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Research Article

# EFFECTS OF MACRO PROPAGATION AND SOIL STERILIZATION ON THE CONTROL OF NEMATODES AND PERFORMANCE OF PROPAGULES FROM THREE PLANTAIN CULTIVARS.

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A R T I C L E I N F O

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A B S T R A C T

Scarcity of planting materials for propagation of plantain has been linked to farmers' dependence on natural regeneration of plants for the supply of planting materials. These planting materials are not often enough to meet the demands indicated for self-sufficiency in plantain production. Thus, rapid production of planting materials (macro-propagation) through the use of relatively large corm pieces is suggested to ameliorate this short supply of planting materials. This study evaluated the performance of three most common plantain propagules obtained through macro-propagation when subjected to some sanitation routines (paring and non-paring). The cultivars used include False Horn, French and True Horn plantains. Paring of the corm before planting is a cultural method within the reach of farmers which ensures that the planting of clean materials by peeling the corms to remove infested tissue. The experiment was arranged in a completely randomized design of six treatments replicated three times. plant emergence at 8th week after planting and growth parameters measured at 4 - week interval from 8 to 20 - weeks after planting revealed that performance in terms of plant height, stem girth and leaf area was best enhanced with non-pared False Horn propagules > French > True Horn cultivars. The false horn cultivar had early emergence and better growth performance probably because of its ability to tolerate poor soil. The three observed nematode species (Hoplolaimus pararobustus, Helicotylenchus multicinctus and Meloidogyne spp.) were predominantly higher in non-sterilized soil. The fact that growth parameters appear greater among non-pared propagules when compared with pared propagules might be an indication of stress as a result of wound from paring. Farmers however should not hesitate on paring because of its greater advantage of protection of planting materials against plantain pests and diseases. They are also encouraged to expose soil for multiplication of propagules to some levels of heat so as to reduce nematode population.



## INTRODUCTION

Plantain (*Musa paradisiaca* AAB Group) is an important crop in sub Saharan Africa where about 70 million people derive their livelihood from it (1). Plantain is known to be low in sodium (2). It contains very little fat and no cholesterol; therefore it is useful in managing patients with high blood pressure and heart disease. The capacity of the plantain to neutralize free hydrochloric acid suggests its use in peptic ulcer therapy (3). The plantain plant has also some medical properties. The leaves can be pounded and applied to the wound to suppress bleeding. Several varieties of plantain are cultivated in West Africa. These are classified as French Horn Plantain, False Horn Plantain, or the True Horn Plantain (4). The local names of the sub varieties of French Horn plantain include Apempa, Oniaba and Nyeretia apem. That of the False Horn are Borodewuo, Apantu pa, Borode sebo and Osoboaso while the True Horn sub varieties comprise Asamienu and Aowin. All these native varieties are classified as triploids with AAB as the genomic group. The main plantain production system in Africa consists of small backyard plots with a few plants (5) and whose expansion and orchards has often been hampered by the scarcity of planting materials (6; 7). Farmers depend on natural regeneration of plants for the supply of planting materials (suckers) but this is a slow process due to hormone-mediated apical dominance of the mother plant (8; 9) which would often produce small numbers (10; 11). Thus, farmers obtain a few suckers that are essentially used to replace lost or mature and harvested plants on the same plots. Rapid production of planting materials can be achieved through various vegetative multiplication methods, including micro propagation. While these aseptic production methods can provide large numbers of planting materials they are not adapted to the conditions of small-scale farmers nor are they routinely applicable to agricultural realities of the developing world, particularly in Africa. Therefore, user-friendly techniques that

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require little technical skills or equipment would prove more attractive to adoption by small-scale farmers. Macro-propagation techniques which involve the use of whole suckers or relatively large corm pieces for rapid multiplication of healthy planting materials require little technical skills. These techniques include repression of apical dominance to stimulate lateral bud development and increase suckering rate can be accomplished by mechanical means through complete or partial decapitation, or by detached corm techniques.Traditional planting of plantain does not emphasize pest and disease control measures. Newly planted fields are established for the most part, with untreated suckers from existing fields. Consequently, suckers used for the new orchards are invariably infested with nematodes and other soil borne pests and diseases. Transplanting the contaminated materials facilitates the persistence and spread of nematodes and weevil problems and shortens the lifetime of plantain orchards to only one or two cycles of production, beyond which most plants topple, become unproductive or simply die (12;13;14). Several sanitation techniques exist for the control of diseases and soil borne pests in the plantain planting materials. These range from paring, heat treatment to the use of pesticides (nematicides) with a wide range of costs, labour input and environmental risks. There has been paucity of information on the effect of paring and macro-propagation on the performance of plantain propagules. This paper presents data from an investigation on the performance of three cultivars of plantain propagules to paring.

## MATERIALS AND METHODS

### *Experimental Site:*

The study was conducted on the Teaching and Research Farm, University of Ado- Ekiti during the dry season (November to February) of 2011.

