

**Full Length Research Paper**

Indigenous Management of Enset Root Mealybug (*Cataenococcus Ensete*) Williams and Matile - Ferrero (Homoptera: Pseudococcidae) in Gedeo Zone, Ethiopia

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Abstract

This research was initiated with the objective of assessing indigenous knowledge of Enset root mealybug (*Cataenococcus Ensete* Williams and Matile-Ferrero) management and to document information which can be used in developing integrated management strategy against Enset root mealybug with the ultimate goal of helping in constructing the scientific basis for the conservation and sustainable use of the plant in Gedeo Zone, Ethiopia. Three districts representing major Agro-Ecological Zones namely Dilla Zuria, Gedeb and Wonago and two sub districts from each district were selected for the survey in 2012/13. A total of 180 farmers were interviewed. Three focus group discussions and field observations were undergone in 90 Enset farms. The result shows that 26% of sampled farms were infested with Enset root mealy bug and Enset root mealy bugs count per plant recorded in Dilla Zuria, Gedeb and Wonago District were 64, 51 and 76 respectively. Based on farmers' response and field observation; plants of 2-4 years of age were frequently found to be infested with the insect. Damage was very high during dry and hot period of the year and majority of farmers said that symptoms of Enset root mealybug attack cannot easily be known and before severe plant damage. Farmers usually prefer preventive measures. Clean seedling selection, hygiene, fallowing, use of farmyard manure, increasing soil moisture, uprooting the infested plants and burning the hole, removing alternate hosts, control of ant and variety selection were major indigenous pest management techniques employed by the farmers. Farmers have been using indigenous methods of pest management for centuries and societies tested this immense experience several times. Closer examination of indigenous pest management by scientists can give valuable information on how to develop control strategies which are suitable for small scale farmers and therefore, huge consideration must be given during the development of sustainable pest management strategies.

Key words: *Cataenococcus Ensete*, Enset, Gedeo Zone, Indigenous knowledge

Introduction

Enset (*Ensete ventricosum*) supports more than 20% of Ethiopia's population as staple and co-staple food (Tadesse, 2002; Brandt *et al.*, 1997). Throughout its growing period, the leaves and pseudostem have various uses (Shigeta, 1991). It is typically multi-purpose crop of which every part is thoroughly utilized for human food, animal feed, fiber, construction material and medicine (Azerefege *et al.*, 2009). Enset is primarily produced for the large quantity of carbohydrate rich food and secondarily for fiber. Its production is strongly related with the cultural, economic and social life of the people in Enset growing regions. Gedeo zone is characterized by its Enset based agro-forestry system and such system is also found in Sidama, Gurage, Hadiya and Kembata zones of the country (Tadesse, 2002).

The crop has existed for several hundred years as sustainable form of agriculture in country in general and in southern region in particular (Tadesse, 2002). However, the sustainability of Enset agriculture is pressured by a number of biotic and other factors that reduces its yield (Addis *et al.*, 2006). The main biotic stresses are bacterial wilt, Enset root mealybug, nematodes, fungi and other vertebrate pests like mole rats (Addis, 2005; Bogale *et al.*, 2004).

Enset root mealybug (*Cataenococcus Ensete* Williams and Matile-Ferrero, 1999) is one of the major pest that the farmer concerns growing the crop. It was first reported in Wonago, Ethiopia in 1988 (Tsedeke, 1988). The insect is known to attack Enset in Gedeo, Sidama, Gurage, Kembata Tembaro, Hadiya, Keffa and Bench zones and Amaro and Yem districts (Addis *et al.*, 2008). Enset root mealybug is known by different local names in different areas. It is known as 'Tsete' in Gedeo, 'Chea', 'Churcha' and 'Hufaro', in Sidama, 'Buno', 'Osk', 'Oote' and 'Dachu' in Bench zone. Enset root mealybugs are found on roots and corms. However, during periods of extreme drought the mealybugs tend to move towards the corm when some of the roots dry out and die (Addis, 2005). Enset plants infested with mealybugs have a retarded growth and dried lateral leaves. It causes stunted growth and the damage appears

more severe during the dry season (Azerefege *et al.*, 2009). The dispersal mechanism of the pest is facilitated by movement of infested suckers, infected corms, farm implements during cultivation, repeated transplanting operations and association with ants (Addis, 2005; Azerefege *et al.*, 2009; Quimio and Tessera, 1996).

