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DEPARTMENT OF ZOOLOGICAL SCIENCES

STUDIES ON THE STATUS OF STORED GRAIN INSECT PESTS OF MAJOR CEREAL CROPS IN SEBETA AWAS WOREDA, OROMIA REGIONAL STATE, ETHIOPIA.

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A Thesis submitted to College of Natural and Computational Sciences, School of Graduate Studies, Department of Zoological Sciences in partial fulfillment of Masters of Science in General Biology/Insect Sciences.

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By

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A Thesis presented to the school of Graduate of the Addis Ababa University in partial fulfillment of the requirements for the MSc in Biology

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Abbreviation /Acronym

DDT- Dichlorodiphenyltrichloroethane.

GDP- Gross Domestic Products

ICRISAT-International Crops Research Institute for the semi-Arid tropics.

IMAS- Improved Maize for Africa Soils.

ISMA- Integrated strategic Managments for Africa.

NUE- Nitrogen Use Efficient.

NuME- Nutritionally Enriches Maize for Ethiopia.

SIMLESA- Sustainable Intensification of Maize – Legume Cropping System in Eastern and Southern Africa.

SSA- Sub-Sahara Africa

WEMA- Water Efficient Maize for Africa .

UG- *Puccinia graiminis*

UK- United Kingdom.

Abstract

Cereals crops are mostly cultivate for the purpose of consumptions and commercial uses. Cereals crops also are cultivated for the industrial raw materials. The study insects pest and local community perception on their pest status in Sebeta Awas Woreda, Oromia Regional State was carried out from August 2018 to August 2019. The main objective of the current study is to investigate the status of stored grain insect pests of major cereals grown in the Sebeta Awas District. .A total numbers of 125 respondents were randomly selected for both quantities and qualitative data collection through questionnaires and interviewees. The data were analyzed by using simple descriptive statistical methods such as frequency and percentage. All the respondent background information and dominant cultivated crops were collected from each respondent. The majority of respondents were male and their main source of income was from crop cultivation Cereal crops such as Barely, Wheat, Sorghum, Teff and Maize were the dominantly cultivated crops in the study area. All respondents reported that they had pest problems. The major pests were insects, nematodes, rodents, birds and wild animals. The majority of respondents faced pest problems (insects). Cereals crops were most susceptible to damage by insect pests. Cereal crops such as Barely, Wheat, Sorghum, Teff and Maize were damaged after storage at the warehouse by different kinds of insects such as termites, lesser grain borer , warehouse moth and maize weevil.

Thus proper controlling methods need to be used to reduce grain loss in storage due to insect's pests. The most common methods used were application of pesticides, mechanical control, biological control, physical control cultural control and chemical control. Most respondents were able to use cultural and chemical control methods in the study area.

Key words: -Agriculture, Cereal Crops, Pests, Perception, Respondents, Insects.

1. Introduction

1.1 Background of the study

Cereal crops are interchangeably called grain crops. In many publications and correspondence, they are simply called grains or cereals. As of 2012, the top 5 cereals in the world ranked on the basis of production tonnage are maize (corn), rice (paddy), wheat, barley and sorghum. These crops are also among the top 50 agricultural commodities in the world with maize ranking second next to sugarcane. Rice (paddy) ranks third, wheat – 4th, barley – 12th, and sorghum – 30th. Another cereal, millet, ranks No. 42 (FAOSTAT, 2014).

Cereal crops are mostly grasses cultivated for their edible seeds (actually a fruit called a caryopsis). Cereal grains are grown in greater quantities worldwide than any other type of crop and provide more food energy to the human race than any other crop. Wheat and rice are the most important crops worldwide as they account for over 50% of the world's cereal production. In the UK, wheat is the cereal most commonly used for the manufacture of food products, although many other types of cereals (e.g. maize and barley) are used. The starchy carbohydrates which are provided by cereals are essential in human nutrition. Rice is a staple diet for half of the world's population, the remaining half cultivating the other cereals pending on climate and soil. Nowadays, cereals provide a very significant proportion of both human and animal diets despite the fact that most grains are, to a greater or lesser extent, deficient in a number of essential nutrients. A primary problem is the low level of essential amino acids such as lysine, methionine and threonine in the major cereal storage proteins.

(http://www.agrsci.dk/afdelinger/forskningsafdelinger/gbi/grupper/molekylaer_genetik_og_bioteknologi/cereals).

In Europe, Barley was very popular for bread-making. Barley was also introduced from Europe and was commonly grown for its high food value for both animals and humans. Oats had a lower food value than barley but they grow well in the damper climate.

Ethiopia's crop agriculture is complex, involving substantial variation in crops grown across the country's different regions and ecologies. Five major cereals (Teff, wheat, maize, sorghum, and barley) are the core of Ethiopia's agriculture and food economy, accounting for about three-fourths of the total area cultivated, 29 percent of agricultural gross domestic product (GDP) in 2005/06 (14 percent of total GDP), and 64 percent of calories consumed (FAOSTAT 2014). There has been substantial growth in cereals in terms of area cultivated, yields, and production since 2000, but yields are low by international standards, and overall production is highly susceptible to weather shocks, particularly droughts. Thus, raising production levels and reducing their variability are essential aspects of improving food security in Ethiopia, both to help ensure adequate food availability and to increase rural household incomes. Ethiopia's crop agriculture in general, and the cereals subsector in particular, face serious challenges. Although a majority of production increases in the past occurred due to increases in the area cultivated, recent data on production (from 2000/01-2008/09) suggest that yield increases and intensification may be contributing to greater production. Given that little suitable uncultivated land remains in the highlands apart from pasture land, production gains in terms of yield increases are critical to meet agricultural growth goals. Soil degradation from erosion and soil compaction threatens crop yields (Taddesse, 2001; Hamza and Anderson, 2005). Furthermore, uncertain rainfall and very low levels of irrigation are other constraints of cereal production in Ethiopia.

