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Assessment and Identification of Insect Pests on Sweet Oranges (Citrus sinensis) in Tony Farm, Dire Dawa, Ethiopia

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ABSTRACT: *Aims:* This study focused on the assessment and identification of key insect pests on sweet oranges (*Citrus sinensis*) plantation in Tony farm of Dire Dawa town. It was also explain the abundance of key pests and effective controlling methods.
Methodology and Results: The farm lands of sweet oranges stratified in to nursery stage and adult stage by using stratification method technique. Then random sampling method of data collection was carried out in both strata. By this method direct observations were taken place and the data collected from this area were analyzed. The larvae and adult stages of key insect pests of sweet oranges were identified by using the dissecting microscope. Citrus leaf miners, leaf dogs and cottony cushion scale are key insect pests of sweet oranges in this area. From these citrus leaf miners are highly dominant where as orange dog is less in abundance.
Conclusions: Citrus sinensis plants in Tony farm are highly damaged by these key insect pests particularly nursery stages of plants are devastated.

KEYWORDS: Citrus leaf miner, Cottony cushion scale, Leaf dog, dissecting microscopy, larvae.

1 INTRODUCTION

Citrus orange (*Citrus sinensis*) is a high value crop grown in the tropical and sub-tropical regions of the world. Currently citrus is cultivated in more than 130 countries with Brazil, China and USA being the biggest producers; Spain and South Africa the most important exporters (Ismail and Zhang, 2004) as stated in Mekbib *et al.,* 2006). It is among the most important fruit crops of Ethiopia. Its cultivation started in Upper Awash Valley and Malkessa areas in South East Ethiopia (Kassahun. *et al*., 2006). Sweet orange cultivation covers 82% of the total citrus areas surveyed in the country. This represented under government ownership 97%, individual 2.6% and association farm 0.4% (Mekbib *et al*., 2006).

Numerous fruit crop pests have been recorded in Ethiopia. Forinstance, in Arbaminch (South Eastern) lost the production of citrus up to 80% (Mekbib *et al*., 2006). Red scale, leaf miner, Mediterranean fruit fly, false codling moth, thrips, aphids and budmites were identified as a major pest on all citrus farm of Ethiopia (Sundari and Santhi, 2006). Production of sweet orange is also threatened by the devastating of leaf and fruit spot disease caused by *Phaeramularia angolensis* (Kassahun *et al*., 2006).

Ethiopia is a new comer in citrus trade (Seifu, 2003). Over past 30 years exports amount have dropped due to poor quality delivered on to the market, which is mainly due to lack of improved production practices and technology transfer has hampered industry growth (Tamesse, 2009). Due to the most common pests of plants such as aphids, white fly, fungus, worms, leaf miner, snails and scale insects; qualities of product released to the market become decreased (Armizage, 1994). Some pests have explosive burst of population increases, rapidly reaching a level where vast damage is caused (rats and

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locusts). However, other pest species cause huge damage and yet their population growth rate is relatively small such as codling moth (*Cydia pomonella*) (Stansly *et al*., 2011). One important characteristic of pests is the degree to which they are normally regulated by their natural enemies such as predators and parasites (Mackenzie *et al*., 2002).

2 MATERIALS AND METHODS

STUDY SITE DESCRIPTION

This study was carried out in Tony farm. The location of Tony farm is $09^0$26'00" of latitude and $41^0$05'00"E longitude in Dire Dawa town. Its altitude is 1160 m and the rainfall of this area is 500 mm per year. The mean monthly maximum temperature range between 31-34^{o}C while the mean monthly minimum temperature range between18-22^{o}C.The farm land characterized by loam, sand and alluvial soil types occupied by many farming activities such as production of fruits, vegetables and cereal crops.

SAMPLING DESIGN

Citru sinensis plants were stratified into nursery stage and adult stage depending on their stage of growth. Badawi and Al-Ahmed (1990) and Sauza and Carvelho (2002), used simple random sampling method on stratified farm land. Insect pests of sweet oranges were brought to the laboratory and they were identified by dissecting microscope (Cherry and Stansly, 2011). The stage and characteristics of the insect pests of sweet oranges were identified while the morphological features study was conducted in the laboratory.

