*International Journal of Agriculture and Environmental Research*

ISSN: 2455-6939

Volume:01, Issue:01

# EFFECTS OF BANANA BORER WEEVIL (*COSMOPOLITES SORDIDUS*) ON PLANTAIN ORCHARD REHABILITATED WITH PARED CORMS, POULTRY MANURE AND BIO-ACTIVE MULCH.

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**ABSTRACT**

Investigations have shown that there is a strong relationship between soil fertility and plant health, in the sense of the plant's ability to resist pests and diseases. Poor land management and declining soil fertility often result in negative feedback cycle, characterized in part by an increase in soil-borne pests and diseases. An investigation was carried out to evaluate the effects of weevil damage to a plantain orchard at the Teaching and Research Farm of Ekiti State University, Ado Ekiti. The plantain orchard had experienced yield decline which necessitated the development of a strategy for rehabilitation. The experiment was performed using the randomized complete block design involving eight treatments of pared control, non-pared control, pared mulch, non-pared mulch, pared manure, non-pared manure, pared mulch + manure and non-pared mulch + manure with three replicates each, on plantain farm established at 2.5 x 2.5 m spacing. Adult plantain/banana weevils (*Cosmopolites sordidus*) were introduced at the base of each selected flowered plant (5 males and 5 females). Weevil damage to the corms was estimated at harvest. Non-pared mulched suckers had the highest number of weevil and larvae infestation and percentage peripheral damage than pared unmulched suckers. Generally, all plants established from non-pared sucker treatment combinations had higher percentage peripheral damage and higher number of larval infestation than those established from pared sucker treatment combinations. Unpared systems enhances weevil and pest infestations hence, plantain farmers are encouraged to adopt pared or clean sucker treatment before planting.

**Keywords:** Mulch, manure, plantain, rehabilitation, banana weevil, damage

ISSN: 2455-6939

Volume:01, Issue:01

## INTRODUCTION

Plantain, *Musa paradisiaca* is a major source of food in many regions throughout the world. Total world production of this crop is estimated to be over 76 million metric *tonnes*, out of which an estimated 12 million metric tonnes are produced in Africa annually, and it is very critical in bridging the gap between the demand and supply of the basic carbohydrate staples (INIBAP, 2003).. Plantain production and sales is no doubt one of the major economic activities for income generation by both large and small scale holder farmers in Africa, particularly Nigeria; including those who produce the crop within their home compounds or garden.

In recent decades, plantain produce bunches with less than ten fingers on the field with low soil fertility. This yield decline has been attributed to soil nutrient depletion, outbreak of pests (particularly banana/plantain weevil and burrowing nematodes). and also by disease causing micro-organisms (especially *Mycosphaerella fijiensis*) which affects farmers income and may endanger food security.

Application of organic materials help to restore the soil fertility lost from the plantain farm and improve crop yield. It also affects the biological dynamics and biodiversity in the soil. These relate to the fact that soil organic matter depends on the quantity of organic materials naturally added to the soil from decayed plant/animal bodies, or through deliberate application of organic fertilizers. The organic fertilizer sources include: manures from livestock houses such as poultry, plant residues including mulch and green manure, etc (Agboola, 1982). Application of organic manure also improves the soil microbial properties (Belay et, al, 2001) as it also increases plant growth as well as its yield.

The banana borer, a black weevil, *Cosmopolite sordidus*, is a phytophagous insect specific to bananas. It is one of the most important pests in bananas and plantain. Attack by the weevil is of great concern to farmers. Adult females bore hole into banana / plantain corms to lay their eggs (About 50 to100 eggs per year). Larvae hatch after one week, feed and burrow tunnels in the corm of banana / plantain. These tunnels weaken the plant, damage the root system and seriously increase the risk of toppling. In case of heavy infestation, feeding and development of the banana / plantain is disturbed and may cause significant yield loss. Heavily affected plants may produce symptoms of withering which may lead to eventual death.