Insect pests both under field and storage conditions cause losses estimated to over 10%. Farmers of Sebata Awas grow cereals like maize, sorghum, wheat, barely and teff among others under the existence of all of the constraints mentioned above (Personal communication with the district bureau of agriculture). The main purpose of this study is to investigate the status of stored grain insect pests on cereals in the Wereda.

1.2. Objectives

1.2.1. General objectives

- To identify the status of stored grain insect pests of the major cereals grown in Sebeta Awas Wereda.

1.2.2. Specific objectives

1) To identify insect pests on the stored grain cereals in Sebeta Awas wereda.
2) To investigate the extent of damage and/or losses stored grain insect pests cause to different crops.
3) To examine the insect pest management practices farmers use against stored grain insect pests.

2. Literature Review

2.1. Cereal production and productivity

Cereals are cultivated on large hectares of land annually in Ethiopia to ensure adequate provision of grain for the entire population. Worldwide production of Maize (*Zea mays*), rice (*Oryza sativa* L.), Sorghum (*Sorghum bicolor* (L.)) Moench], and Millet (*Pennisetum glaucum* (L.) R. Br.) In 2010 were 844 million Maize, 672 million Rice, 56 million Sorghum and 29 Millet million metric tons, respectively. Grains are the most important sources of food for man and his animals worldwide and they constitute a major source of energy of high biological value, vitamins and roughages (Ofuya and Lale, 2001; Turaki *et al*. 2012). In order to provide for the food security of the citizen, surplus grains are preserved in stores to serve amongst others, as a source of domestic food supply throughout the year, generate revenue for the farming families, provide seed for the following year's cropping and to provide a steady supply to the strategic stock (Ofuya and Lale, 2001).

2.1.1. Teff

Currently, Ethiopia produces over 90% of the world's teff. But because of its growing popularity, teff production has attracted other countries including; Australia, China, India, South Africa, and the US. ... The grains are a daily food staple for about 50 million people – about 60% of the country's total population (Ayalew et al, 2011).

Ethiopia, located in eastern Africa, is considered the center of origin of teff (National Research Council, 1996). Nutritionally, 100 g of teff grains have 357 kcal, similar to that of wheat and rice (Cheng et al., 2017). Yet, its grains are comparably rich in iron, calcium, and fiber (FAO, 2015).

Teff with 11% of protein is an excellent source of essential amino acids, especially lysine: the amino acid that is most often deficient ingrains (Ayalew et al, 2011). Teff grains are low on the glycemic index, which makes them suitable for people with Type 2 diabetes. The grains are also gluten-free. This, in particular, attracts individuals who suffer from gluten intolerance or celiac(https://www.researchgate.net/publication/327944059_Teff_A_Rising_Global_Crop_Current_Status_of_Teff_Production_and_Value_Chain)

2.1.2. Sorghum and Millet

Africa is the center of origin and also a major producer of several cereals like Sorghum, Pearl Millet, Finger millet, Teff and African rice. Agriculture is the 'engine for growth' in Africa. With subsistence agriculture practiced by majority of small holder farmers, yield gaps are high and poor soils, amongst other constraints add to the difficulties for sustainable farming and incomes. Cereals like Sorghum, Millets, Wheat, Maize and Rice are major staple foods of the most population. These cereals are grown over an area of 98.6 m ha producing 162 m tons. Sorghum is the second most important cereal after maize with 22% of total cereal area (Emana Getu et al, 2008).

Pearl millet is a climate hardy crop which is grown in harsh conditions, but as a subsistence crop. Harvested from an area of 20m ha in the semi-arid regions of Africa pearl millet contributes 19% area to cereal production (Ayalew et al., 2011).

Cereal yields in Africa are lower than half the world average. The average fertilizer (N + P2O5) consumption is 16.24 kg/ha (FAOSTAT, 2010) which is 1/6th compared to the world consumption of 98.20 kg/ha. Increasing productivity of the small holder farmers, bridging the yield gaps by providing appropriate inputs along with improved technologies such as stress

resistant and high yielding varieties and empowering farmers to better manage climate risk will be will be a huge step towards agricultural transformation in Africa. The primary demand for sorghum and millets is for food in Africa, especially in the dryland regions where these are the principal crops.

This continuing demand is reflected in the trend for increasing area under sorghum and millets in Africa over the last fifty years but crop productivity has not kept pace with this increasing demand. This is due to both a lag in crop improvement efforts in these crops and the extreme environmental conditions and the low- input agriculture under which these crops are grown. Thus, it is immediately evident that crop improvement efforts combined with improved agronomic practices is a must for these crops in Africa, especially in view of the reducing arability of land. Interventions of the Bill and Melinda Gates Foundation-supported HOPE project (Harnessing Opportunities for Productivity Enhancements) for sorghum and millets that started in 2009, have demonstrated that yield gains from as low as 17 to as high as 141 per cent for these crops are possible through the use of improved varieties and associated improved agronomic practices.

The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) has the mandate for research and development of sorghum, pearl millet and finger millet, among other crops.