Calculation on number of sample in the population and in each stratum:

N = 3100 (population)

NH1 =1000 (number of nursery stage or non over lapping units in nursery stage)

NH2= 2100 (number of adult stage or non over lapping units in adult stage)

d = absolute error (0.57 by assumptions depending on my study

S2 =sample variance (10.24 from previous researchers)

n = sample size

Z (α/2)2 =1.96 (from table of normal distribution)

α=0.5,

nh = number of sample units in stratum

Sample size of the population: $n=\frac{Z_{\frac{\alpha}{2}}^2 s^2}{d^2}=\frac{1.96\ (10.24)^2}{(0.57)^2}=120$

Number of sample units in each stratum (nh) = $\frac{\mathrm{n}}{\mathrm{N}}\mathrm{NH}$

Let, number of sample unit of nursery stage is nh_1 and number of sample unit of adult stage is nh_2

$nh_1 = \frac{n}{N}NH1$, $nh_1 = \frac{120}{3100}(100)$, $nh_{1=39}$

$nh_2 = \frac{n}{N}NH2$, $nh_2 = \frac{120}{3100}(2100)$, $nh_{2=81}$

The sample size was calculated by $\mathbf{n=\frac{Z_{\frac{\alpha}{2}}^2 s^2}{d^2}}$, where $\alpha = 0.5$, n= sample size, s^2= sample variance, d=absolute error and $\boldsymbol{Z_{\frac{\alpha}{2}}^2}$= obtained from table normal distribution (1.96). Also $\boldsymbol{s^2 = 10.24}$, which gained from previous researchers and d= 0.57 by assumptions. From this the calculated number of sample size is 120. When the size of stratum is given, proportion allocation is the only available and there is difference in size between strata. So the number of sample units in the stratum (nh) was calculated by $\boldsymbol{\frac{n}{N}NH}$, where NH=total number of non over lapping units in stratum, n=total sample size and N=total population size. Generally, from the 3100 populations of sweet oranges, which include 2100 adult stage and 1000 nursery stage, the study was conducted on 39 and 81 sweet oranges of nursery stage and adult stage, respectively.

DATA ANALYSIS

Quantitative and qualitative information, which collected from the laboratory activities and field observations were grouped, tabulated and interpreted in terms of percentages. Finally, possible definitions, conclusions and recommendations were forwarded.

3 RESULTS

FIELD ANALYSIS

Field work was done on insect pests of sweet oranges found in the Tony farm in Dire Dawa town. Daily observation was carried out to handle good information from the pests (morning, mid day, and afternoon). Three types of key insect pests were described from the farm land. These are: Leaf dogs (Orange dogs), Cottony cushion scale, and Citrus leaf miner. Then their presences and abundances were checked by using parameters such as time of feeding and parts of plant they feed. Finally, some control methods are applied to identify necessary method to control the influence of these pests. Cultural, Chemical and Mechanical methods are applicable for all of them except chemical method were not workable for citrus leaf miners in Tony farm.