To manage the pest use of farmyard manure, application of common insecticides such as Malathion, Dimethoate, Endosulfan, Fenitrothion, Chlorpyrifos and Diazinon, use of insecticidal plant extracts, and repeated ploughing and sanitation of Enset fields has also been reported as a control option for reducing Enset root mealybug population (Tadesse, 2006). Although attempts have been made to control the Enset root mealybugs by different institutions/organizations; cost effective, indigenous management and user-friendly control measures have not yet been developed. Therefore, this study was initiated with the following objectives: to assess indigenous knowledge of farmer for management of Enset root mealybug across locations and to document information which can be used in developing integrated management strategy against Enset root mealybug with the ultimate goal of helping in constructing the scientific basis for the conservation and sustainable use of the crop.

Materials and Methods

Site description

Field surveys were conducted in Gedeo administrative zone (Dilla Zuria, Gedeb, and Wonago districts) of South Nation and Nationality People Regional State (SNNPRS) of Ethiopia in 2012 and 2013 cropping seasons. Thus, the area was characterized as warm humid temperate with mean annual temperature ranges between 17 °C and 22.4° C and mean annual rainfall between 1200 and 1800 mm. It has an altitude in the area ranges from 1200 masl in the vicinity of Lake Abaya to 2993masl (Ethiopian Mapping Authority, 1988).

Field survey

Three districts namely Dilla Zuria, Gedeb and Wonago Were selected. In the selected districts, preliminary survey was conducted to identify basic information Such as number of peasant associations (PAs), household in PAs, pest outbreak time (history) and climate data. Socioeconomic characteristics of the farm households such as age, level of literacy, land holdings, family size and resource ownership were also included.

In order to document and assess the indigenous knowledge management associated with Enset root mealybug in the study area interviews, three focus group discussions and field observations of 90 farms were undertaken. A total of 180 farmer households (HH) from the three districts were participated in interviews using a structured questionnaire. Among all informants; 81 % were male, all are head of family and 88% can read and write. They all grow Enset and more than 30 years of age. The interview questionnaire was pre-tested and modified accordingly. Pilot test of the data collection tool was made for three days. Cropping pattern, sources of suckers, frequently grown varieties, variety selection criteria, uses, maintenance and indigenous Enset root mealybug control techniques were assessed. Field observation was employed to document indigenous management methods used by farmers. Data analysis was made using SPSS Software.

Results and Discussion

Average count of adult Enset root mealybug was recorded in Dilla Zuria, Gedeb and Wonago districts which were 64, 51 and 76 mealybugs per plant respectively. Addis *et al.*, (2008) reported that in Yirgachefe district 87 adult Enset root mealybugs were counted from roots and corms per plant and low number of mealy bug per plant (26) was recorded in Gedeb district. In this study, Farmers emphasized that younger Enset plants are more susceptible to mealybug attack which is also true according to Azerefege *et al.* (2009). The observations showed that mealybug severity was found to be higher in the study area where there is mixed cropping of Enset with coffee, fruit trees and other multipurpose trees together. This might be due to low level of soil disturbance as compared to mono crop system of Enset cultivation and farmers also justify that coffee or some tree species like Dok'ma (*Syzygium guineense*) are alternate hosts for Enset root mealybug. Enset farm management found to be poor in the study area. Plants were closely cultivated, poor sanitation of the farm and alternate hosts were found growing within and around Enset farm. The insect attacks the crop at any age, with infestations being most serious on 2 to 4 years old plants. 60% of farmers found Enset plants with 2-4 years of age are more attacked by Enset root mealybugs and plant age less than 2 years follows (Figure 1). Moreover, susceptible age of a plant to Enset root mealy bug infestation was also found up to 4 years of age.