2.1.3 Maize(Corn)

Maize is the most widely-grown staple food crop in sub-Saharan Africa (SSA) occupying more than 33 million ha each year (FAOSTAT, 2015). The crop covers nearly 17% of the estimated 200 million ha cultivated land in SSA, and is produced in diverse production environments and

consumed by people with varying food preferences and socio-economic backgrounds. More than 300 million people in SSA depend on maize as source of food and livelihood. The top 20 countries, namely South Africa, Nigeria, Ethiopia, Tanzania, Malawi, Kenya, Zambia, Uganda, Ghana, Mozambique, Cameroon, Mali, Burkina Faso, Benin, DRC, Angola, Zimbabwe, Togo, and Cote d'Ivoire, account for 96% of the total maize production in SSA. (FAOSTAT, 2015). The planted land of maize and grain production has increased significantly across regions in SSA since 1961 (FAOSTAT, 2015). Of the 22 countries in the world where maize forms the highest percentage of calorie intake in the national diet, 16 are in Africa (Nuss and Tanumihardjo, 2011). Maize accounts for almost half of the calories and protein consumed in ESA, and one-fifth of the calories and protein consumed in West Africa. Regional average yields are as high as 1.7 t/ha in West Africa and 1.5 t/ha in East Africa, and 1.1 t/ha in Southern Africa (Smale et al., 2011). Even though some countries (e.g., Ethiopia with >3 t/ha) have made significant productivity gains, the average yield of maize in SSA (estimated at <1.8 t/ha) is still far below the global average yield of maize (~5 t/ha) and considerably below the 4.4-5.4 t/ha on-farm trial results of improved varieties under optimal inputs and improved management conditions undertaken by within SSA. Several projects have been designed and implemented in SSA with funding from diverse donors to improve productivity at the farm level over the last ten years. The Drought Tolerant Maize for Africa (DTMA), the Improved Maize for African Soils (IMAS), the Water Efficient Maize for Africa (WEMA), and the Nutritionally-enriched Maize for Ethiopia (NuME) are among the key projects in SSA, developing and deploying stress resilient and nutritionally enriched maize in SSA. These projects have made significant contributions in terms of improved variety releases and delivery of seed. More than 180 distinct drought tolerant (DT) maize varieties have been developed and released through DTMA, and

nearly 52,000 metric tons (MT) of seed was produced and delivered across 13 target countries in SSA in 2014 alone. Partners working under IMAS **p**roject have released 11 Nitrogen use efficient (NUE) maize hybrids, and produced 2,300 MT of seed in 2014. Many DT and NUE varieties are being scaled-up in eastern, southern and West African countries, with significant present and potential impacts (Alene et al., 2009; Kostandini et al., 2015,). Similarly, under the Integrated Striga Management for Africa (ISMA) project, IITA, CIMMYT and partners in Kenya and Nigeria came together to develop and deploy Striga- tolerant improved maize varieties. Some of the projects have also developed improved crop management practices, including cereal-legume rotation to control Striga and to improve soil fertility (Kamara et al., 2008). Sustainable intensification of maize-legume cropping systems in eastern and southern Africa (SIMLESA) is another major project being implemented in SSA.

2.1.4 Wheat

In all African countries, wheat consumption has been steadily increasing during the past 20 years as a result of growing population, changing food preferences and a strong urbanization trend which has led to a growing 'food gap' in all regions, largely met by imports. In 2013 alone, African countries spent over $12 billion dollars to import more than 40 million metric tons of wheat, equating to about a third of the continent's food imports. During 2010-2013, the average quantity of wheat import in SSA was about 17.5 Million metric tons per annum, which is close to 80% of the total domestic wheat consumption in these countries (USDA, 2014). Each year, less than 30% of wheat consumption in the region is covered from domestic production. In addition to the increasing trend in volume of wheat import in SSA, wheat prices (both producers' and world market prices) have increased substantially over the last half-decade. Domestic price volatility is very high. Both price and volume of wheat imports already impose

substantial challenges to many SSA countries on their foreign currency reserve and annual trade balance. Thus, for SSA countries, it is essential and timely to look into the exiting wheat production and productivity potentials and exploit these potentials through putting proper policies, institutions and market arrangements in place and create incentives to all actors in the wheat value chain.

The average wheat productivity in SSA is 1.7 tons/ha (FAOSTAT, 2014), nearly 50% below the world average. The national average wheat productivity in SSA varies across countries. It ranges from 0.7 tons/ha in Burundi to 3.4 tons/ha in Mali. Yield data from experimental stations and crop models indicate a very high yield potential, among the highest reported for spring wheat. Therefore, the yield gap between yield potential and average farm yields is significant, often greater than 5-fold. This yield gap can be filled through use of improved technologies (improved varieties/seeds, agronomic practices, fertilizer and pesticides), and better institutional and market arrangements creating incentives to wheat producers and other actors involved in wheat marketing and processing.

The occurrence of UG 99 in Uganda in 1998 has led to the establishment of the Borlaug Global Rust Initiative in 2005 and several projects have since then since supported breeding of high yielding rust resistant varieties. Kenya and Ethiopia had been established as hubs for screening and more than 50 000 wheat accessions from programs around the world are annually evaluated in Njoro, Kenya and Ethiopia. Identifying rust resistant wheat lines at these locations is of paramount importance to stop the spread of UG 99. Several rust resistant varieties were identified in Kenya and Ethiopia and are grown on large scale thanks to support from various donors for seed production (AfDB, BBSRC, BMGF, DFID, GIZ, USAID). The food crisis of 2008 and the socio-economic impacts it created worldwide resulted in an awakened attention on

food security and the need for local production of staple food crops to minimize dependence on imports and meet the national needs for these crops. In 2010, AfDB initiated consultations among agriculturalists and specialists from its low-income Regional Member Countries (RMCs) and from CGIAR Centers working in Africa to address the need for food security in those countries. This has led to the launching of AfDB-funded project "Support to Agricultural Research for Development of Strategic Crops in Africa" (SRD-SC), involving CGIAR Centers and other international and regional research institutions (FARA, ASARECA, CORAF/WECARD), all working in partnership with national research institutions, farmers and other stakeholders. The wheat component builds on 3 hub-countries (Ethiopia, Nigeria, and Sudan) where a major thrust is deployed and 9 'partner' countries (Eritrea, Mali, Mauritania, Niger, Kenya, Lesotho, Tanzania, Zambia, and Zimbabwe) benefitting from hub country results and adapting them to their local conditions. Considering the growing importance wheat has for food security in Africa, African Union Heads of State endorsed their Agriculture Ministers' endorsement in January 2013, to add wheat to the list of strategic crops for Africa. Africa has the potential to become self-sufficient for wheat, through government commitment, appropriate policies and the contribution of female farmers and young people. This Wheat framework for Africa's Agricultural Transformation Agenda contributes to the goal of greatly reduce Africa's dependency on wheat import and on the long-term make Africa a wheat self-sufficient continent. (Tadesse Habtamu and Afework Bekele(1996)

