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# Effect of paring, mulching and fertilizer application on performance of pot-grown plantain suckers.

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## ABSTRACT

*Objective*: Yield decline in plantain orchards has been linked to problems of pests (nematodes and weevils), diseases and declining soil fertility. This study evaluated the effects of paring, mulching and fertilizer application on the establishment and growth of pot-grown plantain suckers in a sandy loam with moderate organic matter content, low total N and high available P.

*Methodology and results*: The mulching materials used included sawdust, tithonia and oil palm bunch refuse applied at 50 tons/ha while compound NPK 15-15-15 fertilizer was applied at a rate of 300kg/ha. The trial was arranged in a completely randomized design (CRD) of sixteen treatments replicated three times. Growth parameters measured at two-week intervals showed that performance was best enhanced in non-pared suckers which received tithonia mulch and fertilizer. Tithonia mulch and fertilizer had complementary effect on nutrient availability because it decomposes to release nutrients and increase organic matter which aid plantain growth.

*Conclusion and application of findings*: Although paring did not enhance plantain growth as much as in unpared suckers (which are more susceptible to weevil and nematodes infestation), farmers should not be reluctant in adopting the pared sucker technique which confers protection on the roots. Therefore, the longevity of orchards established with pared and unpared suckers should be adequately monitored.

**Key words**: mulch, paring, plantain, establishment.

## INTRODUCTION

Plantain (*Musa AAB*) is mainly cultivated as a component of the multi- storey cropping systems in homestead gardens, backyard farms in urban and peri-urban areas and in mixtures (intercropping) with food and tree crops in the outlying farms. Output expansion from these extensive production systems through growing more plantains cannot be rapidly attained as yields are affected by limited application of improved husbandry technologies. Small to medium-sized orchards favoured by elites seeking to diversify revenue sources, emphasize monoculture and intensive management. High yields are obtained in the planted (parent) crop and in one to two ratoons after which output declines because the management recommendations did not envisage perennial orchard productivity. Plantain orchard decline is due to high mat formation, reduced root ramification, invasion by obnoxious weeds and low levels of soil organic matter. This low organic matter exacerbates the

pests and diseases problems (Coyne *et. al.,* 2004) such that an orchard can become unproductive and moribund.

The routine husbandry practices applied to sustain orchard productivity emphasize the use of clean planting materials and continuous provision of nutrients into the plantain production systems. Paring (peeling) of the suckers removes roots infested with nematodes while corms with severe stem borer problems would be detected and discarded (Swennen, 1990). Inorganic fertilizer use to increase nutrient supplies especially nitrogen (N) and potassium (K) is recommended while organic materials in the form of manure and mulch would increase nutrient and soil organic matter content (Adelaja and Olaniyan, 2000). Besides, mulch keeps the soil moist (Muller and Kotsch, 1994), protects the soil from erosion and suppresses weeds (Zuofa and Onuegbu, 1997), serves as nutrient sources when they decay (Liasu and AbdulKabirKhan, 2007) and improves soil fertility as well as other soil physical properties such that plantain yield increases (Salau *et al.,* 1992, Ruhigwa *et al.,* 1995; Rotimi *et al.,* 1999). However, the problems with natural mulches are the large quantities required, non-availability due to competing on-farm and off-farm uses, the low content and release of nutrients, especially nitrogen (N) and phosphorus (P) which emphasizes the need for complementary use of inorganic fertilizer (Ojeniyi, 2010).

There is no information available on the combined use of paring to obtain clean suckers, application of mulch and chemical fertilizer to improve soil quality on plantain production. This paper presents data from an investigation on the effects of paring, different mulching materials, chemical fertilizer and their combinations on establishment and growth of plantain suckers.

## MATERIALS AND METHODS

The study was conducted on the Teaching and Research Farm, University of Ado- Ekiti during the rainy season (April to December) of 2008. The surface layer (0-15cm) of soil classified as Oxic Paleustalf was randomly sampled and analyzed for particle size distribution, pH, and organic matter, total N, exchangeable K and available P using the methods described in IITA (1979).The soil is an acidic sandy loam with low organic matter and total N content. Available P is moderate while the exchangeable cations are low (Table 1)

**Table 1:** Some chemical properties of the soil used for the studies

| Parameter | $Ca^{2+}$ | $Mg^{2+}$ | $Na^{+}$ | P | $K^{+}$ | %N | % OM | pH |
|---|---|---|---|---|---|---|---|---|
| Value | 1.00 | 0.60 | 0.10 | 10.31 | 0.09 | 0.07 | 1.00 | 4.37 |

