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SUCKER PARING AND GOOD MANAGEMENT PRACTICES: STRATEGIES FOR THE REHABILITATION OF AN OLD PLANTAIN ORCHARD AND CONTROL OF PSEUDO-STEM BORER (*Odoiporus longicollis*)

Oso, A.A., Longe, O.O. and Ayodele, O.J.

Department of Crop, Soil and Environmental Sciences, Ekiti State University, Ado-Ekiti

ABSTRACT

The reduction in number and sizes of orchards, poor husbandry practices which cause declining productivity as farms age and complications from pests and disease-causing organisms limit plantain production in Nigeria. The rehabilitation and pests / disease control should be emphasized rather than the normal practice of opening up new sites when plantain orchards decline sets in. This requires a package of agronomic practices with which to sustain plantain yields. A moribund plantain orchard on the Teaching and Research Farm, Ekiti State University, Ado-Ekiti was used for a rehabilitation study. The experiment was a randomized complete block design with three replicates of eight treatments established at 2.5 x 2.5 m spacing. The treatments consisted of pared and non-pared control, pared and non-pared with 600 kg.ha^{-1} NPK 15-15-15 fertilizer, pared and non-pared with 30 MT.ha^{-1} poultry manure and compost mixture, pared and non-pared with fertilizer plus the compost and poultry manure mixture. General good management practices such as proper field sanitation, removal of dry old leaves and pests infested plantain stumps and pseudo-stems after harvest and pruning of emerging plantain suckers were also maintained to prevent and control the identified pests prevalent in the area; particularly the pseudo-stem borer (Odoiporus longicollis). Data were collected on plant height, plant girth, leaf area, and number of functional leaves, number of fingers per hand, number of hands per bunch and bunch yield. Pared suckers with compost + poultry manure mixture treatment gave the best performance in terms of pseudo-stem height and girth, number of leaves and leaf area. Also, the combination of pared suckers, fertilizer and compost + poultry manure mixture produced the highest bunch yield. Hence, rehabilitation of moribund orchards with the use of clean planting materials as well as the adoption of good routine management practices like proper field sanitation, removal of dry old leaves and pests infested plantain stumps and pseudo-

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stems after harvest and periodic pruning of emerging suckersis a suggested alternative to the abandonment of orchards by farmers.

Keywords: Puedo-stem borer (*Odoiporus longicollis*), sucker paring, compost + poultry manure mixture, inorganic fertilizer, moribund orchard

INTRODUCTION

Plantain (*Musaparadisiaca*) is the leading commercial fruit crop in more than 52 tropical and sub-tropical countries of the world, with an annual production of over 40 million metric tonnes (MT);out of which 22 million MT come from five African countries (Cameroon, Rwanda, Tanzania, Zaire and Nigeria) (FAOSTAT, 2007). Large-scale plantain production is being promoted as a viable venture in Nigeria considering its high potential as a cheap source of daily dietary carbohydrates for rural and urban inhabitants and raw material for composite flour (INIBAP, 1992; RMRDC, 1992). These potentials necessitated the research emphasis in plantain yield optimization from which orchard agronomic practices have evolved (Swennen, 1990;Adelaja and Olaniyan, 2000). Unfortunately, yields decline rapidly after harvesting the planted (parent) crop and perhaps one to two ratoons suggesting that perennial productivity of plantain orchards were not desired from these recommendations. Attack of plantain plants by the pseudo-stem borer (*Odoiporus longicollis*), leading to yield reduction and death of plants in extreme cases does not also help matters.

Concerns about the yield decline in plantain orchards which Ortiz and Vuylsteke (1994) referred to as 'yield decline syndrome' have been expressed so often that it is now an established fact and that the causes could bebiotic and abiotic. The biotic factors include pests and disease organisms (macro and micro), surrounding plants such as weeds, organic matter and other living factors; while the abiotic or non-living factors include soil fertility decline, especially rapid organic matter depletion (Frison and Sharrock, 1999), climate change, diminishing farm sizes and increasing poverty and hunger. Rapid depletion of soil fertility and declining plant yield derives, in part, from the recommended practices which have not emphasized the conscious addition of organic materials and control of pests and diseases. Thus, the soil organic matter decomposes rapidly under the humid conditions and associated shading of the orchard floor by plantain leaves; while crop pests / diseases, once started, continues to spread rapidly if not checked.