Ethiopia is the largest wheat producer in the Sub-Saharan Africa with about 0.75 million ha of durum and bread wheat. Wheat is one of the major cereal crops in the Ethiopian highlands, which range between 6 and 16 N, 35 and 42 E, and from 1500 m to 28 m. At present, wheat is produced solely under rainfed conditions. About 60 percent of wheat area is covered by durum and 40 percent by bread wheat. Of the current total wheat production area 75.5 percent is

located in Arsi, Bale, and Shewa regions. 6 percent of the 13 million ha classified as highly suitable for wheat production is located in Arsi, Bale, and Shewa. Altitude plays an important role in the distribution of wheat production through its influence on rainfall, temperature, and diseases. In Arsi, Bale, and Shewa regions, the soil, moisture and disease conditions in the 1900-2300 m altitude zone are favorable for the production of early- and intermediate- maturing varieties of bread wheat. This is estimated to comprise 25 percent of the total wheat area, while the remaining 75 percent falls in the 2300-2700 m zone. There, early-, intermediate- and late varieties are grown. Soil types used for wheat production vary from well-drained fertile soils to water logged heavy vertisols. (Thenkabail, P,S . knox J.W ozdogan M, and Mariotto L, (2012) .

2.2. Major Insects Pests Associated to Stored Grain Cereals

Grains are however, very susceptible to infestation by insect pests. Most important insect pest of stored grains in the tropics is Coleopteran (beetle) (Hill and walker, 1990; Chimoya and Abdullah, 2011). Others are Lepidoptera (moth) microorganism and to rodent pest in storage (Makundi , 2008).

These pests are responsible for losses of grains in storage amounting to several million US dollars annually and are thus major threat to the food security programmers of any nation, particularly developing countries where the storage of agricultural produce is handled mainly by resource poor- farmers (Ismaila *et al.,* 2010; Balami *et al*., 2011). Insects population are also known to breed in commodity residues in farm equipments, vehicles, storage bins, flour mills, ware houses and port storage facilities and have been termed residual populations (Hagstrum *et al*., 1996). Infested commodities may however be more important source of stored product insect than residues because of their large volume.

In some part of Africa, most cereal crops at the time of harvest typically had an infestation level (of stored product pest) of 1-2 % (Hill and Walker, 1990). In the Philippines, Maize weevil

l*Sitophilus zeamays* began to infest maize field 4 or 5 weeks before harvest and increased continuously until 93% of cobs were infested at harvest (Schwettmann, 1988). Maize weevil *Sitophilus zeamays***,** Khapra beetle *Tragoderma granarium* Rice weevil *Sitophilus oryzae*, Rust-red flour beetle *Tribolium castineum* and lesser grain borer *Rizhophatha dominica*are some of the pest responsible for losses of grain in stores. Losses and damage to stored products by insects and mites may be manifested directly through consumption of the commodity (e.g. consumption of the embryo of seed or grain and contamination with live insects, insect fragment, exuviate, excreta and chemical secretions (Howe, 1965). Damage grains may become inedible and unsalable and in the case of seed, the germination capacity may be impaired (Obeng-Ofori 2008). Furthermore, bacteria and fungi penetrate the commodity through the damage lesions (Evans, 1987).

Estimate of post harvest crop losses worldwide have been given as 10- 20% but 25- 40% for the tropics by the other workers (Hill and Walker, 1990). A number of studies made in the tropics consisting of spot checks of produce for over 30- year's period arrived at losses ranging from 10-80% for cereals (Anonymous, 1978).

The knowledge of the socio-economic characteristics of the grain handlers, pest spectrum distribution and relative seasonal abundance is imperative in implementing any pest management strategy in the stored product environment (Lale, 2002; Chimoya and Abdullahi, 2011) especially in the developing countries where mass storage facilities are lacking (Ismaila *et al.* 2010; Balami *et al*., 2011;).This study was therefore carried out with the objective of determining the socio-economic characteristics of the store owners, identifying the type of pest, their prevalence, severity and methods employed by the store owners in controlling the pest.

Since information on major insect pest associated with stored grain in this part of the country is lacking in literature (Chimoya and Abdullahi, 2011).

The major crop pests in the Ethiopia were desert locust (*Schistoceria gregoria*), Lepidopterous pests (butterflies and moths), coleopteran pests (beetles), pests of stored products, especially stored cereals crops (beetle and moth). (Joseph Mokennon, 1999). There are different techniques of pest management practice normally used were physical, mechanical, regulatory methods, biological, chemical, integrated, genetic methods, resistance varieties, cultural, natural control, legislative control and traditional methods.

2.3. Stored grain insect pest management methods

2.3.1. Natural methods

Measures that checks or destroy pests without depending on human for their continuance or success. No human involvement it's in the hands of nature to control the pests. Natural control includes climatic factors such as wind, temperature, sunshine and rain, topographic features such as rivers, lakes and mountain can influence pest movement. Naturally occurring predators, parasites and pathogens regulate pest populations (Emana Getu et al. 2008).

2.3.2. Physical control

Includes the use of electricity, sound waves, infrared rays, or light to kill insects or attract them to killing mechanisms. The most common physical methods are those, which employ heat or cold. No insects can survive temperature of 60 to 65ºc for very long (Emana Getu et al. 2008).

2.3.3. Cultural methods

includes good tillage, pruning fertilization, selection of crop plant varieties timing of planting and harvesting, irrigation management, crop rotation and use of trap crops help reduce population of weeds, microorganisms, insects, mites and other pests. Use proper soil, water, PH, fertilizers applications to ensure maximum plant vigor (Abraham Tadesse et al. 2008).

