CHAPTER ONE

INTRODUCTION

Tomato, ranking 1st in the world for vegetables, accounts for 14% of world vegetable production over 100 million metric tons/year $ 1.6 billion market; Food and Agriculture Organisation FAO, 2010). It is from night –shade family: Solanaceae.The main vegetable which cultivated in Sudan from this family includes Potato *Solanum tuberosum*.L, Eggplant *Solanum melongena*.L, Pepper *Capsicum annum* and Hot pepper *Capsicum frutescens* (Said ahamed *et al*., 2003).

In Sudan there are fifteen states cultivating tomato crop, but the main products areas are; Gezira, Khartoum and Nile State. Tomato cultivated in both open fields and greenhouses. It is the second popular vegetable after onion in Sudan. The tomato varieties which was used in Sudan are; Peto 86 and Strain B and there also varieties for summer season such as: Eloths and Sophie ,beside these there are local varieties like : Omdurman and Gezira .The vegetable areas in Sudan 584000 fedans in 1999 (Mohamed *et al*.,2003) and the total number of the greenhouses which cultivate tomato and cucumber in Khartoum State 800 houses in the year 2011. The total production of tomato in Sudan in the year 1999 was 707715 tons and the total production of tomato for one greenhouse (350m^2) in Khartoum reached 5 ton per season (Abdol hafeez *et al.*, 2012).Tomato attacks by many diseases and pests in Sudan. The important disease of tomato in Sudan include; Damping off- of seedling, Tomato yellow leaf curl virus (TYLCV),Powdery mildew, Bacterial spot, Late blight and Blossom end –rot .Also there others diseases like; Alternaria, leaf spot and Fuzarium wilt (Juha, 1996).The major insects pests of tomato in Sudan are ; Cotton white fly *Bemisia tabaci* (Genn) and American boll worm *Heliothis* *armigera* (Hb).Beside this there are a miner pests such as ;root-node nematode *Meloidogyne javanica* (Treub),Cotton leaf worm *Spodoptera littoralis* (Boised),Cotton jassid *Empoasca lybica* (De Berg),Cotton soil termite *Microtermes thoracalis* (jost),Tomato bug *Cyrtopeltis tenuis* (Reut),Grey blister beetle *Epicauta aethiops*(Latr),*Epilacbna canina* and *Sarcophage destructor* (Schumtterer,1969).*Tuta absoluta* appeared in Sudan in 2010..The damage of *T.absoluta* in Sudan was reported from Khartoum,Gezira,White Nile, Kassala, River Nile State and Northern causing 60-100% of tomato crop loss .The chemical control is the only management option applied to control *T.absoluta* in Sudan (Mohamed and Mohamed.,2013).

Therefore it has now become necessary to search for the alternative means of pest control which can minimize the use of synthetic pesticides .The botanical pesticides are the important alternative to minimize or replace the use of synthetic pesticides as they possess an array of properties including toxicity to the pest, repellence, anti feedance and insect growth regulatory activities against pests of agricultural importance .The uses of botanic pesticide have many advantages over synthetic pesticides which include: in general possess: it has low mammalian toxicity thus constitute least or no health hazard environmental pollution, on risk of developing pest resistance to these products, less hazard to non-target organisms, no adverse effect on plant growth, it is less expensive and easily available because of their natural occurrence especially in oriental countries (Prakash and Rao, 1997).In this study seed-ethanolic extract of *Jatropha curcas* will be tested against 2nd larvae of *Tuta absoluta*.

The objectives of this study are:

1. To carry out a survey about *Tuta absoluta* in Khartoum State on the areas of summer tomato pests in the schemes of West Soba,South Salyate,El faki hashim and Wad ramly.
2. To evaluate the lethal effect of seeds ethanolic extracts of *Jatropha curcas to* the second larvae instars of *T. absoluta*.
3. To study the preference of *T.absoluta* for the leaves and fruits of five vegetables; tomato, potato, eggplant, pepper from family Solanacea and cucumber from family cucurbitaceous.

CHAPTER TWO

2. LITERATURE REVIEW

2-1-*: Tuta absoluta* (Meyrick, 1917).

Common name:-Tomato leaf miner, tomato borer, South American tomato moth and South American tomato pinworm (NAPPO, 2012).

2-1-1-Back ground:

Tuta absoluta belong to the family Gelechiidae which includes nearly 400 genera and about 4000 species of small moths represented nearly all over the world. The most important insects at this family etc the pin boll worm *Platyedra gossypiella* in the widest spread and one of the most destructive of all cotton pests. The potato tuber moth *Phthorimace operculella* is a widest spread pest of stored potato (Richards and Davies, 1983).

