth plus harrowing, P15H = Ploughing at 15 cm depth plus harrowing, NT = No tillage.

### 3.2 Ginger yield in the Rain forest zone

Figure 2 shows the average yields of ginger as affected by tillage methods and tillage depths in the Rain forest zone. As shown in the Figure, no tillage plot gave the least yield in the zone. The highest yield was recorded in the plot ploughed at 15 cm depth and harrowed once. A comparative analysis done between selected treatments displayed a reasonable difference in the performance of the crop. For instance, ploughing at 15 cm depth and harrowing gave a yield increase of 9,541.14 kg/ha (62.84%) above the yield in no tillage plot and 8635.67 kg/ha increase (57.46%) above the yield in the plot ploughed at 5 cm and harrowed. Among the plots without harrowing, ploughing at 15 cm depth gave a yield increase of 530.44/ha above the plot ploughed at 5 cm depth. Among the plot ploughed with harrowing, the plot ploughed and harrowed at 15 cm depth gave a yield increase of 6 975.86 kg/ha (45.94%) above the plot ploughed and harrowed at 5 cm depth.

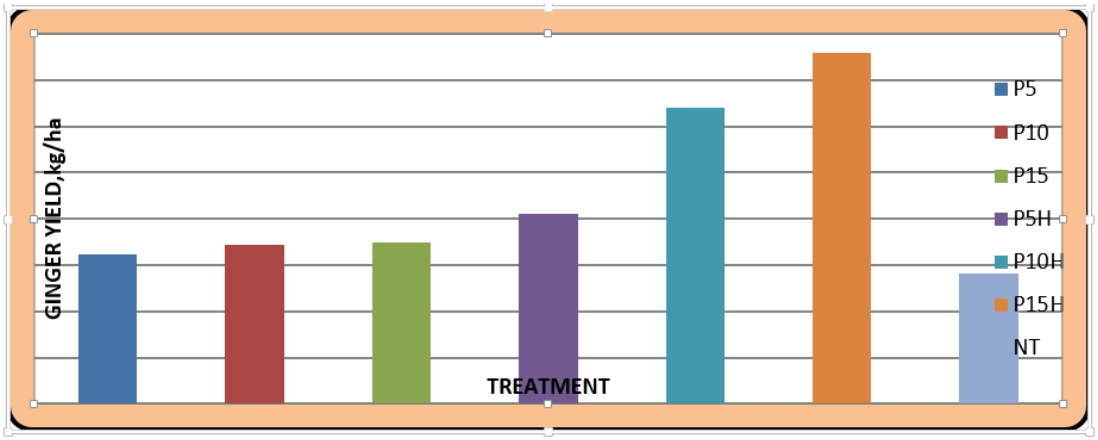


Fig 2. Ginger Yield for Different Tillage Methods and Tillage Depths in the Rain Forest Zone

Keynote: P5 = Ploughing at 5 cm depth, P10 = Ploughing at 10 cm depth, P15 = Ploughing at 15 cm depth, P5H = Ploughing at 5 cm depth plus harrowing, P10H = Ploughing at 10 cm depth plus harrowing, P15H = Ploughing at 15 cm depth plus harrowing, NT = No tillage.

The field data were subjected to statistical analysis using the ANOVA model. Results show significant difference between the parameters at 1% level of significant. The means of the treatments were compared using the Least Significant Difference (LSD) test. Results show that there are differences between the means of the treatments for all the parameters in the two zones.

## 4. CONCLUSIONS AND RECOMMENDATIONS

The conclusions from this study are that: Appropriate tillage system and tillage depth for ginger production in the derived Savannah and Rainforest agro ecological zones of Nigeria have been determined.

No tillage system gave the least results in terms of the yield for ginger in the rain forest and derived savannah agro ecological zones of Nigeria.

The appropriate tillage system and tillage depth for ginger production in the derived Savannah and Rainforest agro ecological zones of Nigeria is ploughing at15 cm depth and harrowing

No tillage system should not be adopted for ginger production in the rainforest and derived savannah zones of Nigeria.

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# APPENDICES

A3: Marking out the field

A4: Harrowing Operation in the Rain Forest zone

A7: Planting in the Derived Savannah

A8: Planting in the Rain Forest zone

A9: Germinating ginger

A10: Ginger 90 Days After Planting