***Soil Sterilization and Experimental Design:***

Twenty kilograms of top soil- a sandy loam was weighed into each of 36 polyethylene bags of 55cm high and 40cm deep. 18 of the weighted soils were poured into an opened aluminium container for sterilization while the second 18 were not sterilized. The aluminium container was put on a raised platform an heat was supplied through fire woods. The soil was turned severally to ensure proper heat distribution. The process was carried out for one hour after which the soil was left to cool before re-bagging into the polythene bags. There were six plant material treatments on each side of Sterilized (S) and Non Sterilized (NS) soils, as follows:

HNP – Horn + non-pared
HP – Horn + pared
FHNP – False Horn + non-pared
FHP – False Horn + pared
FRNP – French + non-pared
FRP – French + pared

The trial was arranged in a Completely Randomized Design (CRD) and treatments were replicated three times. The propagules used for the study were harvested suckers of False horn, French and True horn plantain cultivars. The pseudo stems of the suckers were cut off and the corms uprooted. The corms were split into pieces weighing about 25g and containing at least 2-3 buds each. Two propagules of each cultivar were planted into eighteen bags. Watering and weeding exercise were frequently done.

***Data Collection:***

Data collected include pseudostem height and girth (measured in cm) and leaf area (cm2) at two week intervals starting the 8th week after planting. The leaf area was calculated as length x width x 0.83 (13).

***Nematode Count:***

Soil sample was taken from each designated polythene bags and pebbles were removed from each sample. A 100ml portion of each of the sample was measured into a serviette placed in a plastic sieve. The sieve was then placed in a plastic plate and water was carefully added to the plate until the soil appeared to be moist (modified Baermann tray). The set up was allowed to stand for twenty-four hours after which the resulting suspension was decanted. Plant parasitic nematodes were identified to species level.

***Data Analysis:***

Data were subjected to t-test and analysis of variance; means were separated using Duncan's Multiple Range Test at 5% level of probability.

## RESULTS

Figure 1 shows the percentage sucker emergence at 8 weeks after planting. There was 100% emergence in FHNP, FRNP followed by 67% emergence in FHP; 33% in HNP and FRP while HP had not emerged at 8WAP.

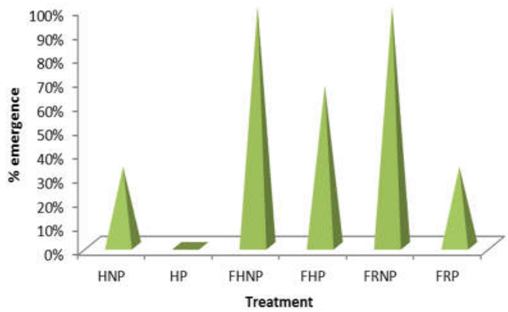


**Figure 1** Percentage emergence at 8th week after planting.

Figure 2 shows the nematode densities and species in the soil after the experiment. There was combination of three species of nematodes in the soil namely Meloidogyne spp., Hoplolaimus pararobustus and Helicotylenchus multicinctus. It was observed that the three species were predominantly higher in non-sterilized soil.

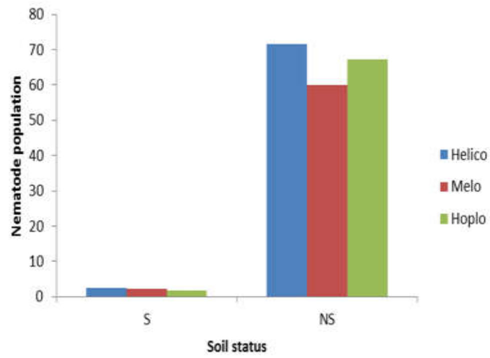


**Figure 2** Showing the nematode densities in the soil used after the study.

The responses of propagules to paring at 8, 12, 16 and 20 weeks are shown in Tables 1 a&b. Significant differences were observed in plantain growth parameters between pared and non- pared propagules. The non-pared propagules had taller plants, thicker girths, wider leaf areas and higher number of leaves when compared with the pared propagules at 1 and 5 % levels of probabilities.

**Table1a** Pseudostem height and girth in pared and non-pared treatments

| Treatment | Plant height (cm) | | | | Plant girth (cm) | | | |
|---|---|---|---|---|---|---|---|---|
| | 8 | 12 | 16 | 20 | 8 | 12 | 16 | 20 |
| Pared | 10.57 | 18.17 | 36.67 | 45.57 | 5.67 | 9.13 | 16.57 | 18.20 |
| Non - pared | 23.90 | 36.33 | 52.67 | 59.27 | 13.13 | 17.63 | 21.60 | 23.70 |
| t-test | ** | ** | * | * | ** | ** | * | ** |