2.3.4. Mechanical control

It's a method in the control of populations by means of a device which affects them directly or which alter their physical environment radically. For example, people used to pick their personal parasites such as lice from their body. These methods include cultivation (control weeds. It also used some insects and other soil inhabiting pests), exclusion (is a mechanical control technique that consists of using barrier to prevent pests from getting into an area), trapping (physically catches insects pests within an area or building) (Emana Getu et al. 2008). Regulatory pest control government agencies are authorized to destroy weeds and plant that cause fire hazards harbors harmful pathogens or animals or are noxious to people or livestock's in and around agricultural areas. Includes, Quarantine (prevent movement of designated pest within a state to prevent spread of pests to non- infested area), eradication (the total elimination of the pests from a designated area) (Abraham Tadesse et al. 2008).

2.3.5. Biological control

Its regulation by natural enemies: predators, parasites and pathogens. Cultural methods such as crop rotation, tillage, mixed cropping, removal of crop residues and adjustment of harvest or sowing times may also be considered as biological control (Emana Getu et al.2008)

2.3.6. Genetic method

The use of sterile male technique in controlling medically important insects and fruit eating pests were well documented. As far as cereal pests are concerned the use of genetically modified organisms like Bt maize and Bt cotton are common (Emana Getu al. 2008)

2.3.7. Varietal resistance

A number of cereal crops varieties such as maize and sorghum have capacities to overcome insect pest attack such as stem borers, aphids and many other insect pests. Some of the crop varieties that are resistant to insect pests are also high yielding. Antibiosis and Antixenosis are the two resistance modalities that can work for stored grain insect pests (Abraham Tadesse et al. 2008).

2.3.8. Chemical method

Chemicals such as Acetylic, Malathion dust and many others were recommended against stored grain insect pests (Abraham Tadesse et al. 2008). However, it is recommended to use chemical control as the last resort.

3. Materials and Methods

3.1. Description of the Study Area

The study was conducted on the Sebeta Awas District (Awash Melka surrounding: Roban Jirecha, Rebeto, Buru, Sego) local community perception on status of stored grain insects' pests associated to the major cereals (Maize, Wheat, Teff, and sorghum) grown Awash Melka district of Sebeta Awas Wereda located in Oromia regional National State of Finfinne Special Zone. Awash Melka district was founded in 1930 E.C and became a village in1999 E.C. It is located about 50 KM South of Addis Ababa by Road, across the Awash River from the Melka kunture which is the Paleolithic sites in the upper Awash Valley with a latitude and longitude of 8˚4′29″N 38˚36′30″E. Three waterfalls lie downstream of the bridge across the Awash here, which provides access south to Butajira.

The total population of the study area was about 10618 from these total population about 5850 females and about 4768 are males & above according to the sample survey gathered in the 2008 E.C.

The climate of this study area was *Weina degas* with about a temperature of 18^{oC}- 20^{o}c and the average annual rainfall was about 80mm. The area seems to be highly distributed by anthropogenic and natural factors like overgrazing, deforestation and soil erosion. The most common crops that are cultivated in the study area are cereals, vegetables, fruits and cash crops. The impact of pest animals such as monkey, termites, birds and rodents are very tremendous in this area. Among the animals pest in the study area insects and Rodents are very dominant.

3.2. Methods of data collection

The study was carried out from August 2018 to August 2019. The preliminary surveys were carried out in August 2018 to August 2019. In this study, all available and relevant information about the study area was gathered. The level of damage and status of insect's pest on the stored cereal crops was gathered by using semi-structured and close ended questionnaires and interviews. Moreover, grains samples were collected to investigate insect pests associated to cereal grains in the study area. From the Kebeles, a total number of 125 respondents were randomly selected for interview and questionnaires for data collection.

For grain sample collection only 25 farmers were randomly selected from the 125 farmers. Grains amounting quarter of a kilo per grain was collected from each farmer. The collected data was analyzed by using simple statistical methods such as frequency and percentage and tabulated by using tables and graphs.

3.3. Data Analysis

The collected data were organized in to tables. Both quantitative and qualitative data were analyzed by using simple descriptive statically methods such as frequency and percentage.

4. Result and Discussion

Background of the respondents is shown in Appendix -2. The respondents were male biased as the percentage for male was 72, while that of female was 28. As far as age was concerned mid age particularly from 41-50 years old was dominating as the percentage was 48%. The majority (72%) of the respondents were married, while the least (4%) was divorced. Most of the respondents (48%) had an education status ranging from 1-4 grades, while the least (4%) was 1st degree holders. The majority of the respondents were farmers (88%), while the rest were daily laborers, business men and developmental agents with the proportion of 4% each. The majority of the respondents (68%) were Orthodox religion followers, 16% each were protestant and waqefata.

The background of the respondents is less in line with farmers of the developing country who is substance in nature and who can also understand post-harvest problems. Social problems like divorce and widow are low indicating the existence of good working environment in the district. The present result is in line with Emana et al. (2008) who reported farmer's background determines how effective they are in producing crops.

Percentage of farmers growing different crops are shown in Table 1. Teff, wheat, sorghum and maize in descending order are the most commonly grown cereals in Sebeta Awas district. Barley is the least grown crop. According to Emana Getu et al. (2008) Ethiopian crop production is dominated by teff and followed by maize, sorghum and wheat in descending order by taking area coverage. As far as Sebeta Awas is concerned there is a little bit deviation which could be due to the highland nature of the district.

