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# Plantain Production Systems of Ekiti and Ondo States, Nigeria: Farmers' Perception of Loss in Perennial Productivity and Abandonment of Orchards

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#### **Authors' contributions**

*This work was carried out in collaboration between all authors. Authors AAO and MOO both designed the study. Author AAO administered the questionnaires, performed the statistical analysis, and wrote the first draft of the manuscript. Author OJA did some literature searches. Author MOO commented on the study. All authors read and approved the final manuscript.*

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## ABSTRACT

Plantain orchards are usually abandoned after two or three production cycles due to yield decline as accentuated by the non-adoption of management practices. This study was conducted to identify the causes of loss in perennial productivity that necessitate orchard abandonment. Information provided by 170 and 146 respondents, selected at five farmers each from two towns in each local government area of Ondo and Ekiti States, to questionnaire and interview schedules was analyze with descriptive statistics. Farmers were mainly married males, 40-60 years age and with 26.0 and 21.2% as illiterates; 67.1 and 61.8% had owned the farms for less than 15 years in Ekiti and Ondo States respectively. The farms were in small holdings with 80.8 and 78.8% cultivating less than 2.7 hectares (ha) which 32.9 and 38.2% allow to go into fallow in Ekiti and Ondo States respectively. Drought and damage by strong winds caused snapping while wind damage, shallow soils, high mat formation and root damage by pests caused plantain toppling.

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Ants, termites and grasshoppers were the commonest insect pests while 58.9 and 32.4% of farmers in Ekiti and Ondo States were aware of the presence and destructive effects of the banana weevil (*Cosmopolites sordidus*) respectively. The decline in productivity which results abandonment of plantain orchards after two or three ratoons could be due to ignorance exhibited by farmers especially in the awareness of pest incidence and damage.

**Keywords:** *Plantain production systems; perennial productivity; yield decline; abandonment of orchard; banana weevil.*

## 1. INTRODUCTION

The annual output of 2.4million metric tonnes (MT) which comes mainly from the southern states with humid and sub-humid climatic conditions makes Nigeria the largest producer of plantain in West Africa [1,2]. The main plantain production comes from the plants which are components of the multi-storey cropping systems in homestead gardens, backyard farms in urban and peri-urban areas and in intercropping with food and cash crops in the outlying (distant) farms [3]. The most often encountered production systems in south-western Nigeria consist of few plantain stands in food crop farms and those established as natural shade to nurse seedlings in cacao plantations and for boundary demarcation [4]. The cocoa belt in Nigeria is now mainly located in Ekiti and Ondo States where the lowland rainforest agro-ecological characteristics support the good growth and yield of the tree crop and the associated plantains maintained at various densities and levels of management. These predominant traditional production systems are characterized by low productivity [5] but the continuous availability of harvestable bunches makes the contribution of plantain to the subsistence economy substantial and a guarantee to all-year-round food security and rural income generation.

The National Horticultural Research Institute, Ibadan established in 1975 has national mandate for plantain which was also accepted as a mandate crop of International Institute of Tropical Agriculture (IITA), Ibadan in 1976. The earlier research activities for plantain improvement were in germplasm collection and evaluation, agronomy and farming systems but the emphasis changed to breeding host plant resistance for the control of black sigatoka disease. The improved agronomic practices available for orchard establishment and management of the planted crop are expected to satisfy the needs of ratoon crops. This is hardly the case as the orchards experience substantial yield decline and would be abandoned for new fields after the second or third ratoon crop [6]. The yield decline is not readily noticed in the traditional homestead and intercropping field production systems and so appear to attain perennial productivity despite the low adoption of improved cultural practices. This loss of perennial productivity is due to a combination of biotic and abiotic factors. Soil fertility decline, especially rapid organic matter depletion [6,7], climate change, diminishing farm sizes and increasing hunger and poverty are factors the farmers cope with by working the land more intensively. Unfortunately, a higher level of interacting biotic constraints- high mat formation, weeds, pests and diseases [8]- causes low returns to labour and other inputs which limit the lifespan of the orchards.

