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Destitution, Biology, Yield Loss and Management of Sweet Potato Weevils (cylas formicaries (fabrcius) Insecta: Coleoptera) in Ethiopia

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Abstract
Sweet potato weevil is the most destructive of all sweet potato pests. It affects both sweet potato stems and roots in the field and in the storage. Sweet potato weevil (*Cylas*sp.) is the cosmopolitan insect and most serious insect pests of sweet potato in Central America, Africa and Asia; production losses often reach 60-100%. Three species have been identified in Africa: Cylasformicaries(F.), Cylaspuncticollis Boheman and Cylasbrunneus (Olivier). The weevil spends its entire life cycle on the host plant, and both larval and adult stages damage the tubers and vines. A number of management techniques of sweet potato weevils have been developed and used though out the world. Effective control of this pests requires implementing an integrated pest management approach. The most important measures are cultural control, use of resistant varieties, chemical control, mechanical, biological and integrated pest management. Integration of sweet potato weevils management has often been thought as one of the better pest management options in tropical sub tropical regions
Keywords: Sweet potato weevils; Integrated Pest Management (IPM); Life cycle; *Cylas* sp.

1. INTRODUCTION

The sweet potato, *Ipomoea batatas*(Lam.) is a dicotyledonous plant that belongs to the family Convolvulaceae, and a tuberous root crop important for food security. It is cultivated in over 100 developing countries and ranks among the five most important food crops in over 50 of those countries (FAOSTAT, 2012). It is one of the most widely grown root crops in SSA, it is particularly important in countries surrounding the Great Lakes in Eastern and Central Africa, in Angola, Madagascar, Malawi and Mozambique in Southern Africa, and in Nigeria in West Africa. China being the largest producer worldwide. In Africa, it is grown predominantly in small plots by poorer farmers, and hence known as the "poor man's food." Sweet potato is among well-known and established crops in Southern, Eastern and South western parts of Ethiopia. It is produced annually on over 53 thousand hectares of land with total production over 4,240 tons and average productivity of 8.0 tons per hectare (CSA, 2011).

Ethiopia is one of the largest sweet potatoes producing country in east Africa and the Southern Nations Nationalities and Peoples' Region (SNNPR) is the major sweet potato producing region in the country. According to the CSA agricultural sample survey data (2011), it is the 2nd to potato in area of production and productivity. The production and productivity of the crop is affected by a number of constraints.

Among the major biotic constraints for sweet potato production insect pests are recoded as the major one (Adhanom *et al.,* 1985; Ferdu *et al.,* 2009). A complex of insect pests recorded in sweet potato producing areas of the country. The stem and root feeders like sweet potato weevils, *Cylaspuncticollis,*(Coleoptera: Curculionidae); sweet potato butterfly, *Acraeaacerata* (Lepidoptera: Nymphalidae), sweet potato hornworm, *Agrius convolvuli* (Lepidoptera: Sphingidae), tortoise beetles, *Aspidomorpha spp*., *Laccoptera spp*. (Coleoptera: Chrysomelidae); and virus transmitters *Aphis gossypii*(Homoptera: Aphididae) and *Bemisiatabaci*(Homoptera: Aleyrodidae) are the major ones.

For the last 20-30 years a number of researchers were involved in Sweet potato Entomology in Ethiopia. They have made different applied and basic studies and a number of recommendations were made. Crop improvement research on this crop in Ethiopia started in early 1970's and resulted in release of about 23 varieties with their appropriate production packages. Therefore, this paper is focusing on entomological researches and reviewing those findings and availing the information for users in suitable form.

Since the inception of agricultural research in the country, a number of survey works were made by different researchers and investigated the dynamics of insect pests associated with sweet potato in the Ethiopia. The 1st and 2nd comprehensive review of entomological researches on root and tuber crops in general were made by (Tsedeke, *et al.,* 1986 and Ferdu, *et. al.,*2009) respectively. The pests recorded on sweet potato in Ethiopia are presented in. Among these, only sweet potato weevil (*Cylaspuncticollis*) and the sweet potato butterfly (*Acraeaacerata*) are the major ones (Emana and Adhanom, 1989; Azerefegne, 1999) and they have also received better research attention.