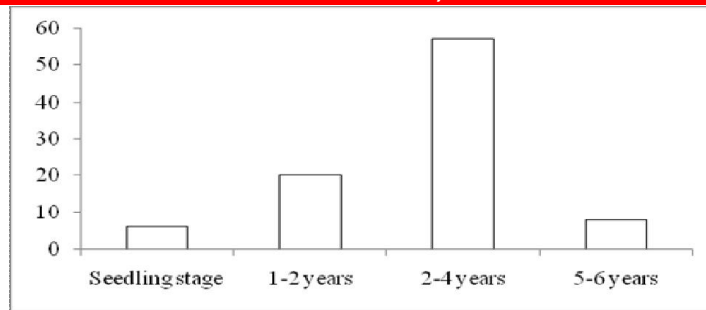


Figure 1. Frequent Enset root mealybug infestation observed across different age categories of Enset plant by Dilla Zuria, Gedeb, and Wonago farmers

In all sampled areas, farmers considered Enset root mealybug, bacterial wilt and mole rats to be the most important pests of Enset. Field observation and majority farmers’ response showed that damage by Enset root mealybugs was severe during the dry and hot seasons (Figure 2). Brandt *et al.* (1997) also indicated that the damage of Enset root mealybugs appeared more severe during the dry season. In addition, Ngeve (2003) also mentioned that cassava root mealybugs’ impact was higher in the dry season crop.

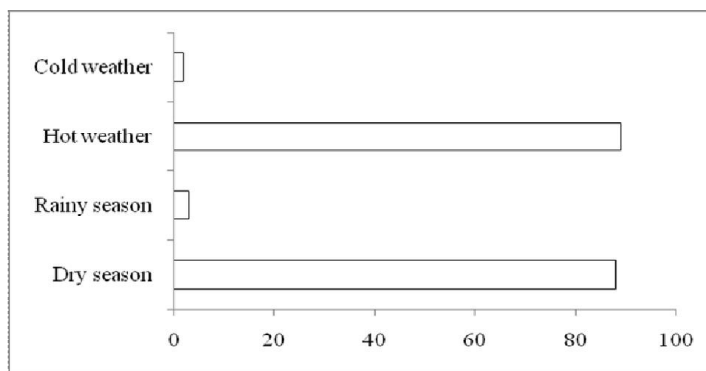


Figure 2. Farmers’ experience of Enset root mealybug infestation under different weather conditions in Dilla Zuria, Gedeb and Wonago districts

Indigenous management of Enset root mealybug

Clean Seedling selection

Farmers select seedlings which are healthy and roots free from any sign of mealybug infestation. They tend to prefer seedlings coming from highland areas where the prevalence of Enset root mealybug is low. Sometimes farmers trace history of seedlings to see from which farm that these seedlings came and be sure the seedling material is clean.

Hygiene

Preparatory hygiene measures might also include exploiting the fact that adult female mealybugs are unable to survive for more than three weeks in the soil without any plant material/food supply. Therefore, crop rotation (during one or two cropping seasons) and/or removal of grasses and weeds in Enset fields also help to control this pest. Infested Enset plants need to be properly disposed of so that all the plant debris decays and no re-growth occur. Tadesse *et al.*, (2003) reported that repeated ploughing and sanitation of Enset farms reported as a control option for reducing Enset root mealybug population numbers in Sheka zone.

Fallowing

Farmers responded that after harvest of Enset they keep the farm from six month up to one year of fallow period. Farmers till the land during sunny season and expose the soil to direct sun light. During this period the land will be treated with fresh manure which is composed of animal faces and urine. Farmers believe that fallow period would improve the fertility of the soil and also will reduce population of root mealybug.

Use of farmyard manure and ash

Use farmyard manure and ash was also considered as one of management options of Enset root mealybug. Farmers responded that fertile soil can improve performance of a plant and make the plant more resistant to Enset root mealybug attack. In addition to this when there is infestation farmers usually apply fresh manure (preferably goat or sheep manure) mixed with water equal proportion

with the manure around the plant. Gedeo farmers use farmyard manure for centuries, most importantly improve soil fertility. Farm yard manure contributes to better plant performance through improved crop nutrition (mostly nitrogen (N), but also possibly potassium (K), and even sulphur (S)). More robust plants are better able to ward off pests and diseases and the manure could directly inhibit mealybug development (Azerefege *et al.*, 2009). Farm yard manure can also improve the soil and root health conditions.