*: P < 0.05 **: P < 0.01

**Table1b** Pseudostem height and girth in pared and non-pared treatments

| Treatment | Leaf area (cm2) | | | | Leaf number | | | |
|---|---|---|---|---|---|---|---|---|
| | 8 | 12 | 16 | 20 | 8 | 12 | 16 | 20 |
| Pared | 415.00 | 842.37 | 2827.84 | 4250.23 | 2.33 | 5.00 | 13.33 | 18.00 |
| Non - pared | 959.87 | 2996.12 | 4276.47 | 11058.24 | 7.67 | 11.33 | 17.33 | 23.00 |
| t-test | ** | ** | ** | ** | ** | ** | * | * |

*: P < 0.05 **: P < 0.01

The growth performance of plantain propagules at 8 and 12 weeks after planting (WAP) are shown in Tables 2 &3. False Horn plants were tallest with thickest girth, largest leaf area and highest leaf number. French plants were next in terms of growth performance while True horn plants had the least growth performance.

**Table 2** Pseudostem height and girth; leaf area and number in relation to propagule at 8 weeks

| Propagule | Pseudostem height (cm) | Pseudostem girth (cm) | Leaf area (cm2) | Leaf number |
|---|---|---|---|---|
| True Horn | 3.67c | 2.07c | 11.16c | 0.33c |
| False Horn | 22.47a | 10.90a | 1226.91a | 7.00a |
| French | 8.33b | 5.88b | 132.41b | 2.67b |

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

**Table 3** Pseudostem height and girth; leaf area and number in relation to propagule at 12 weeks

| Propagule | Pseudostem height (cm) | Pseudostem girth (cm) | Leaf area (cm2) | Leaf number |
|---|---|---|---|---|
| True Horn | 8.67c | 5.57c | 245.44c | 1.67c |
| False Horn | 34.33a | 13.17a | 2997.99a | 9.00a |
| French | 11.50b | 8.03b | 596.04b | 5.67b |

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

The growth performance of plantain propagules at 16 and 20 WAP are shown in Tables 4 &5. False Horn plants were tallest with thickest girth, largest leaf area and highest leaf number. However, they were not significantly thicker when compared with French plants. Also, True horn plants were not significantly taller than French plants.

**Table 4** Pseudostem height and girth; leaf area and number in relation to propagule at 16 weeks

| Propagule | Pseudostem height (cm) | Pseudostem girth (cm) | Leaf area (cm2) | Leaf number |
|---|---|---|---|---|
| True Horn | 22.67b | 9.73b | 1456.62c | 7.67b |
| False Horn | 43.33a | 14.90a | 11482.39a | 12.00a |
| French | 23.33b | 13.53a | 2718.24b | 11.67a |

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

**Table 5** Pseudostem height and girth; leaf area and number in relation to propagule at 20 weeks

| Propagule | Pseudostem height (cm) | Pseudostem girth (cm) | Leaf area (cm2) | Leaf number |
|---|---|---|---|---|
| True Horn | 27.00b | 11.60b | 2467.67c | 10.67c |
| False Horn | 49.17a | 16.03a | 8737.89a | 16.00a |
| French | 28.67b | 14.27a | 4102.91b | 14.33b |

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

## DISCUSSION

The study had shown variable cultivar response of *Musa* species to propagule emergence and growth through macro propagation. Propagule emergence was observed to vary among the pared and non-pared treatments. This suggests that emergence of propagules may not be totally dependent on paring or cultivar type. The effect of paring on growth parameters such as plant height, plant girth and leaf area showed that significant differences occurred between pared and non-pared suckers. The fact that these parameters seemed greater in non-pared suckers might be an indication of stress on pared suckers as a result of wound from paring. Nevertheless, paring of the suckers before planting them into the field would help to expose larval galleries and also reduce snapping and toppling resulting from banana weevil and nematode damage (16). An investigation carried out on the incidence of banana weevil and parasitic nematodes in the second ratoon of plantain grown from pared and non- pared suckers also revealed that growth in the plot established from non- pared suckers was enhanced in the second ratoon crop despite the high incidence of weevils and parasitic nematodes (17). Among the three propagules cultivars used for this study, false horn cultivar gave the tallest height, thickest girth, largest leaf area and highest leaf number. This was followed by French and true horn cultivars respectively. This may be due to the fact that false horn type of plantain is reported to be the most widely distributed and it has the ability to tolerate poor soil conditions (18). In conclusion, non- pared propagules and false horn cultivar performed best in terms of plant height, plant girth, leaf area and number. Finally, the study indicated that the three observed nematode species (Hoplolaimus pararobustus, Helicotylenchus multicinctus and Meloidogyne spp.) were significantly higher in non-sterilized soils than in sterilized ones.

## CONCLUSION

In conclusion, non- pared propagules and false horn cultivar performed best in terms of plant height, plant girth, leaf area and number; while soil sterilization significantly reduces nematode population in the soil and subsequent attack on plantain roots in the field; and this will go a long way in promoting the healthy growth, development and production of plantains

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