Sweet potato weevil (*Cylas*sp.) is the cosmopolitan insect and most serious insect pests of sweet potato in Central America, Africa and Asia; production losses often reach 60-100% (Chalfant *et al*., 1990; Jansson and Raman 1991;Smit, 1997). Even small weevil populations can reduce sweetpotato root quality. In response to weevil feeding, sweet potato storage roots produce bitter tasting and toxic sesqui-terpenes that render them unfit for human consumption.

Ashebir (2006) was made a comprehensive survey and reported that, the sweet potato weevil was to be found in all woredas surveyed in southern Ethiopia. Although there were difference in extent of stem and tuber damage and weevil population density per plant parts (Ashebir, 2006). High level of stem and tuber damage and high number of larvae per tuber was recorded in DembaGoffa and ArbaminchZuriaworeds (Ashebir, 2006); at Nazret and Melka were (Emana 1987), Awassa, at Areka and Humbo (Emana and Amanuel, 1992; Adhanom and Tesfaye, 1994).Theobjective of this papper is to determine the incidence and severity of sweet potato weevils and subsequent damage to sweet potato crop under natural infestation pressure, and toknow the effect of cultural control, mechanical control, biological control, chemicalcontroland other yield components of sweet potato.

2. Distribution and Ecology of Sweet Potato Weevils

The sweet potato weevil is one of the major pests of sweet potato worldwide. Three species have been identified in Africa: Cylasformicaries(F.), CylaspuncticollisBoheman and Cylasbrunneus(Olivier). Their distribution in Africa has been surveyed, and it appears that all the three species have a similar life history, making all of them difficult targets for conventional pest control measures (Allard &Rangi, 1990). Cylaspuncticollis only occur in Africa, being recorded from Burundi, Cameroon, Chad, Congo, Ethiopia, Guinea, Kenya, Malawi, Mozambique, Nigeria, Rwanda, Senegal, Sierra Leone, Somalia, Sudan, Tanzania,and Uganda (Hill & Waller, 1988). Cylasformicarius is pan tropical, from west Africa, through to east Africa, southern Africa, Madakaskar, Mauritius, Seychelles, India, Bangladesh, Sri Lanka, South east Asia, China, Philippines, Indonesia, USA, West Indies, Mexico, northern South America and several other locations around the world(Hill & Waller, 1990).

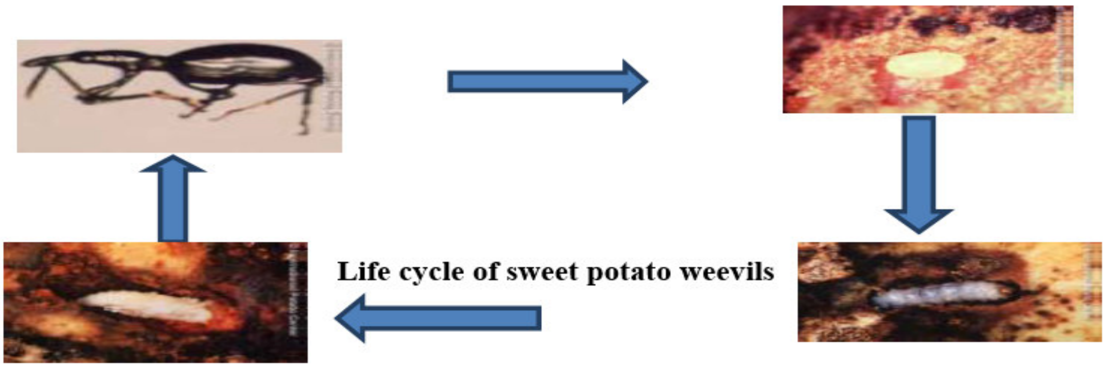
The adult females lay their eggs in small pockets, at the base of the stem and in the tuber. The larva cause considerable damage to the tuber by feeding on it and burrowing extensively through it. The ability of the adult to fly is very limited, so that flying is only a minor mode of distribution of the weevil crawling is probably more important.

Infestation by the weevil varies with season. In the tropics they are more numerous on sweet potato growing during the dry season. In sub-tropical and warm temperate regions, they could temperature late in the season markedly limits the egg laying ability of the adult female. At temperature between 21 and 15.5 eggs laying is low, below 15.5 egg laying stops completely. Temperatures at or below freezing can kill the adult in seven days, the larva in 15 days, and the pupae in 21 days (Onwueme, 1978).