Effectiveness of synthetic insecticides for the control of plantain borer weevil has been severally reported, but the potential residual toxicity and adverse effects of the synthetic chemicals on the environment has negated its usefulness and necessitated the search for other methods of control and management that are eco-friendly and has little or no residual effects on the environment.

ISSN: 2455-6939

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Paring of corms superficially to remove lesion tissues, followed by treatment with extracts, powder and ashes of botanicals, such as Red Acalypha (*Acalypha wilkesiana*) has been found effective and can be used to produce clean planting materials (suckers) to establish new orchards, expand or rehabilitate existing orchards or replace lost plants (Fogain *et al.,* 2002)**.**

This study therefore investigated the effects of corm paring on weevil damage to plantains in an orchard rehabilitated with poultry manure and mulch. The study involves the cultural method of corm/sucker paring, as well as management of the old farm land with organic manure and mulch treatments, to control or reduce plants damage by the banana/plantain weevil (*Cosmopolites sordidus*), in an old plantain orchard.

## MATERIALS AND METHODS

### *Experimental Site*

The study was conducted on a rehabilitated farm of the Teaching and Research Farm of the Ekiti State University Ado Ekiti, Nigeria. The farm is located at on the bearing $7^0$ 31N and $5^0$ 13E approximately elevation of 436m above sea level. The experimental site had been cropped for about 11 years with leguminous crops, yam and cassava before establishing plantain orchard. The plantain orchard flourished for about three years before a rapid decline in vigor and yield. This therefore necessitated the rehabilitation of the orchard with various mulch materials and poultry manure.

### *Description of Experimental Set-up*

The trial was arranged in a completely randomized block design of eight treatments with three replicates each. The total area of the farm is 1999.5 $m^2$. The stands were established with a spacing of 2.5m x 2.5m. The mulch which was a mixture of sawdust and wood shavings; oil palm bunch refuse and mixture of weeds and some bio-active plant parts such as the leaves of Neem plant (*Azadirachta indica*), *Acalypha wilkesiana,, Panicum maximum*, *Tithonia diversifolia* and *Chromolaena odorata;* plus poultry manure were applied at the rate of 30$MTha^{-1}$. Paring, mulch and poultry manure were combined into eight treatments as follows; pared control, non-pared control, pared mulch, non-pared mulch, pared manure, non-pared manure, pared mulch+ manure and non-pared mulch+ manure.

### *Weevil Collection*

Weevils were obtained from an old plantain plantation through split pseudo-stem trapping method. Fresh pseudostems were split into two equal halves and placed with the cut surface to the ground. at About 5-7 disc-on-stumps traps were made by cutting small disk-like pieces of

ISSN: 2455-6939

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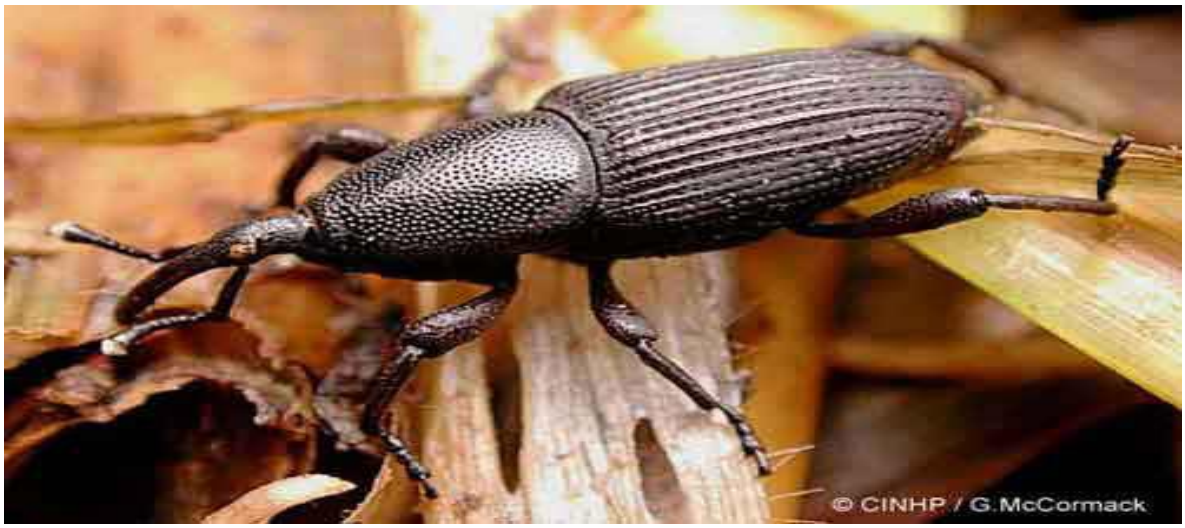
harvested stumps, leaving small allowance to permit entry of adult weevils. The split pseudostems and discs were then turned upwards to carefully remove and collect weevils and the traps replaced.