Larvae of the stem borer weevil feed on tissues of the succulent plantain sheath by tunnelling extensively and may reach asfar as the true stem. If larvae emerge during the advanced pre-flowering stage of the plant, the ascending flower bud and the peduncle inside the pseudo-stem can be eaten and damaged, resulting in non-emergence of the flower bud which decays inside the pseudo-stem (Padmanaban et al., 2001). In severely infested plantations, more than 20% plants

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do not flower due to this reason. During advanced stages of infestation, the plants stem, when split open, exhibits extensive tunnelling both in the leaf sheath and in the true stem. Rotting occurs due to secondary infection by pathogens and a foul odour is emitted. When the true stem and peduncle are tunnelled after flowering, the fruits do not develop properly, presenting a dehydrated condition with premature ripening of the bunch itself. Stem weevil infestation interferes with the translocation of nutrients and water, retards growth and development and increases susceptibility to wind lodging. Weakening of the stem by larval tunnelling may result in breakage by wind or inability to bear the weight of the maturing bunch. It is estimated that the stem weevil causes 10-90% yield loss depending on the growth stage of the crop and management efficiency.

The farmers' coping strategy for this decline and limitation to the length of plantain plantation lifespan due to stem borer damage, is a more intensive land use management and pests / diseases control strategies that will enhance production and good health of plants.

Plantain is a heavy feeder of nitrogen (N) and potassium (K) which are often rapidly depleted and most deficient in orchard soils (Zuofa and Onuegbu, 1997). Besides, the soils developed from basement complex rock parent materials have low inherent nutrient fertility even as heavy precipitation and long rainy seasons that characterize the humid and sub-humid zones and the sandy, porous and structure less soils encourage heavy nutrient leaching losses (Agboola*et al*., 1997). These conditions compound the features of plantain orchards already experiencing yield decline and so would be routinely abandoned.van Asten*et al*. (2005) attributed the conspicuous dearth of good quality yield data from plantain fields to : (1) dominance of mixed cropping systems in which plantain is grown at mixed densities as a nurse (secondary) crop to the seedlings of tree cash crops (2) absence of single harvest period (3) length of cropping cycle varies due to cultivar, nutrition, climate, cropping system and disease/pest pressure which complicate productivity calculations and (4) bunch yields depend on seasons and vary from farm to farm and at village and regional levels. This difficulty is reflected in plantain production which showed 24.6% increase in area cultivated and 21.8% yield decline from 7.50 to 5.41 $MT.ha^{-1}$between 1990 and 2004 (Faturoti*et al*., 2007) even as these average national yields are very low compared to 30-50 $MT.ha^{-1}$ from research stations (Swennen, 1990).

Plantain orchards can be rehabilitated when yields begin to decline as the possibility of moving to new sites is now hampered by land hunger due to competition from non-farm uses. Opeke (2005) recommended the rehabilitation of moribund tree crop plantations through phased or complete replanting that involves removing old unproductive trees and plots re-established with new seedlings. Farmers are hardly aware of how to enhance the health of plantain orchards, and often plant suckers are obtained from fields infested by nematodes, banana weevils and stem

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borers. Although nematode, weevil and stem borer infestation controls with synthetic pesticides are easy, fast acting and effective; the chemicals are costly and have high mammalian toxicity among other potential environmental hazards. One cultural method within the reach of farmers is the planting of clean suckers obtained by paring (peeling) the corms to remove infested tissue and whose efficiency has been improved by hot water treatment or the use of plant extracts applied as root dips, soil amendment, root exudates, aqueous extracts, seed powders and cakes (Musabyimana*et al*., 2001; Sikora*et al*., 2005).Field sanitation is also imperative in the control of these pests. Dried old leaves must be removed to allow the detection of early symptoms of infestation. Suckers should be pruned periodically and infested pseudo-stems must be removed from the field and destroyed. Plantain stumps kept in the field after harvest must be removed and destroyed as they serve as refuge and breeding sites for pests and disease causing organisms (Padmanaban & Sathiamoorthy, 2001).

This study therefore examines the effect of paring suckers to obtain clean planting materials, application of inorganic fertilizer and compost + poultry manure mixture, both singly and in combination; general good management practices such as proper field sanitation, removal of dry old leaves and pests infested plantain stumps and pseudo-stems after harvest and periodic pruning of suckers, for the rehabilitation of a moribund plantain orchard.