3. Biology of Sweet Potato Weevils

The sweet potato weevil is the most destructive insect throughout tropical and subtropical sweet potato production areas. Sweet potato weevils can attack sweet potatoes in the field and in storage. Larval tunneling causes trepan production in the storage roots, which imparts a bitter taste and leaves the sweet potatoes unsuitable for human consumption. The adult sweet potato weevil is a snout beetle that resembles an ant. The weevil has a narrow head and thorax. The head and abdomen are dark metallic blue, and the thorax and legs are reddish orange. The antennae are reddish brown and are clubbed on the end. The adult is about 0.25 inch long. The weevil eggs are white or pale yellow and broadly oval. The larvae are dirty white with a C-shaped body and a pale brown head. The weevil spends its entire life cycle on the host plant, and both larval and adult stages damage the tubers and vines(Sorensen, 2009).

The biology of sweet potato weevil was studied in Awassa and Nazreth Research Centers. The weevil required 30 and 31.5 days to complete its life cycle in Awassa and Nazreth, respectively. It was also reported that the weevil could complete nine generations at Awassa and eight at Nazreth(Emana and Amanuel, 1992).



Source: T. Ames, N.E.J.M. Smit, A.R. Braun, J.N. O'Sullivan, and L.G. Skoglund. 1996.

All sweet potato weevil species have a similar life history. The adult female lays eggs singly in cavities excavated in vines or in storage roots, preferring the latter. The egg cavity is sealed with a protective, gray fecal plug. The developing larvae tunnel in the vine or storage root. Pupation takes place within the larval tunnels. A few days after eclosion, the adult emerges from the vine or storage root. Because the female weevil cannot dig, she finds storage roots in which to lay her eggs by entering through soil cracks. Alternate hosts of sweetpotato weevils are *Ipomoea* spp. Weeds(Ames,1997). Adults of all species may be conveniently sexed by the shape of the distal antennal segment, which is fillform (thread-like, cylindrical) in males and club-like in females.

The males have larger eye facets than the females. At optimal temperatures of 27–30°C, *C. formicaries* complete development (from egg to egg) in about33 days. Adult longevity is 2 1/2 to 3 1/2 months andfemales lay between 100 and 250 eggs in this period.At suboptimal temperatures, development takes longer.At 27°C, *C. puncticollis*has a total development time of about 32 days, whereas *C. brunneus*takes 44 days. Adults of the first species live an average of 100 days, whereas the latter dies after about 2 months. *C. puncticollis* females lay 90–140 eggs in their lifetime, whereas *C.brunneus*females lay 80–115(Ames and Braun, 1996)

4. Management of Sweet Potato Weevils (Control Measure)

Studies have been done to find suitable management options for this pest, which is by far the most important insect pest of sweetpotato in sub-Saharan Africa (Smit, 1997; Kabi*et al*. 2001). Studies have been done on the relationship between rooting characteristics and tuber infestation in Kenya, Uganda and Ethiopia. Other studies examined the possibility of using pheromones to trap weevils to levels that do not cause economic yield losses. These studies have not resulted in a concrete measure to control the pest. Studies have also been done on the use of entomopathogenic nematodes to control this pest. The challenge in using entomopathogens is to find a suitable delivery system. Unfortunately, no varieties have so far shown reasonable levels of resistance to this pest; research to produce transgenic varieties resistant to the pest seems to be a reasonable option for consideration.