Table 1**.** Proportion of farmers grown cereal crops in Sebeta Awas

Crops grown		Percentage
Common name	*Scientific name*	
Teff	*Eragostis tef*	75

Barely	*Hordeum Vulgare*	21
Wheat	*Triticum* spp	68
Sorghum	*Sorghum bicolor*	53
Maize	*Zea mays*	47

Purposes for which cereal crops are grown in Sebeta Awas district are shown in Table 2. The highest proportion of farmers grows cereal crops for consumption. Only few farmers grow cereals for industrial purpose. Cereals are said to be poor man crop as their market value is low in relation to other crops like coffee, oil crops and vegetable crops among others. (Abraham Tadesse et al. 2008).demonstrated that pest control using chemicals is unaffordable by cereal growers as the crops is mainly used for consumption which is in line with the current findings.

Table 2. Purposes for which cereals crops are grown in Sebeta Awas district

Purpose	Frequency	Percentage
Consumption	100	80
Commercial use	15	12
Industrial	10	8
Total	125	100

The land share of each individual farmer by cereal crops is presented in Table 3. About 36% of the respondent farmers indicated that land share of teff per individual farmer was 2 hectares. The least land share is by maize which 0.25 ha. This result is contrary with many places in Ethiopia where these cereal lots are grown. As far as teff is concerned the current result is in line with what is true for the country. For maize is the least is not true elsewhere in the country.

Table 3. Plots of the Land share allotted to each cereal crop by individual farmers in Sebeta Awas District

Cereal crops	**No. of respondent farmers**	**Percent respondent farmers**	**Hectares**
Teff	45	36	2.00
Wheat	35	28	1.50
Barely	25	20	1.00
Sorghum	10	8	0.50
Maize	10	8	0.25

Methods of cereal crops cultivation at Sebeta Awas is shown in Table 4. The highest proportion of farmers uses crop rotation in growing cereals in the district followed by shifting cultivation. Crop rotation is one method of pest control particularly for field pests. However, some stored grain insect pests are field to storage pests. Hence, the use crop rotation can also contribute to the control of stored grain insect pests of cereals.

Table 4. Methods of cereal crops cultivation in Sebeta Awas district

Methods	Number of farmers responded	Percent farmers responded
Crop rotation	60	48
Shifting cultivation	40	32
Counter plugging	25	20

Farmers estimated damage stored grain cereals to 30%. As shown in Table 5 These damages are shared among Apes/Monkey, Insects and Aves/birds. An insect causes the highest damage share followed by rodents.

Table 5. Pests that causing damage to stored cereal grains at Sebeta Awas district

Types of Pests	Damage percentage
Apes/Monkey	20
Insects	40
Rodents	25
Aves /Birds	15

Insect species identified from cereal grains at Sebeta Awas are shown in Table 6. Termites cause damage ranging from 0 to 100%. The highest damage was recorded on teff grain stored in mud made storage and kept under wet condition. Weevils mainly the genus Sitophilus caused up to 20% grain damage to maize, sorghum, wheat and barley. Lesser grain borer only recorded on wheat. Due to the highland nature of the study area the overall stored grain damage by stored grain insect pest is low. (Abraham Tadesse et al. 2008) reported grain losses averaging 50% from different cereal growing areas of Ethiopia which is a bit in contrary with the current findings.

Table 6. Types of insects recorded on stored cereal grains at Sebeta Awas district

Types of Insects	Percent damaged grain	Type of crops
Termites	0-100	Teff
Weevils	20	Maize, sorghum, wheat and barley
Lesser grain borer (*Rhyzopertha*	10	Wheat

dominica)		
Ware house moth (*Ephestia* spp)	5	Maize
Angoumois grain moth	5	Maize

As shown in Table 7 cultural control methods followed by biological control are dominating insect pest control practices in the study area. The use of combinations of method only had 20% share. These findings are in line with Emana Getu et al .(2008). The other mechanisms of the controlling methods also used.

Table 7. Stored grain insect pest control methods under practice at Sebeta Awas district on cereals.

Types	Percentage farmers using each control methods
Cultural	30
Biological control	25
Botanical	10
Chemical control	15
Combinations	20

As the shown in Table 8. Demonstrated different types of storage structures used at study area. All grains can be stored in Madebaria, but Barmel is only used for storing teff. Some of the structures are similar to what (Abraham Tadesse et al. 2008) reported.

Table. 8 Local storage structures used for storing cereal grains at Sebeta Awas district

Storage area	**Types of cereal crops stored**				
	Teff	**Barely**	**Maize**	**Wheat**	**Sorghum**
Dogogo/ made of mud/	√	√		√	√
Gotera	√		√	√	
Barmel	√				
Madebaria	√	√	√	√	√

5. Conclusion and Recommendations

5.1. Conclusion

As far as cereal grains storage insect pests are concerned only up to 20% grain damage was recorded except when teff is stored in mud made structure and kept under wet condition which may result in total grain losses, which is generally low for stored grain insect pest damage so far recorded in the country mainly due to the highland nature of the Sebeta Awas district. Hence, the status of stored grain insect pests in the study area can be said major damage.

5.2. Recommendations

- To rectify the current findings extensive further study is required.
- Farmers need to get advice from the Developmental Agents to avoid heavy losses to stored maize grain particularly termites on Teff.
- Cereal grains production and productivity data under Sebeta Awas condition need to be documented as the author failed to get any published material during his study.

6. Reference s

Abraham Tadesse, Amare Ayalew, Emana Getu and Tadele Tefera (2008). Review of Research on post-harvest pests. Abraham (ed.) Proceedings of the 14th Annual Conference of the Plant Protection Society of Ethiopia (PPSE) 19-22 December 2006, Addis Ababa, Ethiopia [http://dx.doi.org/10.1111/brv.12225] [PMID: 26456883]. Agriculture Organization of the United Nations. http://faostat.fao.org/default.aspx.

Alene AD et al (2009). The economic and poverty impacts of maize research in West and Peri Urban Agriculture—Closing the Nutrient Cycle for Urban approaches Autrailam farm Business managements Journal 9, 13-26.

Anonymous (1978). Banana CA storage .Bulletin of the international Institute of Registrations 18,312.