The few studies conducted on plantain production systems had concerned marketing analysis [9] and economic assessment in relation to resource use efficiency and the nature of costs and returns in orchards [10]. Thus, information is lacking on the management of

orchards for perennial productivity. This becomes critical as the desired expansion of plantain output should be matched by increased adoption of improved husbandry practices otherwise the orchards will diminish in size, become unproductive (moribund) and ultimately be abandoned. Since the yield decline is common to all plantain production systems, farmers need to be aware of the features and causes, and the available cultural practices that would be adopted as mitigation measures. This study involved a survey of the features of the plantain production systems in Ekiti and Ondo States, Nigeria with the view to determining the ability of the farmers to identify the constraints to perennial productivity.

## 2. MATERIALS AND METHODS

The survey was carried out in Ekiti and Ondo States located in the eastern portion of south-western Nigeria geo-political zone located between longitudes  $4^{\circ}23' - 6^{\circ}02'E$  and latitudes  $5^{\circ}50' - 8^{\circ}05' N$  during the early season (June-August) of 2010. Ekiti and Ondo States, with land masses of 6,353 and 15,820 km<sup>2</sup> had 2.38 and 3.44 million populations respectively according to the 2006 Census [11]. The States experience tropical climate with two distinct seasons: rainy season in March/April-October/November and dry season in November-March when the moist south-westerly monsoon winds and dry north-east continental winds blow across Nigeria respectively [12]. Mean annual rainfall varies from 1,250 mm in the northern extreme to 2,000 mm on the coast while temperature range is 21-28°C. The humid and sub-humid conditions impose natural vegetation that changes with latitudinal extent from mangrove and freshwater swamp forests in the southernmost areas near the coast to lowland forests in the central area and derived savannah and guinea savannah in the northern and north-east portions [13].

Purposive sampling was used to select the sample for the study. The first stage involved selection of two main plantain producing towns in each of the 16 and 18 Local Government Areas in Ondo and Ekiti States respectively based on crop production data in the Agricultural Development Programme (ADP). Snowball sampling was used to randomly select five [5] plantain farmers in each town which produced sample sizes of 160 and 180 in Ekiti and Ondo States respectively. Questionnaire was administered to the 340 respondents and additional information was obtained through personal interview to avoid misinterpretation of some questions. The data obtained were subjected to descriptive statistical analysis of frequency counts and percentages.

## 3. RESULTS

### 3.1 Social Characteristics of Plantain Farmers in Ekiti and Ondo States

Information on farm household characteristics of 146 and 170 respondents in the two states with regard to age, educational background, family life and size, farming experience and farm features is presented in Table 1. Majority of the farmers were males, belonged to the 46-50 year old bracket and had moderate literacy as 45.9 and 48.2% of the respondents had formal education at the secondary and tertiary levels in Ekiti and Ondo States respectively. The marital status showed that 90.4 and 95.9% were married and had mainly 1-2 wives while 88.4 and 95.3% had up to 10 children in Ekiti and Ondo States respectively.

### 3.2 Features of Plantain Production Systems in Ekiti and Ondo States

The features of the plantain farms in Ekiti and Ondo States are shown in Table 2. The plantain farms are mainly smallholdings as shown by 80.8 and 78.8% of respondents cultivating less than 2.7 ha in Ekiti and Ondo States. Equal proportion of farms had been cultivated for less than 10 and above 10 years in Ekiti State while more farms (58.2%) had been cultivated for less than 10 years in Ondo State. Plantain was grown sole in 32.2 and 25.9% of the farms in Ekiti and Ondo States respectively whereas intercropping was the practice in 66% of the farms in both states. The number of plants/mat was four (4) and above in 66.4% of the farms in Ekiti State while almost equal proportion (44.7 and 40.6%) maintained 2 and 3 plants/mat in Ondo State.