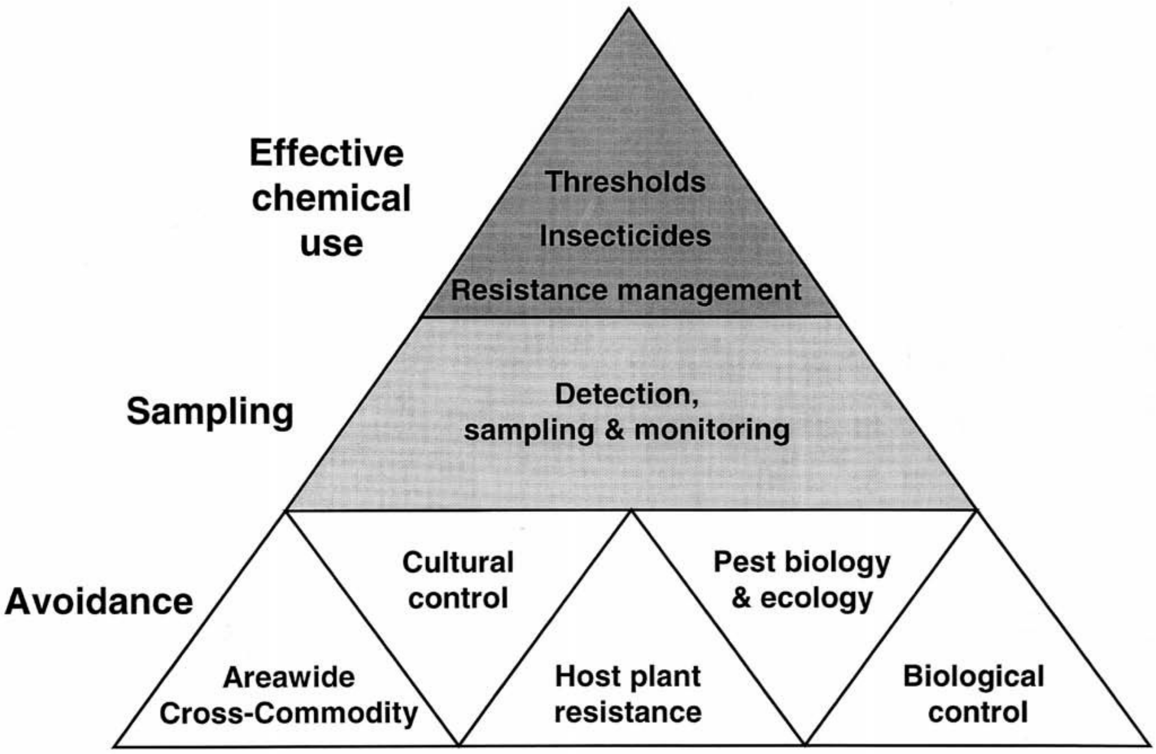


Figure2. Conceptual diagram of integrated weevil's management in sweet potato. The pyramid structure is inherently stable and contains three keys to weevil's management: avoidance, sampling, and effective chemical use (From Ellsworth 1999, Naranjo 2001).

4.1 Cultural Control

Cultural practices have proved to be effective against the sweetpotato weevil and should be the main basis of control (Amen, 1997). Cultural practices include:

- ❖ Uninfected planting material, especially vine tips.
- ❖ Crop rotation.

- Removal of volunteer plants and crop debris (sanitation).
- Flooding the field for 24 hours after completing a harvest.
- Timely planting and prompt harvesting to avoid a dry period.
- Removal of alternate, wild hosts.
- Planting away from weevil-infested fields.
- Hilling-up of soil around the base of plants and filling in of soil cracks.
- Applying sufficient irrigation to prevent or reduce soil cracking.
- Use proper plant spacing
- Companion cropping
- Salt water management

Sowing dates: Effect of sowing dates on sweet potato weevil's infestation was evaluated at Awassa and Areka research centers in the 1994 cropping season (Adahanom and Tesfaye, 1994). Among the six planting dates extending from June to September, higher tuber infestation was obtained from the late plantings. The highest tuber attack (over 64%) and the lowest yield was obtained from September planted sweet potato followed by the early and late August plantings at Areka. The second planting date July 10 gave the highest yield with low weevil infestation. Similarly, higher levels of tuber infestation were recorded from September planting followed by the early and last week of August at Awassa. In general, late planted sweet potato attracted high level of sweet potato weevil damage at both locations. A similar study conducted in Wolayita indicated that sweet potato planted in August sustained lesser damage than September planted ones (Tesfaye, 2002).

Resource poor farmers in Ethiopia stagger to manage the pest with some cultural practices that includes earthling up around the tubers (Emana, 1990).Earthing up of soil around the plant three times at monthly intervals starting from the second month after planting significantly reduced infestation of tuberous roots and this practice could enable to delay harvesting for more than six months (Emana, 1990).

Table1. Effect of sowing date on sweet potato tuber infestation due to sweet potato weevil at Areka and Awassa

Areka			Awassa		
Planting date	Yield ton/ha	Infestation (%)	Planting date	Yield ton/ha	Infestation (%)
June 25	6.7	0.57	June 19	17.3	18.96
July 10	14.8	0.54	July 1	17.1	45.51
July 24	4.3	8.40	July 16	16.7	62.87
August 8	12.2	28.46	August 2	20.1	81.12
August 22	10.2	23.32	August 16	9.9	70.76
September 6	4.8	64.02	September 3	8.1	87.03
CV%	22.6	21.10	CV%	11.7	23.3
LSD0.05	3.93	8.29	LSD0.05	3.41	25.85
LSD0.01	1.59	11.79	LSD0.01	4.85	36.76

Crop rotation: all sweet potato residues must be eradicated when the rotation crops are being grown.
Prompt harvesting: it appears that the weevils are most serious if harvesting of the tubers is delayed. Harvesting early may help to avoid infestation.
Earthening up: to prevent tuber exposure on the field and planting of disease free materials.