Increasing soil moisture

Farmers would also perform different to preserve moisture and clay nature of the soil also plays a role. They justify that high infestation of mealybug is associated with shortage of moisture in the soil. In some places farmers mix fresh goat or sheep manure with equal proportion of water and add it to Enset plants which they believe that the soil is dry. Where there is water or source of irrigation during dry seasons, farmers irrigate the Enset farm.

Uprooting the infested plants and burning the hole

If the infested plants are few, they uproot the plants and burn the exposed plant hole. The uprooted plant sometimes might be >2 years of age in which case they do use the corm for household consumption. But if the plant is at seedling stage then it will be used for animal feed. When slow growth and desiccated leaves of a plant observed, farmers suspect there could be mealybug infestation (Figure 3). Mealybug attacked plants are more easily uprooted and therefore with minimum force they try to pull up the plant. Because all roots are vulnerable and weakened, the plant was easily being uprooted. Symptoms usually identified after severe attack by the insect and only 25% of the respondents said they identify the problem early. Most of the farmers responded that they are unable to see signs of Enset root mealybug infestation as early as possible for possible intervention and sometimes they may not know the cause for the low performance until the plant dies (Figure 4).

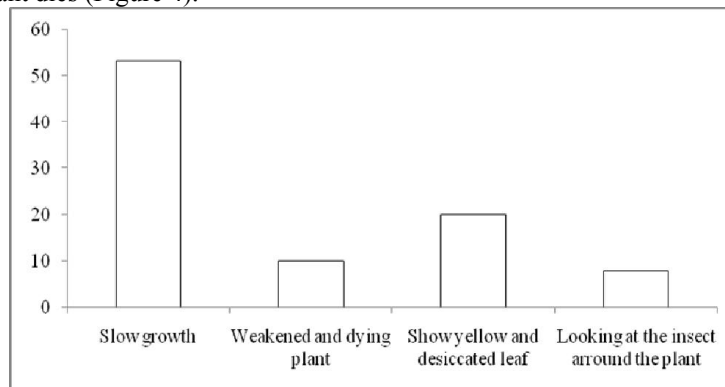


Figure 3. Plant Symptoms which were used by the farmers to identify root mealybug attack in Dilla Zuria, Gedeb and Wonago districts

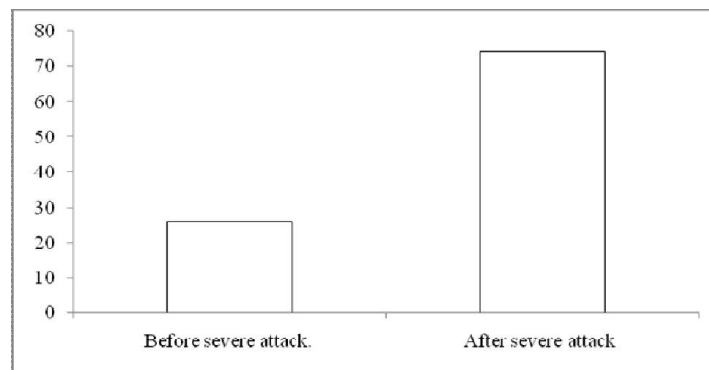


Figure 4. Farmers experience of when plant shows symptom due to mealybug attack in Dilla Zuria, Gedeb and Wonago districts

Remove alternate hosts

There are a few alternate hosts of mealybug and most of them are trees. Some farmers unknowingly keep these trees of fire wood and different purposes. Respondents stressed that it is very important to remove such plants before growing Enset seedlings. *Syzygium guineense* (Dok'ma: Common name) was identified as primer alternate host for Enset root mealybug. Grasses in general were also identified as alternate hosts for short term.

Control of ants

Farmers associated presence of ant population with high infestation of Enset root mealybug and they use this knowledge for mealybug inspection purpose. During field observation, Ants were found in large number around Enset plants infested with Enset root mealybug. Therefore, farmers consider control of ant would reduce mealybug population. **Jahn et al.**, (2003) reported that control of ant can also reduce level of mealybug infestation.