Twenty kilograms of topsoil were weighed into each of 48 polythene bags of 55cm height and 40cm depth. There were sixteen treatments as follows:

| | |
|---|---|
| PCFo: pared+control without fertilizer | NPOFo: non-pared+oil palm without fertilizer |
| PCF1: pared+control+fertilizer | NPOF1: non-pared+oil palm+ fertilizer |
| NPCFo: non-pared+control without fertilizer | NPSFo: non-pared+sawdust without fertilizer |
| NPCF1: non-pared+control+ fertilizer | NPSF1: non-pared+sawdust+fertilizer |
| PSFo: pared+sawdust without fertilizer | PTFo: pared+tithonia without fertilizer |
| PSF1: pared+sawdust+fertilizer | PTF1: pared+tithonia+ fertilizer |
| POFo: pared+oil palm without fertilizer | NPTFo: non-pared+ tithonia without fertilizer |
| POF1: pared+ oil palm+fertilizer | NPTF1: non-pared+tithonia |

The mulch treatment consisted of 0.5kg of respective mulch material while 60g of NPK 15-15-15 was added to each of the treatments 2 weeks after planting. The trial was arranged in a Completely Randomized Design (CRD) and treatments were replicated three times. At the expiration of the experiment, the soils in the bags

were sampled, air-dried and analyzed for organic matter and major nutrients.
Growth parameters measured include pseudo stem height and girth at the soil level, and leaf area. Data were subjected to one-way analysis of variance and Duncan Multiple Range Test (DMRT) was used to separate the means.

## RESULTS

The growth performance of plantain between pared and unpared suckers at 16 weeks is shown in Table 2. There were no significant differences in pseudo stem height, girth and leaf area during the weeks under observation.

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**Table 2:** Plant height, girth and leaf area at 16 weeks in relation to paring or non paring treatment

| Treatment | Plant height | Plant girth | Leaf area |
|---|---|---|---|
| Pared | 39.78[a] | 13.70 [a] | 1269.38 [a] |
| Non-pared | 42.33 [a] | 14.73 [a] | 1437.40 [a] |

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

The growth performance of plantain as influenced by different mulching materials at 16 weeks is shown in table 3. Tithonia mulch gave the tallest and thickest plants with largest leaf area, followed by the oil palm bunch refuse and sawdust mulch treatments.

**Table 3:** Plant height, girth and leaf area in relation to type of mulch applied at16 weeks.

| Mulch | Plant height | Plant girth | Leaf area |
|---|---|---|---|
| Tithonia | 48.42[a] | 16.67[a] | 1713.94[a] |
| Oil palm bunch refuse | 44.67[ab] | 14.71[ab] | 1488.49[ab] |
| Sawdust | 34.42[b] | 12.58[b] | 1115.68[b] |
| Control | 36.46[ab] | 12.82[b] | 1123.72[b] |

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

The responses of plantain to fertilizer application at 8, 12 and 16 weeks are shown in Table 4. Significant differences were obtained in pseudo stem height, girth and leaf area of suckers that received fertilizer than those which did not at 16$^{th}$ week.

**Table 4:** Plant height, girth and leaf area at 8, 12 and 16 weeks in relation to fertilizer or non fertilizer treatment

| Treatment | Plant height | | | Plant girth (cm) | | | Leaf area | | |
|---|---|---|---|---|---|---|---|---|---|
| | 8 | 12 | 16 | 8 | 12 | 16 | 8 | 12 | 16 |
| Fertilizer | 18.60[a] | 30.41 [a] | 50.29[a] | 8.39 [a] | 11.02[a] | 16.27[a] | 394.32[a] | 789.00[a] | 1848.74 [a] |
| No fertilizer | 20.06 [a] | 28.05 [a] | 31.49[b] | 9.12[a] | 10.58[a] | 12.09[b] | 410.08[a] | 651.47[a] | 919.44[b] |

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

Results of the analysis of soils at the experiment are shown in Table 5. About 100% increase was recorded for organic matter in NPTF1.Tithonia creates a favorable micro-climate for the activities of soil microorganisms which help to improve and maintain the biological and physico-chemical qualities of the soil. A slight increase was also recorded in PTF0 and NPOF1 while a sharp decrease was observed in PSF0.An increase in %N was observed among all the treatments with the highest increase in NPTF1.Similarly, an increase in exchangeable K was observed among all the treatments with the highest increase in NPTF1.