4.2 Varietal Resistance for Sweet Potato Weevil

Varieties with immunity or a high level of resistance are not available. Some varieties have low to moderate levels of resistance. Others escape weevil damage because their storage roots are produced deep in the soil or because they maturequickly and can be harvested early.

Several researches have verified the presence of variability in sweet potato genotypes for resistance to sweet potato weevil. However, some of the materials reported to be resistant succumb under high weevil population pressure. Emana (1990) evaluated sweet potato varieties for resistance to the weevil from 1987- 1989 and found that 38 % of the varieties to be resistant and remaining were moderately resistant at Areka. At Awassa however, 55 % of the varieties were reported to be moderately resistant and the rest were susceptible.

The reason for the variation in the level of resistance at the two locations was attributed to the difference in population density of the pest. Fields at Areka had been cultivated for only three years with sweet potato when the trial was conducted and the pest has not yet established itself. However, the varieties differed in the degree of damages and infestation levels they sustained. Varieties like Koka-26 and Cemsa had the lowest level of infestation and adult weevil density in the field. On the other hand, varietiesTIB-1102 and TIB-1-1102 had higher levels of tuber infestations. It is known that varieties with deeper roots suffer less from the attack of sweet potato weevils. The study also showed that Koka-26 and Cemsa had deeper roots than the other varieties considered (Temesgen and Tesfaye, 1995b).

4.3 Mechanical Control

Mechanical controls have proved to be effective against the sweetpotato weevil and should be the one of the basis of control (CARDI, 1995).This practices include:

- Hand picking
- Screening

4.4 Biological Control

Microbial control: Promising biological control agents for sweet potato weevils appear to be the fungi B. bassianaand Metarrhiziumanisopliaeand the nematodes Heterorhabditisspp. and Steinernemaspp.The fungi attack and kill adult weevils, whereas the nematodes kill the larvae.

Predators: Ants, spiders, carbides, and earwigs are important generalist predators that attack weevils. They are described more fully in the section on "Natural Enemies."

Plant juices: for example pepper juice and garlic juice

Sex pheromones: The species-specific pheromones of all three *Cylas*species that are released by female weevils and attract males have been identified. Pheromone lures for *C. formicarius*are commercially available. Pheromonetraps are used as monitoring, training, and management tools. Many effective traps have been designed by farmers using locally available materials. Traps are so sensitive that their failure to catch weevils is a good indication that the pest is not present (Amen, 1997).

Place 1-2 pheromone traps per hectare of sweet potato planted. Traps should be placed in the field as soon as planting is completed. The rubber with the female pheromone "perfume'' should be placed 15-20 cm above sweet potato leaves. Water should be in the base of the trap at all times. Move the trap around the field every week. Change rubber septa with the female pheromone every 6-8 weeks (CARDI, 1995).

Trap Spacing: Trap spacing is dependent upon the size of the fields. As a general rule, consult the following table to determine the number of traps required.

Table 2. Size of field, Acres # of traps per field

Size of field, Acres	# of traps per field
1	2
2	2
3	2
4	3
5	3
10	5
20	10
40	20
80	20

Source: Shoolery, J. N. (1959).

4.5. Monitoring System

A monitoring system for sweet potato weevil in the southern U.S. and the Caribbean basin was recently developed by researchers at the University of Florida's Institute of Food and Agricultural Sciences. This system is also very applicable to other regions of the world. This system uses traps baited with a synthetic sex attractant (sex pheromone) that attracted only adult male weevils. This chemical attracts both *C. f. elegantulus and C. f.formicarius*with equal success.The monitoring system for sweet potato weevil has several potential uses. First, it can be used to help determine weevil population levels in fields and seed beds, and subsequently help to time and evaluate the success of insecticide applications. Secondly, it can provide some level of control by continuously removing adult males from the field. Such a reduction in the male population may help to reduce weevil damage to storage roots. Thirdly, the system can be used as a detection tool in weevil-free zones. Because the sex attractant is very specific and very attractive to sweet potato weevils, it can aid in determining if weevils have become established in weevil-free sweet potato production zones. Lastly, the pheromone may be used around storage bins and outside of storage facilities to detect weevil infestations in stored sweet potatoes.