### 3.3 Identification of Production-related Problems in Plantain

Table 3 shows the distribution of respondents according to their perception of production-related problems encountered on plantain farms. All the farmers identified snapping of plants as a problem and the highest number of snapped plants was  $2.\text{mat}^{-1}$  by 41.2% of respondents in Ondo State and  $3.\text{mat}^{-1}$  and above by 43.2% of the respondents in Ekiti State. The main cause of snapping was wind on 58.9 and 48.8% of farms in Ekiti and Ondo States followed by drought and weight of bunches. The perception for pest and disease as a problem was higher in Ondo State (at 6.5% each) compared to 0.7% in Ekiti State. The problem of poor soil fertility received very low consideration at 0.6 and 0.7% perception in the two states. Plant toppling was also reported in all plantain farms being 1-5 plants in 83.5 and 73.5% of the respondents' farms in Ekiti and Ondo States and as the number of toppled plants increased to 10, 94.5 and 88.8% of the farms were involved. The main cause of toppling was identified as wind by 51.4 and 54.1% of the respondents followed by root damage by pests at 30.8 and 23.5% in Ekiti and Ondo States respectively while shallow soil was a bigger problem than high mat formation. Since root damage by pests in Ekiti and Ondo State was an important factor in plantain toppling, it was necessary to assess the level of awareness and knowledge of farmers on the problem of insect pests on the farms. Black ants were the most obvious problems on 67.1 and 45.3% of respondents' farms followed by termites at 18.5 and 20.0% in Ekiti and Ondo States respectively while grasshoppers were of least importance. The combination of ants and termites was important in 18.8% of respondents' farms in Ondo State but at only 2.7% in Ekiti State which had no score for a mixture of the three insects. More farmers (58.9%) were aware of borers as insect pests of plantain in Ekiti State than Ondo State (32.4%).

## 4. DISCUSSION

Plantain production is a male farmer-dominated business in Ekiti and Ondo States like the main tree cash crop- cocoa (*Theobroma cacao*)- to which it provides natural shades in plantations at the juvenile stage [14]. Thus, cocoa-based agroforestry is the main practice and explains the dominance of men in the cultivation of plantain as earlier noted by Akalumbe [15] while the post-harvest handling activities are within the exclusive domain of the women-folk. Anete and Amusa [16] had noted the fewer roles of women in decision-making in a male-dominated cash crop environment like cacao agroforestry households. The cocoa is usually allocated to the best lands in the distant farms not subject to the existing land tenure and bush fallow systems and which benefit the plantain. This is an extension of the lack of access to resources and property rights to women but whose numerical strength has ensured substantial presence in food-related agricultural activities, especially in the

cultivation of short-duration arable crops [17] that are not soil-exacting and grown in farms of various sizes.

The respondents belong mainly to the United Nations' middle age classification (40-60 years old) and which together with the large proportion in the <45 year bracket mean an active population still able to go about the business of plantain production with vigour. The ageing farming population has been identified as one of the issues of declining agricultural productivity in Nigeria [18] and so at the root of the intractable crisis in agriculture and is set to get worse. Adetunji et al. [19] had observed that cocoa farmers in West African countries have average age of 50 years and above and this age structure also explains the marital status and literacy level of the respondents. The single respondents were small in number while the family structure means that the sample was mainly drawn from male-headed households. The high literacy level, as indicated by 78.8 and 74% of the respondents with formal education in primary to tertiary institutions has a tendency of enhancing the adoption and transfer of improved cultural practices especially when the technology being promoted requires that farmers read the information on labelled products [20,10].

Plantain farms are small in size (<2.4 ha) as related to the fact that most farmers in the cocoa trade are smallholders who own a few trees to about 3 ha land planted to cocoa [21]. The plantain farms were mainly in intercropping mixtures with other crops while sole plantain farms appear to be on the increase probably because of the growing awareness of plantain as a profitable venture and so being promoted for the alleviation of rural poverty. Also, the nutritional value has been recognized primarily as sources of energy (at 31g/100g), low fat (0.4g/100g), supply of vitamin A, ascorbic acid, thiamine, riboflavin and niacin and minerals particularly iron, potassium and calcium while the sodium content (351mg/kg) is low in dietary terms and hence recommended for diabetics [22].

The farms that were 5 years old would probably relate to the sole crops and the nurse plants in juvenile cocoa plantations while the farms over 15 years old would be ratoons in mats that would be severely pruned and eventually destroyed as an orchard management practice to give way to complete canopy closure. The number of pseudostems was 3-4.mat<sup>-1</sup> in the study area which indicates the adoption of de-suckering recommended practice with which to maintain two or three strong suckers along with the planted crop [4].