**Table 5:** Chemical properties of the soil before and at the end of the experiment.

| Parameter | $Ca^{2+}$ | $Mg^{2+}$ | $Na^{+}$ | $K^{+}$ | %N | % OM | $p^{H}$ |
|---|---|---|---|---|---|---|---|
| **Value** | 1.00 | 0.60 | 0.10 | 0.09 | 0.07 | 1.00 | 4.37 |
| **NPCF1** | 1.00 | 0.40 | 0.09 | 0.16 | 0.43 | 0.92 | 5.73 |
| **NPCF0** | 1.50 | 0.50 | 0.12 | 0.18 | 0.28 | 0.53 | 4.55 |
| **PCF0** | 1.60 | 0.80 | 0.22 | 0.18 | 0.46 | 0.92 | 5.36 |
| **NPOF1** | 1.60 | 0.80 | 0.53 | 0.33 | 0.53 | 1.06 | 6.15 |
| **POF0** | 0.90 | 0.50 | 0.16 | 0.38 | 0.39 | 0.70 | 6.40 |
| **POF1** | 0.90 | 0.40 | 0.17 | 0.33 | 0.30 | 0.53 | 3.91 |
| **PTF0** | 1.00 | 0.60 | 0.10 | 0.23 | 0.15 | 1.06 | 3.92 |
| **PTF1** | 0.90 | 0.40 | 0.12 | 0.46 | 0.41 | 0.83 | 4.05 |
| **PSF0** | 1.30 | 0.70 | 0.10 | 0.16 | 0.54 | 0.33 | 4.81 |
| **PSF1** | 1.40 | 0.60 | 0.14 | 0.19 | 0.28 | 0.56 | 4.75 |
| **NPSF0** | 1.20 | 0.50 | 0.22 | 0.31 | 0.43 | 0.86 | 5.50 |
| **NPSF1** | 1.60 | 0.70 | 0.15 | 0.26 | 0.36 | 0.73 | 5.40 |
| **NPTF1** | 1.90 | 1.00 | 0.20 | 0.44 | 0.62 | 2.01 | 4.30 |

## DISCUSSION

The soil reaction is within the range of pH values suitable for plantain production (Adelaja and Olaniyan, 2000). The status of nutrients was low in terms of N, P and K; thus supplementation will be a routine management practice for high plantain yields. The low organic matter content will be the main problem in the management of this soil given the tremendous influence on physical properties related to water supply and retention.

One of the management options is to apply mulch which enhances the nutrient retention capacity of the soil through an increase in cation exchange capacity (Muller-Samann and Kotch, 1994). Mulching has been a widely recommended practice to farmers as a means of conserving moisture and reducing soil erosion in plantain plantations. For example, Rukazambuga *et al*. (2002) found a yield increase in mulched farms. Nevertheless, the banana weevil pest status may be greater in mulched than unmulched systems. Yield loss to banana weevil was 14 tonnes/ha in mulched systems compared to 8 tonnes/ha where mulching was not applied (Rukazambuga *et al*., 2002).The cover of mulch created a favourable microclimate for the activities of soil micro organisms which helped to improve and maintain the biological and physical qualities of the soil thereby improved the growth performance of plantain. Tithonia and fertilizer treatments resulted in better growth of plantain as shown by pseudostem height, girth and leaf area.Tithonia mulch and fertilizer had complementary effect on nutrient availability because when the mulch decomposes, it releases nutrients into the soil and increases organic matter which aids the growth of the plantain. Liasu and AbdulKabirKhan (2007) made similar observation on the interactive effect of tithonia leaf mulch and chemical fertilizer on the growth and yield of tomato. They reported that the combination of fertilizer and tithonia mulch not only promoted growth and yield of tomato better than fertilizer or mulch alone but also improved fruit shapes, fruit number and number of seeds per fruit. This is probably because the nature of the tithonia mulch does not predispose the tomato plant to attack by soil pathogens.

In this study, pared suckers did not significantly enhance plantain establishment when compared to non-pared suckers. An investigation carried out on the incidence of banana weevil and parasitic nematodes in the second ratoon of plantain grown from pared and unpared suckers revealed that growth in the plot established from unpared suckers was enhanced in the second ratoon crop despite the high incidence of weevils and parasitic nematodes (Oso et al., 2010). Afresh-Nuamah (1991) had earlier noted that weevil population starts building up from the second year irrespective of the source of planting material or site of planting. Hence, orchard longevity of pared and non pared suckers' fields should be adequately monitored before a logical conclusion could be drawn on which of them actually enhances plantain growth.

Sawdust was least in performance among the three mulch materials used in this study. This may be due to the fact that sawdust has a particularly tough cellular structure that can actually draw nutrients out of the soil as bacteria tries to break it down. If sawdust is to be

used as a mulching material then it is best that it is broken down into a more composted state before application. *Tithonia diversifolia* was the best mulching material followed by oil palm bunch refuse and saw dust, respectively. Non-pared suckers plus tithonia with fertilizer performed best among all the treatment combinations.

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