Ayalew A, Kena K, Dejene T. (2011). Application of NP Fertilizers for better production of Teff (*Eragrostis tef* (*Zucc*.) *Trotter*) on different types of soils in southern Ethiopia. *J Nat Sci Res* (1): 6-15.

Balami , D.H. Ogboru, I.and Talba, D.M (2011). Cereal Economy in Negeria and the sub-Regional Dimension. A publication of Science Study Group (SSG) , Benue State University , Makurdi. SSGseries 1(29) .

Chimoya and Abdullah, 2011). Pest of stored products and their control. Belhaven press London. UK.PP.274.

Emana Getu and Abraham Tadesse (2008). Review of Entomological research on Maize, sorghum and millet. Abraham (ed.) Proceedings of the 14th Annual Conference of the Plant Protection Society of Ethiopia (PPSE) 19-22 December 2006, Addis Ababa, Ethiopia.

Evans, D.E .(1987). Some biological and physical constraints to the use of heat and cold for infecting and preserving stored products of the 4th international working conference on the stored products protection formerly stored – products Entomology , Agricultural Research Organization, Volcanic cEnter Bet Dagam , Isreal , pp- 149-164.

FAO, (2015). Analysis of price incentives for Teff in Ethiopia Technical notes series, MAFAP, by Assefa B. Demeke M., Lanos B, Rome.

FAOSTAT. (2015). Statistical databases and data-sets of the Food and FAOSTAT.(2014). Food and agricultural commodities production: commodities by regions. Retrieved Aug. 18, 2014 from http://faostat3.fao.org/browse/rankings/commodities_by_regions/E.

Food and Agriculture Organization (FA0). 2010. Crops statistics – concepts, definitions and classifications. Retrieved May 29, 2010 from http://www.fao.org/economic/ess/methodology/methodologysystems/crops-statistics-concepts definitions-and-classifications/en/.

(http://en.wikipedia.org/wiki/Grains).

(http://www.geocities.com/napavalley/6454/cereals.html).

(http://www.face online.org.uk/resources/factsheets/discovering/cereals.doc

(https://www.researchgate.net/publication/327944059_Teff_A_Rising_Global_Crop_Current_Status_of_Teff_Production_and_Value_Chain)**.**

Hagstrum .D.W. and Flinn P.W(1996). Ecology . pages 92-104 in : Integrated management of insects in stored grain

Hamza, M. A., & Anderson, W. K. (2005). Soil Compaction in Cropping Systems. A Review of the Nature, Causes and Possible Solutions. *Soil & Tillage Research*, 82, 121-145. http://dx.doi.org/10.1016/j.still.2004.08.009

Hill.D.S and Walker J.M (1990). Pest of stored products and their control. Belhaven press London. UK.PP.274.

Hill , D.S and Walter J.M (1990). Pests and diseases Of the tropical crops . Longman Scientific and Technical, U.S.A Witter, S.H (1998). The Encyclopedia Americana International edition, Vol, 26 pp 832- 833 . Jiskani , M.M (1993). Plant viruses : Major threats to crops pp. 79> 360- 369.

Howe , R. (1965) The biology of the two common storage species of Oryzaephilus(Coleopteran: Cucujidae) . *Annals of Applied Biology* .44(2):341-355

Ismaila , U,. Gana A.S.Tswanya , N.M. and D ogara, D.(2010). Cereals Production in Nigeria: Problems, Constraints and Opportunities for Bettermengrict. *African Journal of Agricultural Research.* 5(12): 1341-1350.

Joseph Mekonnen (1999). Fundamental newly revised Biology, *Aster Nega publishing enterprise, Addis Ababa Ethiopia* PP.659-665, 675-680.

Kamara AY et al. (2008) (a). Effect of phosphorus application and soybean cultivar on grain and dry matter yield of subsequent maize in the tropical Savanas of north-eastern Nigeria. *African Journal of biotechnology* 7(15): 2593-2599.

Kamara AY et al,, (2008)9(b). A participatory approach to increasing productivity of Maize through Strigahermonthica control in Northeast Nigeria soils. *Canadian J.Agri. Econ.*

Makundi, R.H(2005). Farmer perception of rodent as crop pests: Knowledge, Attitude and Marketing in the Urban and Pre-Urban Areas of Addis Ababa, Addis Ababa, 135:153-157.

National Research Council (1996). Lost crops of Africa volume I grains. Washington, D.C.: National Academy Press.

Nuss ET and Tanumihardjo SA (2010). Maize a paramount staple crop in the Context of Global Nutrition, Comprehension Review in Food Science and Food Safety 9 : 417-436.

Ofuya TI and Lale NES, (2001). Overview of pest problems and control in the tropical storage environments , pp 1-23,. In: Ofuya TI Lale NES (eds,), Pests of stored Cereals and Pulses in Nigeria : Biology , Ecology and Control . Dave Collins publications , Akur , Nigeria , 174p.

Schwettman K.D. (1988). On the field attack of the corn weevil *stiophilus zeamains* montschulsky co-curculionidae and its associated fauna in the Philippines Anz schaedlkdpflanzen-schuntz umweltschutz 61:86-95 (in German with English summary

Smale et al, (2011). Maize revolution in Sub-Saharan Africa. Policy research working paper 5659, World Bank.Washington State University. 2010. Agriculture's next revolution-perennial grain- within sight. ScienceDaily. June 27, 2010. Retrieved July 6, 2010 from http://www.sciencedaily.com/releases/2010/06/100624144111.htm.

Tadesse Habtamu and Afework Bekele (1996) Habitat association of insectivores and rodent *of Alatish National Park, N.western Ethiopia*. *African J.Eco*. 49:1-11

Thenkabail, P,S . knox J.W ozdogan M, Mariotto L, 2012 . Assessing future risks to Agricultural productivity, water resources and food security 78: 773-782.

USD 2014). Key access and utilization description for wheat genetic resources. Wheat productivity and their use of consumption in the domestic and international market.