2-1-2- Taxonomy:

Kingdom:Animalia.
Phylum:Arthropoda.
Class:Insecta.
Order:Lepidoptera.
Sup order:Glossata.
Super family:Gelechioidea.
Family:Gelechiidae.
Sup family:Gelechiinae.
Tripe:Gnorimoschemini.
Genus:Tuta.
Species: absoluta.

2-1-3-Geographical distribution:

Tuta absoluta is originated from South America. It is a serious pest in South America since the 80s and distribution in Argentina, Bolivia, Brazil, Chile,Colombia,Ecuador,Paraguay ,Peru, Uruguay and Venezuela (EPPO ,2005). Also the following countries are currently considered infested with *T.absoluta*;Albania,Algeria,Austria,Bahrain,Belgium,Bulgaria,Cayman,Islan,Cyprus,CzechRepublic,Denmark,Egypt,Estonia,Ethiopia,Finland,France,Germany, Greece,Hungary,Iran,Iraq,Ireland,Israel,Italy,Jordon,Kosovo,Kuwait,Latvia,Lebanon,Libya,Lithuania,Luxembourg,Malta,Morocco,Netherlands,Palestinian,Authority (West Bank), Russia, Saudi Arabia,Senegal,Slovakia, Slovenia, Spain, Sudan, Sweden ,Switzerland, Syria, Tunisia, Turkey,United Kingdom and Western Sahara (NAPPO, 2012).

2-1-4-Description:

Egg is small, cylindrical, creamy white to yellow-orange and 0.35mm long. Females usually lay eggs on the underside of the leaf or stem and to a lesser extent on fruits. Egg hatch in 4-6 day. Larvae are cream colored with a characteristic dark head and lateral spot that extends from the ocellus until the posterior margin. Larvae lack a typical dorsal plate in the prothorax .Instead they have a dark oblique band that does not cover the dorsal midine .The larval has four larval instars before transforming into the pupae stage. No diapauses for the larval instar if the food available. As they grow older, they became greenish to light pink in the second to fourth instar (by feeding on leaves) and measure between 1-8mm.The larval period is the most damaging period to plants and is completed within 12-15 days. The feeding behavior results in irregular mines on the leaf surface. Older (3^{rd}-4^{th} instar) larvae can feed on all part of tomato plant .Fully- grown larvae usually drop to the ground on a silk thread and pupate in the soil and although pupation may also occur on leaves or in the calyx .Pupae are cylindrical in Shape and greenish when just formed, becoming darker in color as they near adult emergence .The pupae are often coated with a white silky bud. Pupae have been found in the mines, outside the mine, the soil, as well as beneath posts and under greenhouse benches. Adult are 5-7mm long with wing span of 8-10 mm.The most import an identifying characters are the filiform antennae ,silverfish-gray scales and black spots present on the anterior wings .Amateur female can lay up to 250 eggs on the host plant , live for two weeks and whereas the males live only one week. Adults are nocturnal in habit, usually remain hidden during the day, showing greater morning –crepuscular activity and they disappears among crops by flying (Eatay, 2000).

2-1-5- Biology:

Tuta absoluta is a micro –Lepidopteron insect. The adults are silvery brown 5-7mm.Total life cycle is completed in average of 24-35 days, with the exception of winter months; when the cycle could be extend to more than 60days.The minimal temperature for biology activity is 4ºC. After copulation, females lay egg up to 300 individual small (o.35 mm long) cylindrical creamy yellow eggs, which are often found alongside the rachis –freshly hatched larvae are light. Yellow or green and only 0-5mm in length .As they mature, larvae develop a darker green color and characteristic dark band posterior to the head capsule. Four larvae instar develop. Larvae do not enter diapauses when food is available, pupation may take place in the soil, on the leaf surface, thin mines or in packing material. A cocoon is built if pupation does not take place in the soil. 10-12 generation can be produced each year .*T. absoluta* can over winter as egg and pupae or adult depending on environmental condition .Under open field condition *T.absoluta* is usually found up till 100 m above sea level (IRAC,2011).