A total number of 240 weevils were collected within three weeks and their sexes were determined with the aid of a light microscope, based on the nature of their last abdominal sternite (males have a more inwardly curved sternite) and small punctuations on their rostrum as described by (Nankinga,1999). Ten adult weevils (5 males and 5 females) were placed at the base of selected flowered plants and left until maturity and harvest. After which corm damage assessment was done using the peripheral damage and cross-section method (Gold *et al.,* 1994).




Adult banana root borer, *Cosmopolites sordidus* (Germar). Photograph by G. McCormack, Cook Islands Biodiversity Database.

***Data Collection***

The peripheral damage (PD) was determined by estimating the percentage of the pared corm area consumed by the weevil larvae. The corms were then sectioned cross wise at 3 and 6cm as described in Gold et al., ( 1994) to suit the corm sizes below the other (upper and lower position). For each cross-section, weevil damage was assessed for the central cylinder and the cortex by estimating the percentage of the corm tissue damaged by weevil in each area. The mean of the four scores (upper cross section inner, upper cross-section outer, lower cross section inner, lower cross section outer) was calculated to generate a total cross-section damage estimate (XT). The corm was then dissected and the number of larvae and adult weevils were recorded. The yield parameters taken include; days to flowering (DF), days to fruit filling (DFF), number

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of days to harvesting (DH), number of hands (NH), number of fruits (NF) and bunch weight (BW).

***Data Analysis***

The data on PD and XT was done using sine transformation formula X* =100$^{x}$arc sine [(sqrt{X+ 0.5)]/100 8$^{x}$22/28. Where X is the PD or XT, X is the transformation data. Similarly, the data on number of weevils and larvae recovered were transformed into logarithmic scale formula N* = Log (N+1), where N is the number of weevils, larvae and N* s the transformed data. The transformed data was then subjected to analysis of variance and means were separated using Duncan Multiple Range Test (DMRT).

Borer tunnels in a plantain stem or corm

Larva, Pupa and Adult Weevils

**RESULTS**

Table 1 shows the number of weevil and larvae recovered during damage assessment of the corm as well as corm area consumed by the larvae on the rehabilitated plantain orchard. Significant damage was observed in the corms of plants established from non-pared suckers either as control or with mulch and manure treatments. Similarly, highest number of weevil and larvae were recovered from the non-pared treatments. Generally, all plants established from pared sucker treatment combinations had lower percentage peripheral damage and lower number of larval infestation than those established from non-pared sucker treatment combinations.

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**Table 1: Mean number of weevil and larvae recovered during damage assessment of the corm**

| Treatments | Weevil* | Larva* | %PD | PD* |
|---|---|---|---|---|
| PC | 0.41d | 0.15d | 11.67 | 122.43d |
| NPC | 0.63bc | 0.56b | 33.33 | 254.01bc |
| PMa | 0.36d | 0.20cd | 6.67 | 95.68e |
| NPMa | 0.66bc | 0.55b | 21.67 | 214.59cd |
| PMu | 0.35d | 0.26cd | 6.67 | 95.68e |
| NPMu | 0.85b | 0.72ab | 50.00 | 309.56b |
| PMa + Mu | 0.56c | 0.30c | 12.67 | 156.00d |
| NPMa+ Mu | 1.05a | 0.92a | 52.00 | 389.00a |

KEYS: PD ( Peripheral damage), * (Transformed data)

Plantain yield as influenced by the different treatments is indicated in Table 2. The highest bunch yield was recorded in non- pared sucker with a combination of mulch and poultry manure treatments. However, this bunch yield was not significantly higher than bunch yields recorded from pared sucker with either poultry manure treatment or in combination with poultry manure and mulch. The lowest bunch yield was recorded in non-pared sucker with mulch treatment.