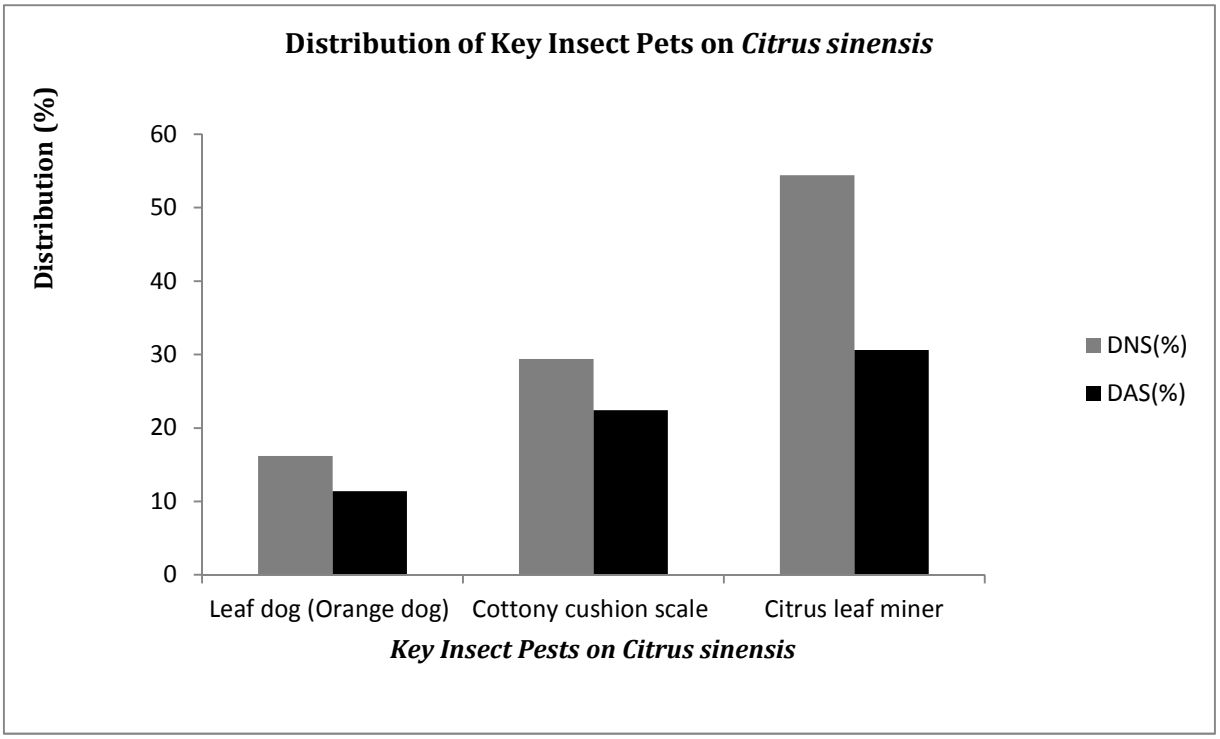

Figure1: Shows Distribution of Key Insect Pests on Sweet Oranges (Citrus sinensis) in Tony farm, Dire Dawa Town, Ethiopia. Abbreviation: DNS - Distribution on nursery stage in % and DAS - Distribution on adult stage in %. From this analysis Citrus leaf miner is highly distributed on both adult and nursery stage of sweet oranges

Table 1: This table shows three key insect pests with their time of feeding, parts of sweet orange they influence and control methods.

No.	Key Insect Pests	Time of feeding	Parts of plant they influence	Control method
1	Leaf dog	Morning and afternoon	Leaves Stem	Cultural Chemical
2	Cottony cushion scale	Every time	Leaves Branches Stem	Cultural Chemical Mechanical
3	Citrus leaf miner	Every time	Young leaves Stem	Cultural Chemical mechanical

Table 2: This table describes morphological characteristics of key insect pests of Sweet oranges at larvae and adult stage from Tony farm, Dire Dawa Town, Ethiopia. These morphological characteristics were done by using dissecting microscopy.

No.	Key Insect Pests	Morphological Characteristics	
		Larvae Stage	**Adult stage**
1	Leaf dog	Dark brown with creamy white Mottled markings Segmented body parts Many prologs (false legs) Large head region One pair of antennae like structure on head region	Largest swallow tail Wings are black with yellow markings near wing margins Spots on fore wings One pair of antennae Two pairs of wings Three pairs of legs
2	Cottony cushion scale	Covered with whitish, cottony substance Segmented body part	Varies in color : orange, yellow, red or brown Segmented body part One pair of antennae Three pairs of legs No wing Body part divided in to three part(head, thorax and abdomen) White sac attached to its body
3	Leaf miner	Very small Seems like maggots Segmented body part Straight in shape	Brownish grey Hind wings fringed with long hairs One pair of antennae Two pairs of wings Smaller than butterfly

4 DISCUSSIONS

This study revealed three key insect pests of sweet oranges in Tony farm land: leaf dog (orange dog), cottony cushion scale, and citrus leaf miner. Under this work field observations and laboratory analysis are managed. As the result their distribution, time of abundance, their influence, control methods and morphological characteristics of key insect pests are explained. Citrus leaf miners are the most abundant from key insect pests of nursery stage and adult stage of *Citrus sinensis* found in Tony farm. As a result both stages are highly affected by citrus leaf miners.

LEAF DOGS (ORANGE DOGS): *PAPILIO CRESPHONTES* CRAMER

Caterpillar stage is commonly known as orange dog caterpillars or orange dogs (Pherson and Goodwin, 2008). The orange dog caterpillars feed on new leaves and young stem of sweet oranges. While they feed on the plant, they devastate the leaves and stem parts of plants. The adult stage of these larvae is called butterfly. Adult butterfly is one of the largest swallow tail species, with a wing span of wings are black with yellow markings near wing margins and spots forming a diagonal across the fore wings. The adult stage feed on nectar of plants while the caterpillars feed on leaves of sweet oranges.

Caterpillars are highly dominant on the sweet orange species at the morning and afternoon because they need less power of sunlight for their feeding time. At the mid-day when the temperature increases they move down to the stem of the orange under the leaf to escape from direct light rays. Therefore, the ability of their feeding at the mid day is less than other times.

Orange dog caterpillars can be controlled on small trees by finding, crushing eggs and caterpillars. This method is highly practiced in Tony farm and they are benefited from this method. Also they use chemical control method to reduce the abundance of orange dog caterpillars. For instance, *Carbosulfon* and *Dimethonate* are known chemicals, which they used to control these pests. Generally, cultural control method is the most dominant method in Tony farm rather than other control methods.