4.6 Chemical Control

Several insecticides have been tested worldwide for the control of *C. puncticollis*; Sutherland (1986) listed 59 different chemical insecticides including botanicals of unknown chemical composition that were tested against the sweet potato weevil. These chemicals, which were applied as post plant foliar sprays, resulted in varying levels of control. The life stages of sweet potato weevils take place underground (but within the plants). Therefore, post-plant application of insecticide requires frequent applications to kill newly emerged adults. This is not cost effective for subsistence farmers. Pre-planting insecticide application by dipping cuttings in systemic insecticide kill weevils within the stem and can protect it for at least one month after planting (Talekar, 1991; Smith and Odongo, 2002).

Emana and Adhanom (1990) evaluated seven insecticides as dipping, foliar sprays and combination of both at Awassa and Areka during the 1987 and 1989 cropping seasons. Spraying begins two months after planting and continued up to the fourth month at fortnightly interval. Out of the seven insecticides cypermethrin and pirimiphos-methyl gave best control of the sweet potato weevil which resulted in higher marketable yield. In another study dipping sweetpotato cuttings in diazinon 60 % EC before planting improved the yield and reduced the level of infestation (Tesfaye, 2002).Treatment of planting materialdipping planting material in a solution of *Beauvoirbassiana*or in an insecticide (such as carbofuran or diazinon) for 30 minutes prior to planting can control sweetpotato weevils for the first few months of the growing season.

4.7 Integrated Management of Sweet Potato Weevil

The integration of insecticides, early planting and earthing up three times starting from one month after planting highly reduced the percentage of infestation by the sweet potato weevil and increased root yield of sweet potato (Mesele*et al.,* 2005). As indicated in percent infestation by sweet potato weevil significantly affected by planting date and earthing up The lowest percent infestation was recorded from early planting time (July 12), while the highest was recorded from late planting time (August 12). By hilling up the soil three times around the root of sweet potato crop the infestation percent was reduced from 21.4 to 17.3 %. The interaction of planting date by earthing up and chemical affected the percent infestation by target pest. Generally, lower percent infestation was recorded from the interaction of early planting by chemical treatment and earthing up as compared to other treatments.

5. Major Constraints of Sweet Potato Production in Ethiopia

Among the major biotic constraints for sweet potato production insect pests are recoded as the major one (Adhanom*et al.,* 1985; Ferdu*et al.,* 2009). A complex of insect pests recorded in sweet potato producing areas of the country. The stem and root feeders like sweet potato weevils, *Cylas*puncticollis*,* (Coleoptera: Curculionidae); sweet potato butterfly, *Acraeaacerata* (Lepidoptera: Nymphalidae), sweet potato hornworm, *Agrius convolvuli* (Lepidoptera: Sphingidae), tortoise beetles, *Aspidomorpha spp*., *Laccoptera spp*. (Coleoptera: Chrysomelidae); and virus transmitters *Aphis gossypii* (Homoptera: Aphididae) and *Bemisiatabaci* (Homoptera: Aleyrodidae) are the major ones.Not only pests and disease other constrains of sweet potato production and yields in Ethiopia include drought, frost at high altitudes, lack ofirrigation, lack of high yielding and adapted cultivars, lack of quality cuttings, damage from handling, lack of appropriate management techniques(Belehu, 2003).

6. Yield Losses of the Crop

The sweet potato weevil is a type of beetle; the adult stage is a black or brown beetle that looks like a large ant. When an adult weevil is disturbed, it often plays dead. It is the most important pest of sweet potato in most sub-Saharan Africa. As well as destroying large parts of the roots and causing unsightly damage, the ‘undamaged’ part of the root also becomes bitter and unmarketable. The weevil larvae also feed in the stems, causing large lumps to appear and damaging the connection to the roots (Stathers and Namanda, 2005).

The main damage is due to larvae developing inside the edible tubers, but yield losses also occur due to adults and larvae feeding on the vines (Sutherland 1986a). Despite the considerable importance of sweet potato to the subsistence economy of farmers, there are few published studies that examine the interactions of sweet potato weevil with sweet potato, its primary host.