Pared sucker with poultry manure applied either singly or in combination with mulch as well as non-pared suckers with poultry manure applied either singly or in combination with mulch produced the highest number of hands and fingers. The least number of hands and fingers were recorded in non-pared suckers with mulch treatments.

Plants established from pared sucker with single application of poultry manure or mulch and in combination with both treatments as well as those established from non-pared sucker with the combination of poultry manure and mulch flowered within a year. Plants established from non-pared sucker with poultry manure and pared control flowered a year after planting. The shortest

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day to flowering, harvesting and fruit filling were observed in plant established from non-pared sucker with mulch treatment only.

**Table 2: Plantain yield as influenced by the different treatments**

| Treatments | Bunch weight ($MtHa^{-1}$) | Number of hands | Number of fingers | Days to Flowering | Days to Harvest | Days to Fruit Filling |
|---|---|---|---|---|---|---|
| PC | 3.16c | 4.66b | 10.00b | 508.33a | 567.33a | 61.00a |
| NPC | 2.50cd | 4.33b | 8.66bc | 331.33d | 386.00b | 54.66a |
| PMa | 4.03ab | 5.66a | 12.66ab | 332.33d | 380.66b | 48.33b |
| NPMa | 4.96a | 5.00ab | 13.33ab | 499.66b | 562.00a | 63.33a |
| PMu | 3.40bc | 3.50bc | 10.60b | 332.67d | 380.00b | 49.00b |
| NPMu | 1.53d | 3.00c | 7.00bc | 225.67e | 270.00d | 43.00b |
| PMa + Mu | 5.00a | 5.20a | 15.00a | 356.50c | 302.50c | 54.60a |
| NPMa+ Mu | 5.20a | 5.00ab | 16.00a | 320.66d | 275.00d | 45.50b |

## DISCUSSION

Plantain suckers obtained through field propagation techniques (non-pared) are usually infested with pests such as the grub of banana weevil. To minimize the risk of transmitting infested contaminants, sanitation (through paring) of suckers is strongly recommended. Paring removes roots that are diseased and infested by pests and confers protection on the roots thereby reducing toppling over (uprooting) and improving root health status (Speijer and Gold, 1996; Sikora et al., 2005).

Plants established from pared sucker treatments (as control or in combination with mulch and manure) showed lower larval infestation and peripheral damage and were clearly distinguishable from plants established from the non-pared treatments. Oso et al., (2010) noted that paring of corm before planting have great effects in reducing weevil and pest damage. The trend in external (periphery) damage, number of weevil recovered and larval infestation rate between the

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non-pared control, non-pared manure, non-pared mulch and combination of non-pared mulch with poultry manure treatments was similar. The interaction of poultry manure and organic mulch with either pared or non-pared suckers significantly increased plantain yield. This is because mulch and poultry manure had complementary effects on nutrient availability to plants. Mulch, when it decomposes releases nutrients and organic matter into the soil for plant sustainability and improved yield.

Incorporation of poultry manure into the soil not only supplies plant nutrients, but also helps to increase below-ground biodiversity by providing an array of substrates capable of supporting diverse soil organisms. Ruhigwa et al, (1995) studied the sustainability of plantain c.v. Agbagba using five mulch types in two cropping systems (i.e. alley system and cut-and-carry mulch system). The yield obtained for the plant crop (i.e. first cycle crop) varied between 17.8 and 11.8 tonnes per hectare. Cumulative yield after 2 years was between 35.4 and 15.8 tonnes per hectare respectively, showing that yield had improved and had been sustained. Mulched plants were larger, had more suckers, survived longer and had healthier root systems compare with non-mulched plants. Rukazambuga (2002) also reported that larger and much vigorous banana and largest bunches were obtained in mulched plots compared with unmulched plots, despite higher banana weevil populations in mulched plots.