2-1-6-Ecology:

The optimum temperature for *T.absoluta* development ranged from 19-23 ºC. At 19 ºC there was 52% survival of *T.absoluta* from egg to adult. As a temperature increase (23ºC and above) development time of the moth would appear to decrease .Pupation development ceases between 7and 10 ºC. Only 17% of the egg hatched at 10 ºC, but no larvae development through to adult moths. No egg hatched when maintains at 7 ºC .Under laboratory condition the total life span of the moth was longest (72 days) at 13 ºC and shortest (35days). At both 23 ºC and 25 ºC development from egg to adult took 28 days at 13 ºC, 37days, at 19 ºC, and 23days and at 25 ºC high mortality of larval stages occurred at all temperatures tested. Under laboratory conditions, first instar larvae were exposed on the leaf surface for approximately 82 minutes before fully tunneling into leaf. Adult longevity was longest at 10 ºC with adult moths living for 40 days (when supplied with a food source) and shorts survived for 16 days. In general more males than females were produced (IRAC, 2011).

2-1-7 -Behavior:

Adult *T.absoluta* is most active at dusk and dawn and rest among leaves of the host plant during the day (Fernandez and Montagne ,1990 ,Viggiavii *et al.,* 2009).Mating usually occurs day after adult emerge usually at dawn. Studies in Chile revealed that the greatest number of males were captured in pheromone traps during the period 7 to 11am.Suggesting that this is the time when males are searching for calling females (Miranda, 1999). Hickel *et al*., (1991) studied the mating behavior *T.absoluta* in the laboratory and determined the sequence of male mating behavior can be divided into two phases. Long range female location and short range female location. Duration of copula is variable sometime taking 2 to 3 hours or extending to as much as 6 hours. Adult females lay their eggs singly (rarely in batches).The larvae normally hatch from the egg in the morning .The larvae consume the mesophyll leaving the epidermis intact. Later instars can attack maturing fruit (Vargas, 1970). Mature larvae purge themselves of food and shorten their body length. Larvae spin a silken cocoon where they transform into pupae .Pupae can be found attached to all plant parts as well as in soil (Torres *et al*., 2001).

2-1-8-Host plant:

In South America, the preferred host of *T.absoluta* is tomato; the pest lays eggs in all above ground portions of plant (leaves, shoots and flowers) including on the fruit (Vargas, 1970).The tomato leaf miner is able to complete it development from (eggs to adult stage) on *Solanum tuberosum* ,*S.melongena, S.gracilius,S.bonariens* and *S.sisymbriifolium* (Galarza,1984). Fernandez and Montage, 1990) conducted host preference studies of *T.absoluta* in laboratory in Venzuela.They found that tomato cultivar “Rome Gigante” was preferred oviposition host and the best host for larvae development when compared to tomato variety Cerasiforme ,eggplant, tobacco,*Solnum htrtum*,Physalis,angulata, S.amertcanum and Potato. Among it is alternative hosts of *T.absoluta* are the weeds *Lyctum chtlense* (Coralillo) ,*Solanum nigrum*and *Datura stramonium* (Eatay,2000). Also there other hosts of *T.absoluta* such as: *Datura ferox,Nicotiana glaucal* (tree Tobacco) (EPPO, 2005), sweet cucumber (Pepino) (FERA,2009) and *Cape gooseberry* (Garzia,2009).*T.absoluta* was reported on greenhouse peppers and bean in Italy (EPPO, 2009).

2-1-9-Damage and economic importance:

Infestation of *T.absoluta* to tomato plants occur throughout the entire crop cycle. Feeding damage is caused by all larval instars and throughout the whole plant. On the leaves, the larval feed mesoghyll tissue, forming irregular leaf mines which may later become necrotic. Larvae can form extensive galleries in the stem which affect the development of the plants .Fruit are also attacked by the larvae and they entry-way are used by the secondary pathogen, leading to fruit rot. The extent of infestation is partly depended on the variety. Potential yield less in tomato quality and quantity is significant and can reach up to 100% if the pest is managed (IRAC, 2011).*T.absoluta* reduced yield and fruit quality of tomato grown in green house and open field. Severely attacked tomato fruits lose their commercial value, 50-100% losses have been reported on tomato (EPPO, 2005). Since it is introduction into Europe in 2006 *T.absoluta* continued to rapidly spread through the European and Mediterranean region when it is a serious pest of field and greenhouses grown tomato. *T.absoluta* is major limiting factor for tomato production in South America (Ferrara *et al*., 2001). It is a key pest of most greenhouse –grown tomato in Argentina (Botton ,2011) and the key pest of tomato production in Chile (Eatay,2000) .*T.absoluta* important Lepidoptera pests associated with processing tomatoes in Brazil (Torres *et al*.,2001).