Adult Weevil of Pseudo-stem borer (*Odoiporus longicollis*)

The Pseudo-stem borer Larvae

MATERIALS AND METHODS

Experimental Site

The experiment was carried out in a four-year old plantain orchard already experiencing yield decline on the Teaching and Research Farm, Ekiti State University, Ado-Ekiti (long. 5º14'E, lat. 7º42'N) between April and December 2011. The site experiences a warm sub-humid tropical

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climate characterized by 1,367 mm annual rainfall received in 112 days and mean temperature of 25-32^{o}C.

Description of Experimental Set-up

The existing plants were uprooted to destroy the mats and the field was lined out and planting holes dug at 2.5x2.5 m spacing. Sword suckers obtained from the existing plantain orchard were pared (peeling of the corm) or non-pared. Soil amendments were control, 600 kg.ha^{-1} NPK 15-15-15 fertilizer, 30 MT.ha^{-1}poultry and compost manure mixture and fertilizer plus manure mixture. Each plot was 2.5x5.0 m and suckers were planted to attain 1,600 plants.ha^{-1} population. The treatments were arranged in a randomized complete block design with three replicates. The manure mixture and fertilizer were applied by side banding 1-2 months after planting (MAP). The compost mixed with the poultry manure to form the compost and poultry manure mixture was originally prepared from a combination of various herbaceous plants which include neem and red acalypha plant leaves that have been variously tested by researchers and proven to have potent control powers against insects; especially weevils, stem borers and nematodes. The field was kept weed-free by spraying systemic herbicide (Glyphosate at 3 kg a.i. ha^{-1}) as and when necessary. Other good management practices such removal of dry old leaves and pests infested plantain stumps and pseudo-stems after harvest, and pruning of emerging plantain suckers were also adopted to prevent and control the identified pests in the area; particularly the pseudo-stem borer (*Odoiporus longicollis*).

Data Collection:

Growth parameters of plant parts above the ground were measured at monthly intervals starting from 4 MAP. The data collected were pseudo-stem height and girth, number of functional and non-functional leaves (a leaf with at least 75% green blade was considered functional). And Leaf Area is defined as the Area of Leaf per plant x Number of Leaves x0.83 (Obiefuna and Ndubizu, 1979).

Data Analysis

The growth and yield data collected were subjected to analysis of variance and means were separated using Duncan Multiple Range Test (DMRT).

RESULTS

The effect of sucker paring on plantain growth performance in the rehabilitated orchardat 4, 6 and 8 months after planting (MAP) is shown in Table 1. There were no significant differences in

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pseudo-stem height, leaf number and leaf area, but pseudo-stem height of non-pared suckers were significantly taller at 6 and 8 MAP.

Table 1: Showing pseudo-stem height, pseudo-stem girth, leaf area and leaf number at 4, 6 and 8 months in pared and non-pared plantain

Treatment	Pseudostem height(3cm)			Pseudostem girth(cm)			Leaf number			Leaf area(cm^2)		
	4	6	8	4	6	8	4	6	8	4	6	8
Pared	73.0 a	104.3 b	141.8 b	25.4 a	34.4 a	42.7 a	8.67 a	18.7 a	17.0 a	10767.3 a	49909.02 a	59471.6 a
Non-pared	71.5 a	121.1 a	164.27 a	25.7 a	37.1 a	48.1 a	6.67 a	15.7 a	17.7 a	8668.9 a	58399.05 a	65307.5 a

Values with the same letters in the same column are not significantly different (P=0.05) by DMRT.

The effect of paring and nutrient management on growth performance of the rehabilitated plantation is shown in table 2. Plantain growth was best enhanced among the pared and compost + poultry manure mixture treatments. They produced significantly taller and thicker plants with larger leaf surfaces. Among the non-pared treatment combinations, growth was best enhanced in the non-pared + fertilizer + compost and poultry manure mixture treatment.

The bunch yield of plantain between parings, compost+ poultry manure mixture and fertilizer treatments at harvest is shown in Table 3.Yield was better enhanced among pared suckers treated plants in all the treatment combinations. However, the best yield parameter in terms of bunchyield (8.08 MT/ha) and number of fingers/bunch (20.73) was produced in pseudo-stems of pared sucker with fertilizer and compost + poultry manure mixture treatment combinations.