Snapping of plantain, indicated by the breaking of pseudostems, was a problem in both states. The three main causes- strong winds, drought and weight of bunches- are interrelated. Plantain is determinate and the terminal bud of the corm develops directly into the inflorescence which is carried up on a long smooth unbranched stem through the centre of the pseudostem emerging at the top in the centre of the leaf cluster. The plant is usually tilted in the direction of the emerging inflorescence which turns downwards. This shooting takes place towards the end of the rainy season and fruiting continues thereafter such that the characteristic heavy windstorms cause snapping especially in tall and heavy-bunched plantains [4]. Also, as soil moisture content decreases into the dry season, the supply of nutrients, especially potassium, is not enough to nourish the plants. The snapping disrupts transport of nutrients and water needed for functioning of leaves and filling of the inflorescences and fingers such that yields decline. Ekiti State respondents had more snapped plants.mat<sup>-1</sup> due probably to shorter rainy season, a rolling topography of hills and plains and more open landscape in which winds move at greater speed. The soils are less fertile on account of the lower organic matter content such that the light-textured surface layers where most of the lateral feeding roots are concentrated lose moisture more quickly after the rains had ceased and without enough water uptake, the pseudostems would snap.

Toppling which involves falling of plantain pseudostems as a result of uprooted corms from the soil was a problem in Ekiti and Ondo States as reported by 90% of the respondents who had 1-10 toppled plantains in each farm. The plantain may not die but the exposed roots get dried and so would not perform the water and nutrient absorption functions needed to nourish the plants even as the leaves now on the floor cannot photosynthesize adequately to fill the fingers thereby causing yield decline. Plant toppling was attributed to shallow soil and high mat formation by average of 20% respondents in the two states probably because of the similarity of these factors and their interactions on the farms. Although a high percentage of respondents identified strong winds as the main cause of plant toppling, this is only possible through the interaction with damage by root pests and shallow soil. This was probably understood by 27% of the respondents who singled out damage by root pests as the main cause of plant toppling. Also, 56 and 19% of respondents in the two states identified ants and termites which inhabit the soil and so would be responsible for substantial root damage while grasshoppers which feed on foliage were the least mentioned as a critical problem. Black ants were more problems due to biting or stinging such that the resultant pains farmers suffer and the need to get treatment or abandon the infested portions slow down manual operations on the farms.

The low awareness of banana weevil (borer) (*Cosmopolites sordidus*) as a major insect pest of plantain might be due to the fact that most respondents cannot even identify the insect. Plantain mats affected by weevils are characterized by splitting of leaf sheaths, tunnelled corms and snapping of pseudostems while serious attacks may lead to massive toppling. The adults which can be seen are small in size (10-15mm long) [23] and are found in moist environments, leaf bases and decayed corms and stems [24], rarely in flight but move mainly by walking at night and can be confused with storage weevils. The larvae (grubs) feed by boring or making irregular tunnels in the corms and rootstock, eventually causing corm decay by facilitating invasion by secondary organisms and leaving a mass of rotten tissue [25]. Injury to the corm interferes with root initiation and sap flow in the plant such that the leaves turn yellow, wither and die prematurely. Young suckers may show symptoms of wilting and die while growth is retarded in older plants which produce small bunches and are easily toppled by the wind. Widespread infestation is caused primarily by movement of planting materials containing the pest in its immature stage. Damage is worst in neglected plants and in ratoon crops while population build-up for infestation is less serious in fertile soils, newly planted fields and with good crop husbandry.

## 5. CONCLUSION AND RECOMMENDATION

Plantain production is mainly from small holdings characterized by intercropping systems are dominant but sole plantain farms are becoming popular. The proportion of five-year old plantain farms actually shifted or allowed to go into fallow conforms to the observation that orchards are abandoned after two-three ratoon crops due to yield decline. The farmers identified snapping and toppling as problems associated with yield decline in plantain production systems. Snapping was due to strong winds, drought and weight of bunches while strong winds, root damage by pests and shallow soil caused plant toppling. Ants, termites and grasshoppers were the main insect pests whereas farmers' awareness of the banana weevil as a problem of plantain production systems was greater in ekiti state. These perceptions emphasize the need to identify existing appropriate management practices to combat the problems of snapping and toppling of plantain pseudostems for subsequent farmers' adoption. Where these are not available, research should focus on the development of practical strategies to mitigate the effects of the problems.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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