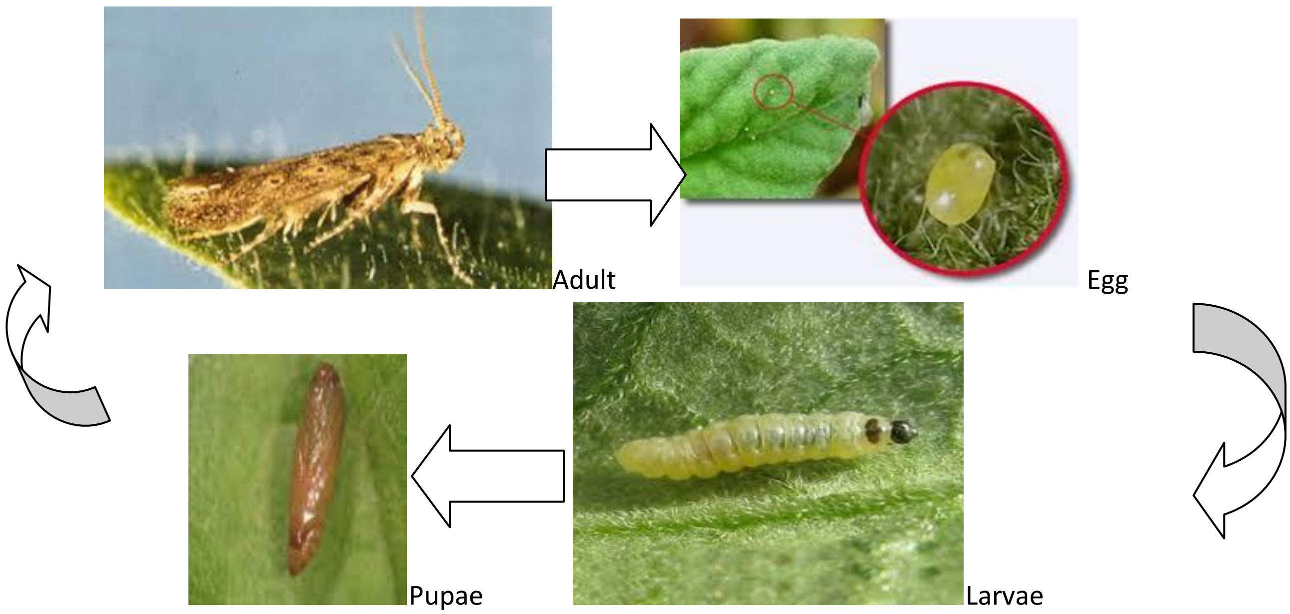


Plate (1) life cycle of tomato leaf miner *Tuta absoluta (NAPPO,2012)*.

2-1-10 -Control measure

2-1-10-1- Cultural control:

Nurseries Greenhouse Tomato production- installing double self-closing doors and covering windows and other opening with 1.6 mm (or smaller) insect mesh can prevent entry or exit of adult *T.absoluta* in greenhouse (Info Agro System,2009a).Inside the greenhouse plant should be checked for evidence of egg, mines, larvae, frass and damage. The underside of fruit, clyces and the fruit itself should be checked (Mallia, 2009). The infested plants or plant part should be removed, especially at the beginning of cultivation and residues should be disposed of carefully ensuring that they are stored in sealed containers until they are seat to waste management facilities (Info Agro System, 2009b).The Solanaceous weed in the vicinity of infestation greenhouse should be removed destroyed (Kopper, 2009).The greenhouse crop products, soil solarization during at least 4 to 5 weeks eliminate pupae that remain on the ground (Info Agro System, 2009b). In open field recommended a 6-week host-free period between cultivation of susceptible crops in summer area, the period should be increased to 8 weeks during the winter to account for slower *T.absoluta* rates of development. The host free period can be reducing if additional strategies to destroy pupae in the soil are used together with this method (M RAM, 2008). In the Unite State, a crop rotation with host frees period essential for reducing (tomato pin worm) population in tomato crop (Zalom *et al*., 2008).The following guideline may also help to suppress *T. absoluta* population in the field situation conventional as the center –pivot irrigation is favored over soil irrigation since these methods disturb eggs, larvae, pupae and can increase mortality in field population (Embrap, 2006).