Sweet potato weevil, *Cylas* sp. are more important since the insect causes damage both in the field and in storage (Schmutterer, 1969); and as such even in low infestations render the tubers unfit for human or livestock consumption (Sutherland, 1986; Ruben, 1989). In Ethiopia, losses attributable to *Cylaspuncticollis* range from 20-75% and considered higher in areas where harvesting is delayed (Emana, 1990; Amanuel, 1994). What makes the situation worsen in Southern Ethiopia is that, subsistence farmers usually plant sweet potato as security and fall back when the food from cereals dwindle. During such time, farmers in this area mainly depend on sweet potato for two to three months every year. Therefore, the end of the rainy season (September and October) is the main planting period during which time; relatively larger plots are devoted to sweet potato production. Unfortunately, late planting (planting at the end of the rainy season) has been observed to be an insecure planting time because of very high weevil infestation and subsequently, yield losses (Alehegne, 2007).

Yield loss assessment studies were carried out between 1984 and 1987 at Nazreth and Water using various insecticides showed that the weevil can cause losses of 10 – 48 % (Emana, 1987). The bitterness resulting from sweet potato weevil damage makes even the partially damaged tubers are unsuitable for human consumption. As lack of storage technologies and for preservation of planting material; farmers practice piecemeal harvesting techniques which keeps the crop in the field for up to six months.

According to Emana (1990), the infestation could increase from 29 to 68 % when harvesting was delayed from five to six months. Moreover, growing sweet potato on the same plot of land for four consecutive years at Awassa resulted in over 70 % infestation; whereas less than 20 % infestation was recorded in plots where rotation of crops was practiced (Emana, 1990). The extent of yield loss was high towards the dry season due to low soil moisture, low biomass yield and possibly high soil crack (Ashebir, 2006). The pest is particularly serious under dry conditions because the insect can reach the root more easily through the cracks that appear as the soil dries out; therefore sweet potato cannot be stored safely in-the ground for long period during the dry season.

Damage: Damage symptoms are similar for all three species. Adult sweet potato weevils feed on the epidermis of vines and leaves. Adults also feed on the external surfaces of storage roots, causing round feeding punctures, which can be distinguished from oviposition sites by their greater depth and the absence of a fecal plug. The developing larvae of the weevil tunnel in the vines and storage roots, causing significant damage. Fars is deposited in the tunnels. In response to damage, storage roots produce toxic trepans, which render storage roots inedible even at low concentrations and low levels of physical damage (Ames and Skoglund.1996). Feeding inside the vines causes malformation, thickening, and cracking of the affected vine.

7. Conclusion

Ethiopia is one of the largest sweet potatoes producing country in east Africa and the Southern Nations Nationalities and Peoples' Region (SNNPR) is the major sweet potato producing region in the country.Among the major biotic constraints for sweet potato production insect pests are recoded as the major one. From the insect pests sweet potato weevils are the highest one in both larval and adult life stages for the yield loss and damage in storage and production levels of the crop.Sweet potato weevil, *Cylas*sp. are more important since the insect causes damage both in the field and in storage and as such even in low infestations render the tubers unfit for human or livestock consumption. In Ethiopia, losses attributable to *Cylaspuncticollis*range from 20-75% and considered higher in areas where harvesting is delayed. Sweet potato weevils are a serious damage for sweet potato cropespecially in dry conditions.For managing and controlling the serious insects' farmers use cultural, monitoring systems, biological, mechanical, chemical and integrated management systems and control methods of sweet potato weevils.

Different authors have reviewed and well summarized the entomological researches on root and tuber crops in Ethiopia. Accordingly, the gaps and challenges were indicted as follows. The studies on root and tuber crop pests in Ethiopia were focused on very few economically important pests. Most of the studies were not continued for a longer durations and similar type of none-detailed studies prevailed in most of the case. The status of pests of the crop is not known except for those which cause significant crop damage.

The sweet potato weevil and butterfly are relatively better studied among the root and tuber crop pests and efforts has been made to develop management practices including use of appropriate varieties, insecticides, botanicals and cultural practices. However, the study on pests and the control methodswere very repetitive. The study were only focused in same things and does not cover all the farmers practiced period or control methods of sweet potato planting. If the soil moisture is not limiting, the farmers were planting sweet potato throughout the year. Moreover, the temporal distribution of sweet potato weevil is one of the study areas which need investigation. The botanicals recommended for the insect were based on laboratory and small-scale field studies.

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