Table 2: Showing pseudo-stem height, girth, leaf area and leaf number at 8 month in relationship with paring and nutrient management practices

Treatment	Pseudostem height (cm)		Pseudostem girth (cm)		Leaf number		Leaf area (cm^2)	
	Pared	Not-pared	Pared	Not-pared	Pared	Not-pared	Pared	Not-pared

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Control	141.80^{c}	164.27^{ab}	42.67^{b}	48.13^{ab}	17.00^{b}	17.67^{a}	59471.31^{c}	65307.52^{b}
Fertilizer	167.93^{b}	157.40^{b}	52.73^{a}	46.43^{b}	18.00^{ab}	18.00^{a}	67362.44^{c}	65181.25^{b}
Manure	191.20^{a}	140.50^{c}	53.77^{a}	40.53^{b}	20.67^{a}	19.00^{a}	118962.1^{a}	67277.10^{b}
Fertilizer + Manure	158.83^{b}	179.77^{a}	50.43^{a}	55.10^{a}	18.67^{ab}	18.67^{a}	78664.83^{b}	85733.27^{a}

Values with the same letters in the same column are not significantly different (P=0.05) by DMRT

Table 3:Showing bunch yield from plantain after treatment

Treatment	Bunch yield (MT/ha)		Number of hands		Number of fingers	
	Pared	Not-pared	Pared	Not-pared	Pared	Not-pared
Control	5.09^{b}	4.86^{b}	4.92^{a}	4.33^{a}	15.42^{b}	13.58^{c}
Inorganic Fertilizer	6.06^{ab}	4.45^{b}	5.07^{a}	4.58^{a}	17.73^{ab}	16.00^{b}
Manure mixture	7.74^{a}	6.45^{ab}	4.89^{a}	4.67^{a}	18.89^{a}	18.33^{a}
Fertilizer + Manure	8.08^{a}	4.54^{b}	4.78^{a}	4.50^{a}	20.73^{a}	18.33^{a}

Values with the same letters in the same column are not significantly different (P=0.05) by DMRT

Plantain stem damaged by pseudo-stem borer tunneling.

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Dead plantain tree due to pseudo-stem borer attack

DISCUSSION

A careful observation of the growth scenario revealed that paring of sucker with compost + poultry manure mixture treatment appeared compatible because plantain established from pared suckers which received compost manure had the best growth performance in terms of pseudostem height and girth, leaf area, as well as number of leaves than all the other treatment combinations. This study has shown that plants treated with compost and poultry manure mixture gave an increased performance in all growth parameters tested, as it contains a high percentage of nitrogen and phosphorus for healthy growth of plants (Ewulo, 2005). Compost and poultry manure are sources of nutrients and organic matter such that their application would improve soil bio-physical conditions for sustainable food production(Munoz *et al*., 2004). The superiority of poultry manure over other organic manures for crops is attributed to increase in soil pH, organic matter content, available phosphorus, exchangeable cations and micronutrients and reduction in soil salinity and extractable ions (Follet*et al*. 1995;Jinadasa*et al*. 1997). Ndukwe*et al.,* (2011) reported that the application of 20 MT/ha poultry manure (on a soil that is averagely fertile) within the first two months of transplanting suckers produced heavier bunches and their components and increase fruit quality of two plantain (*Musa spp AAB*) cultivars in relation to optimum nutrient release and availability for root uptake. Swennen*et al*., (1995) reported that bunch weight was significantly ($P<0.05$) affected by the number of hands and fruits per bunch. In this study, the highest bunch yield in the pared, poultry manure and fertilizer combined treatments also had greater number of hands and fruits per bunch. This study has also revealed that organic treated plantain produced the best bunch yield when compared with the other

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treatments. Since paring seemed compatible with organic manuring, Nigerian farmers should be encouraged to adopt the technique.

In the area of pests' control, the act of sucker paring to obtain clean planting materials and the maintenance of good management practices like proper field sanitation, removal of dry old leaves and pests infested plantain stumps and pseudo-stems after harvest and periodic pruning of emerging suckers have helped to keep the moribund plantain healthy and push the pests away. The active ingredients embedded in some of the plant materials involved in preparing compost for the old orchard rehabilitation, especially neem (*Azadirachtaindica*) leaves has also helped in putting the pests in check, particularly the plantain pseudo-stem borer, *Odoiporus longicollis*.

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