2-1-10-2-Biological control:

The following bio-agents have been reported by Cabello *et al*, (2009) to control *T.absoluta:*

1. Trichogramma pertiosum.

2. Trichogramma achaeae.

3. Nabis pseudoferus.

The egg parasitoid *Trichogramma achaeae* has been identified as a candidate for biological control of the South American tomato pinworm *T.absoluta* on greenhouse condition a high efficacy 91.75% of damage reduction was obtained when releasing 30 adult /plant =(75 adult/m) every 3-4 days on August and September at 2008 in the southeast of Spain .The use of biological pest control, the damsel bug *Nabis pseudoferus*, is being studied to be applied in Spanish greenhouses .Two semi field bioassays on tomato plant, under controlled condition, have shown an important reduction in the number of egg of *T.absoluta* between 92 and 96% when releasing 8 or 12 first stage nymphs of *Nabis pseudoferus* per plant . Urbaneja *et al*., 2009) mention that the mirid *Maerolophus pygmaeus* and *Nesidiocoris tenuis* are endemic to Spain and feed on eggs and larvae of *T.absoluta*. In one of the study, adult of *M. pygmaeus* and N. tenuis consumed 30+eggs and 2 *T.absoluta* daily.

An additional mirid *Tuptocort cucurbitaceaus*,has been recently evaluated as a potential biological control agent against *T.absoluta* and white flies in Argentina (Lopez, 2010).Also there the method of use microbial control such as *Bacillus thuringiensis var Kurstaki* have exhibited satisfactory efficacy against *T. absoluta* larval infestation in Spanish outbreaks .Delayed application of *Bacillus thuringiensis* may cause higher insect mortality if the insect become more susceptible to the pathogen a longer period of feeding on the resistant crop. It is reported that combine application of mass release of *Tichogramma pertiosum* and *Bacillus thuringiensis* resulted fruit damage only 2% in South

America (Medeiros *et al*., 2006). More recently, the muscadine fungi *Metarhiztum anisopliae* (Metschn) Sorokin has been studied for control *T.absoluta.Adult* females infested with *M.anisopliae* resulted in 37% female Egg exposed to *M.anisopliae* were all infested after 72 hours (Pires *el at*.,2009).

2-1-10-3- Botanical control:

Neem seed extract, Azadirachtin act as contact and systemic insecticides against *T. absoluta*. A soil application 48-100% larval mortality was recorded. Application of neem oil in adaxial surface of the foliage cause 57-100% larval mortality and it reported that application directly on larvae caused 52-95% mortality (Goncalves and Vendramis,2008).

2-1-10-4-Chemical control:

Historically *T. absoluta* has been controlled with chemical, organophosphates and pyrethroids were used during 1970s and 1990s until new products introduced in the 1990s such as (abamectin,spinosade,tebufonzide and chlafenpyr) became available (Lietti *et al*.,2005). At least 12 classes of insecticides control *T. absoluta*.The control failures with organophosphate and pyrethroids in South America (Salazar and Araya, 2001).Prompted research on the resistance status *of T. absoluta* .However, newer classes of insecticides are providing good control of this pest (IRAC, 2009).This section describes pesticides used in current outbreak and also mentions insecticides used to control *Keiferia lycopersicella* (tomato pinworm) a Gelechiidae moth that occupies the ecological niche of *T.absoluta* in United State they include:Indoxcarb, Spinsade, Imidaciprid and Pdeltamethr in (FERA,2009,Russe l IPM,2009b).The insecticides abamactin ,indoxcarb,spinosade ,imdacloprid,thiacloprid and lufenuron, were recommended use for outbreak in Malt (Mallia, ,2009). Abamectin it is a natural fermentation product from the soil bacterium streptomyces avermitilis(ex Burg et al)Kim and Good fellow, has good trans laminar action ,penetration the leaf surfaces of the host plant .It attacks the nervous system of the insects and mites causing paralysis within hours. It is primarily a stomach poison although there is some contact activity .It is used against mites and leaf miners (Salvo and Valladares,2007) and spares some of the major leaf miner parasitoids and some predaceous mites ,although it is still highly toxic to bees. The University of California recommends abamectin for control of the tomato pinworm in IPM program(Zalom etal.,2008).Abamectin in MOA group(6), the class Avermectin and the common name is Abamectin and Emamectin benzoate(IRAC,2007).Treatment manual for using methyl bromide fumigation to treat tomatoes from Chile that is potentially infested with *T.absoluta* (PPQ, 2009).