Mulch, apart from its primary role in soil fertility improvement after decomposition; its soil surface protection effect against direct heat of the sun and its ability to suppress weeds and prevent evaporation of soil water, the inclusion of bio-active plants among the mulch materials used for the experiment played a major role in reducing the population of the borer weevil. The active ingredients in the bio-active plants have insecticidal effects which reduced the population of the borer weevils

In the present study, pared treatments apparently conferred some protection on the suckers as it reduced pest infestation. Furthermore, incorporation of poultry manure and mulch may have reduced the rate of water loss to the atmosphere trough evaporation and also protected the soil and its organic contents from direct contact with warm air; thereby increasing soil microbial activity and decomposition of organic materials. This is probably the reason for the high yield from the mulched and poultry manure treatments.

## CONCLUSION

1. Paring of suckers in combination with bio-active mulch and poultry manure application reduced weevil larvae infestation on plantain and increased yield. This technique of sucker sanitation has the potential of high rewards from investment at low cost and therefore should be encouraged among plantain farmers.

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2. Bio-active plant parts such as the leaves of the neem plant (*Azadirachta indica*) and that of *Acalypha wilkesiana, etc,* have insecticidal properties and active ingredients that are capable of reducing the populations of the banana borer weevil (*Cosmopolites sordidus*). Inclusion or use of such plants as mulch in plantain / banana farms therefore, will help reduce the weevil damage in plantain / banana farms.

3. Destruction of all harvest residues or fallen plants by cutting them into small pieces prevents them from becoming harbor for the borer weevils.

## REFERENCES

Agboola, A.A and Omueti, J.A (1982). Soil fertility problems and its management in tropical Africa. Pp. 25.

Belay. A.A., Classens S, Wehner F.C. and De Beer J.M, (2001). Influence of Residual Manure on selected nutrient elements and microbial composition of soil under long-term crop nutrition *South Africa J. Plant and Soil* 18:1-6

Fogain, R., Messiaen, S. and Foure, E., (2002).Studies on the banana borer weevil in Cameroon. *Infomusa* 11: 8-9.

Gold, C.S., Speijer P.R., Karamura E.B. and Rukazambuga NDIM (1994). Assessment of banana weevils in east African highland banana systems and strategies for control. pp 170-190.

INIBAP (2003).Conservation through utilization of bananas and plantains in the Great Lakes region of East Africa- *Final Report.INIBAP*, Montpellier, France.

Nankinga, C.M., (1999) Characterization of entomo-pathogenic fungi and evaluation of delivery, systems for the biological control of banana weevil, *C. sordidus*, *PhD thesis*.

Oso AA,; Olaniyi M.O, Ayodele O.J, Amu A.A, (2010). Incidence of banana weevil and parasitic nematodes in second ratoon of grown plantain from pared and unpared suckers.. *Applied Tropical Agriculture. Vol. 15, Nos 1&2*, pp 1-5.

Sikora, R. A., Bridge, J. and Starr, J.L. (2005). Management Practices: an overview of integrated nematode management technologies. 793-825. In: Plant parasitic nematodes in tropical and subtropical agriculture. (Eds. M. Luc, R. A. Sikora, J. Bridge). *Commonwealth Agricultural Bureau International* 871p.

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Speijer, P.R and Gold, C.S. 1996. Musa root health assessment: a technique for the evaluation of Musa germplasm for nematode resistance. In: *Proceedings of the workshop on new frontiers in resistance breeding for nematode, Fusarium and Sigatoka* held at Kuala Lumpur, Malaysia 2-5 October 1995, Frison, E.A., J-P. Horry, and D. De Waele (Eds.). pp. 62-78. INIBAP Montpellier, France