CITRUS LEAFMINER: *PHYLLOCNISTIS CITRELLA* STAINTON

The adult stage of citrus leaf miner is called moths (Sundari and Santhi, 2006). It is brownish- grey in color, with hind wings fringed with long hairs. The citrus trees are not damaged by the adult months. The damage is caused by larvae when they feed on the leaves. The cater pillars mine in between the epidermal layers of the leaf, which results in distortion of leaf lamina. Similarly, citrus leaf miners affect young stem of *C. sinensis* plants. These larvae do not kill the adult stage of the plant, but can cause unsightly damage (Williams, 2010). However, they highly attack the nursery stage or excessive feeding can retard growth of sweet oranges, because, they are highly dominant on nursery stages. Citrus leaf mines larvae are found in leaf parts of sweet oranges throughout the day, but the adults are seldom seen. This is because; they are nocturnal type of insects (Sundar and Santhi, 2006). Larvae of citrus leaf miners always cause the damage which characterized by silver or yellowish or lines on the surface of the leaf.

Generally, the problem caused by these larvae hold up the growth of the sweet oranges. When the lamina part of the leaf twisted, the photosynthetic process which takes place in the leaf part became blocked. Due to this, the necessary food provided by photosynthesis is decreased. Thus the metabolic rate in the plants body became low (Manner *et al*., 2006). As result, the plant growth decrease from time to time and retarded.

Cultural and mechanical control method is effective for citrus leaf miners larvae. Simple the heavily affected part of plant pruned and burned. Also the affected part of plat can be damped into the ground. Then it became decomposed and changed to soil by micro organisms or decomposers. Chemical control methods are not applied for citrus leaf miner in Tony farm. Since the larval stage of this insect pest usually lives in internal part of the leaves it needs expert to manage it. Heppner and Fasulo (2010) stated that, chemicals such as *Dimethonate, Carbosulfan, Malathion Phosphamidon and Profenophes* are imperative to control citrus leaf miners.

COTTONY CUSHION SCALE: *ICERYA PURCHASI* MASKELL

The cottony cushion scale is now widespread throughout the world wherever citrus is grown (Ebeling 1959). The body of the cottony cushion scale is orange, red, yellow or brown. However, it is most easily recognized by the fluted, cottony white egg sack that is attached to its body. Its larvae stage is called nymphs (Hamon and Rasulo, 2010) and is covered with a whitish, cottony substance. Cottony cushion scales affect by sucking the sap from the leaves, stem and branches of sweet oranges. This insect damages the sweet orange gradually by spreading on the parts of the plant. They usually found on plant parts in groups by condensing on particular area; as the result the food demand by insect pest became increase. Hence, they suck the sap from the body part of the plant and retard growth of plants (Badawi and Al-Ahmed, 1990).

The damage is caused by both larvae and adult stage of cottony cushion scale. As a result they highly affect the sweet oranges next to the leaf miners. That means, they are highly dominated nursery stage of sweet oranges. They can affect the adult stage, but they cannot highly affect due to the hardness of the adult stage (Hamon and Rasulo, 2010). Cultural, mechanical, and chemical methods were most dominant used for this pest. By mechanical method they remove the larvae and adults from the plants and kill them. Also chemicals such as malathion and carbosulfon were used.

OUTPUT OF THE STUDY

Three key insect pests (Citrus leaf miners, cottony cushion scales and leaf dogs) of sweet oranges are identified in Tony farm. Also cultural, chemical and mechanical control methods are applied and positive feed backs are achieved.

5 CONCLUSIONS

Citrus leaf miners, cottony cushion scales and leaf dogs are most dominant key insect pests of sweet orange species in Tony farm. Citrus leaf miners are most dominant in both nursery and adult stage of sweet oranges, where as leaf dogs less in number. The damage is caused by the larvae stage of these insects. The adult Stage of cottony cushion scale can cause damage to the sweet oranges. Generally, these insect pests of sweet oranges are very known and dominant in tony farm of Dire Dawa town.

RECOMMENDATIONS

For interrupting the growth of insect pests of sweet oranges in tony farm, it is better if they use integrated pest management methods. Also increasing the water sources for this farm land is one solution for this problem because this farm land has scarcity of water. Plants can easily grow and resist the damage of pests while the water source is sufficient. In addition to these, they have to make the border between the beds of plants land to reduce the trans-boundary of insect pests from one to other plants. As a general to minimize the effect of insect pests of sweet oranges in this area, the integrated pest management is the essential one.

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