Site selection for Enset production

Majority of farmers (88%) do not practice rotation as management option against Enset root mealybug or Enset bacterial wilt. This is mainly due to the fact that they usually grow Enset near to their home so that house hold dirt and fresh manure can be applied daily. On the other hand, farmers with small farm size do not have enough space for crop rotation and perennial nature of the plant makes crop rotation not feasible. However, few farmers (12%) who do have large farm land or farms in more than one area responded that they use crop rotation method as alternate means of mealybug prevention strategy (Figure 5).

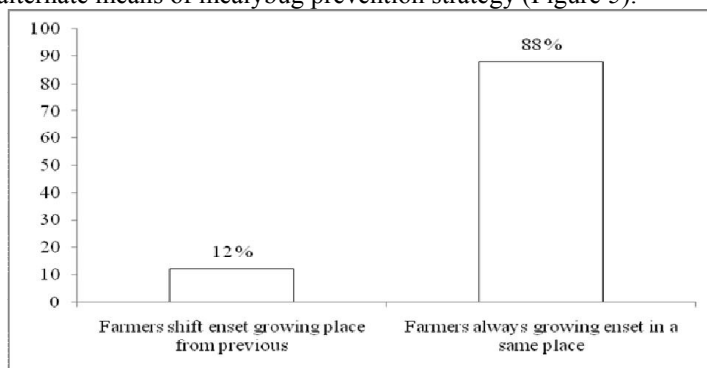


Figure 5. Site selection as a strategy for Enset root mealybug management in Dilla Zuria, Gedeb and Wonago district farmers

Variety selection

The number of Enset varieties grown in farmers' field depended on the farm size, economic status, and culture of Enset production. Time of maturation, production potential, purpose of a plant (medicinal or target harvesting time) and pest tolerance were criteria set by farmers in the study area for Enset variety selection. **Brandt et al.** (1997) also mentioned that wealthier farmers had large number of Enset clones in their farm. In this study, a maximum of seven different Enset varieties were found to frequently grown by farmers. Enset varieties grown recorded based on their vernacular names. The same variety may have different names in different areas and languages and also different varieties by the same name (**Endale**, 1997). **Admassu** (2002) also showed that duplication of names was related to different utilization purposes of clones and the changing of vernacular names after exchange of clones between communities. However, the clone *genticha* is known to the study area and was one of the dominant clones of Enset. It was also identified by farmers that it is tolerant to Enset root mealybug infestation as compared to other Enset clones (Table 1). The other Enset clones which were also dominant and recognized by many farmers in southern Ethiopia are *torecho*, *dembele*, *ado*, *keresie*, *nifo* and *astara* accordingly (Table 1). Despite its late maturity, *genticha* was found to be dominant over other Enset varieties mainly due to its high productivity and tolerance to pests.

Table 1. Rating of frequently cultivated Enset varieties by farmers with respect to plant productivity, quick maturation, tolerance of root mealybug in Gedeb, Wonago and Dilla Zuria districts

S.No	Enset cultivars (frequently used by the farmers)	Productivity of Enset varieties (Rank)	Quick maturation (Rank)	Tolerance for mealy bug infestation	frequently cultivated by the farmers
1	Genticha	1	3	Mild	1
2	Torecho	2	2	-	2
3	Dembele	3	2	-	3
4	Ado	4	3	-	4
5	Qerese	7	2	-	5
6	Nifo	6	1	-	6
7	Astara	5	1	-	7

Conclusion and Recommendation

Many efforts were made in the research area to manage the insect through training and demonstration on improved agronomical practice and other recommended pest management packages from seedling rising till post-harvest handling. However, farmers' adoption study indicated application of recommended improved cultural practice on Enset production in the region is very low. Farmers in the region are still using poor cultural practices to produce Enset production. Therefore, efforts should be made towards the integration of multiple control options. These are development of resistance varieties, implementation of improved agronomic practices, awareness creation of farmers and experts from site selection up to post harvest handling on the importance of the insect and its management. In general, holistic cumulative integrated approach is required in all urgency to manage the insect/pest in the zone for sustainable production of the crop.

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