Appendix -1

Questionnaires to be filled by respondents

Dear respondents! This questionnaire is prepared to determine the types of cereals crops grown in Sebeta Awas districts, *To identify the insect's pest on stored grains associated to major cereals grown in the area, To find out the insect's pest management practice that damage on stored grain cereals and the insects pest management techniques used by local communities to control insects pests on the store grain cereals*

The questionnaire has three parts. The first parts is the back ground of the respondents and the second and third part is *To identify the insect's pest on stored grains associated to major cereals grown in the area, To find out the insect's pest management practice that damage on stored grain cereals and the insects pest management techniques used by local communities to control insects pests on the store grain cereals.* Hence, you are expected to provide your response correctly as your response has a great value on the finding of this study.

So feel free and answer it. Thanks you a lot for your cooperation in advance.

PART-I- BACK GROUND OF THE RESPONDENTS

Instruction: **- show your answer by making √ symbol in the box provided.**

1. Sex: Female ☐ Male ☐
2. Age 18-20 ☐ 20-30 ☐ 31-40s ☐
   41-50 ☐ 51-60 ☐ 61 & above ☐
3. Marital status:- Married ☐ Single ☐
   Divorced ☐ Window ☐
4. Educational Status: 1-4 ☐ 10-12 ☐
   5-10 ☐ First Degree ☐ Above ☐
5. Occupational status:- Business man ☐ Farmer ☐ Daly labor ☐
   Student ☐ Teacher ☐ DA ☐ Other workers ☐
6. Religion:- protestant ☐ Orthodox ☐ Muslim ☐ Waqefata ☐

PART II: Insects Pests on Stored Cereals Crops Grain

This part concerns *to identify stored grain insect pest associated to major cereals (Maize, Wheat, Teff and Sorghum) grown in Sebeta Awas District, Finfinne Special Zone, Oromia National Regional State*. Please put your feeling by using √ symbols on the alternative given below.

7. Which of the Following cereal crop plants are grown in these area?
   A.Teff B. Barely C. Wheat D. Sorghum E. Maize F. shemame

8. Please, specify if there is any other cereals crops grains that can grow in these area ?
   _____
   _____

9. From the above types of cereal crop plant, on question No.8 which one is highly cultivated in these areas?
   A. Teff B. Barely C. Wheat D. Sorghum E. Maize F. Shemame

10. For what purpose can the farmers cultivate the cereal crops?
    A . Consumption B. Source food C. commercial use D. Industrial purpose

11. Please, specify if there is any other uses of these cereals crop other than on the above listed on question number-12.
    _____
    _____

12. Are you members of any farmers association _____
    A. Yes B. No

13. What major cereal crops that can be grown in these area other wheat, Barley, Teff , Maize :
    _____

14. What major cereals crops that can be grown in these areas other than Wheat, Barley, Teff and Maize?
    _____
    _____

15. How many hectares can you cultivate in each year of these crops?
    A. Barely_____
    B. Wheat _____
    C. Teff _____
    D. Sorghum _____please specify other

16. What methods do you use to cultivate those cereals crops?

_____

_____

_____

17. The typical time of cereals crop Grains harvesting in these area were?

    _____

18. What are the main pests that can damage the stored cereals crop grains?

    A. Animals B. insets C. Aves/ birds D. Other

19. What types of insets that can damage the stored cereals crop grains?

    _____

20. From the above insects which group of insects you to damage on your stored cereals grains.

    _____

21. How many hectares of stored grain cereals affected by insects each year?

    A. Barely_____

    B. Wheat _____

    C. Teff _____

    D. Sorghum _____

22. How many ***kuntals o***f each stored cereals grains become affected by the insect?_____

23. Which types of insets pests can affects each stored cereals grains crops in ***kuntals***?_____

24. In average what amount of stored grins cereal were affected by the insect's pest from the total amount of stored grain cereals you get each year?

Part –III. <u>Control mechanisms of insect's pests of stored grain cereals</u>.

25. What is pest?

    _____

26. What is insect's s pest?

    _____

27. Do you have knowledge and damage of stored grain cereals by the insects

    A .Yes B. No

28. If yes on question number 27. What did you know about the pests of insects on the stored grains cereals?_____

29. How the insects did damages on the stored grains cereals

    _____

30. From the following alternatives of insects' pests management practices, which methods can you use to control the damages of stored cereals crops?

    A. Apply pesticides B Biological control C. Cultural control methods

    D. Mechanical control E. Physical control F. Chemical control

31. What pest management practice can be used by you and local farmers to control theses insects pests other on the above control methods on question number- 30

32. Why necessary using any control mechanisms for the insects pests on stored grains cereal crops

    _____

33. Where did you store your crops after harvesting? Please mention each of them you use to stored your products

    _____

34. Why you select this place to store your products?

    _____

35. Do you have other alternatives ways to store your products after harvesting?

    _____

36. If you have please , mention all of them :_____

Thanks for your cooperation

Appendix -2

Background of the respondents

1. Gender	**Frequency (n)**	**Percentage (%)**
Male	90	72.00
Female	35	28.00
Total	125	100
2. Age		
18-20	10	8.00
20-30	15	12.00
31-40	25	20.00
41-50	60	48.00
51-60	15	12.00
Total	125	100.00
3. Marital status	Frequency	Percentage
Married	90	72.00
Single	20	16.00
Divorced	5	4.00
Widow	10	8.00

Total	**125**	**100.00**
4. Educational status		
1-4	60	48.00
5-10	40	32.00
10-12	20	16.00
1st Degree	5	4.00
Total	**125**	**100**
5. Occupational status		
Farmer	110	88.00
Daily labor	5	4.00
Business Man	5	4.00
DA/Developmental Agent	5	4.00
Total	**125**	**100**
6. Religion		
Orthodox	85	68.00
Protestant	20	16.00
Waqefata	20	16.00
Total	**125**	**100**