There are many types of traps which were used against *T. absoluta* such as: Pheromone-Baited traps: Used traps baited with synthetic sex pheromone for monitoring population of *T. absoluta* in open field, greenhouses and packing sites. Sex pheromone–baited traps will capture only adult males. The Sex pheromone *of T. absoluta* has been isolated and identified. The main compound are (3E, 8Z, 11Z)-3, 8, 11-tetradecatrien-1YI acetate and (3E, 8Z)-3, 8-tetradecadien-1-YI acetate in the proportion of 90:10 respectively (Svatos *et al*., 1996).There also the mass trapping: It is involving placing a large number Pheromone-Baited traps in the strategic position within a crop .Large number of adult males are trapped resulting in an imbalance to the sex ratio which impacts the mating pattern of *T. absoluta* .It can be used to reduce *T. absoluta* population and is particularly useful in production of greenhouse tomato (Russel IPM, 2009b).The Pheromone trap density should be 20 to 25 traps/ha inside greenhouse (30 traps/ha for greenhouses density for plant propagation and in open filed 40 to 50 trap /ha (Bolkman, 2009, Fredon-Corse,2009). In addition to that the pan traps: It is easier to maintain and are less sensitive to dust, compared to Delta, Mephail and light traps. It is also have a large trapping capacity than

Delta traps. Rectangular plastic traps that hold 6 to 8 liter of water baited with pheromone lure are recommended for it (Info Agro System, 2009b).

2-1-10-5- Other control methods:

The light traps: It has been used to control *T.absoluta* in the greenhouse tomato production in Italy as following: Install trap at a height of 1 meter or less from the ground and at rate of one trapper 50 to 100 m (Laore Sardegna, 2010).Light traps should be placed near entry doors and used only during sunset and sundown (Bolkman, 2009). Russel IPM, (2009a) recently developed alight trap for *T.absoluta* that capable of capturing thousands of male insects in addition to a substantial number of females per night-light named Fibrolite –TUA it used a combination of sex pheromone and a specific light. Also there laboratory studies on the effect of gamma radiation on life stage of *T. absoluta* were conducted in Brazil. The lethal dose for *T.absoluta* for eggs was found 100 Gy,the dose preventing larvae from completing development was 200 Gy and dose for pupae that prevented adult emergence was 300 Gy .Over all a dose of 300 Gy was found to be lethal to all stage of *T. absoluta*. The dose that resulted in sterile adults when pupae were treated with gamma radiation was 200 Gy (Arthur, 2002).

2-2-Tomato:

Tomato has it is origin in the South America Andes. The word (tomato) comes from the Spanish tomate.It first appeared in Print in 1595.It is from nightshade family Solanaceae. There are around 7.500 tomato varieties grown for various purposes. The tomato is consumed in diverse ways, including raw as an ingredient in many dishes, sauce, salads and drinks (Naika *et al*., 2005).

2-2-1-Taxonomy:

Kingdom:Plantae.

Order:Solanales.

Family:Solanaceae.

Genus:Solanum.

Species:S.Lycopersicum.

Synomyms:Lycopersicum esculentum Mill.

2-2-2-Botany:

Tomato is one of the most important vegetables worldwide. The tomato root vigorous taps root system that grows to a depth of 50cm or more. The main root produces dense lateral and adventitial roots. The stem growth habit ranges between erect and prostrate. It grows to a height of 2-4 m.The leaf spirally arranged 15-50 cm long and 10-30 cm wide, covered with glandular hairs. Inflorescence is clustered and produces 6-12 flowers. Petiole is 3-6 cm.The flowers of tomato Bisexual, regular and 1.5-2 cm in diameter.They grow opposite or between leaves. Calyx tube is short and hairy, sepals are persistent. Usually 6 petals are up to 1cm in length, yellow and reflexes when mature. Ovary is superior and with 2-9 comportments. Most self-but partly also cross-pollinated. The fruit is fleshy berry, globular to oblate in shape and 2.15 cm in diameter. The immature fruit is green and hairy. The tomato seeds are numerous, kidney or pear shaped.3-5 mm and 2-4mm wide. The embryo is coiled up in endosperm .There are three different types of tomato plant can be distinguished: Tall or indeterminate type, semi-indeterminate type and bush or determinate type (Naika *et al*., 2005).

2-2-3-Ecology:

Tomato requires a relatively cool, dry climate for high yield and premium quality. However, it is adapted to a wide range of climatic from temperate to hot and humid tropical. The optimum temperature for most varieties lies between 21 and 24 ºC .The plants can survive a range of temperature, but the plant tissues are damaged between 10 ºC above 38 tomato plant react to temperature variation during the growth cycle, for seed germination, seedling growth, flower and fruit quality. Frost will kill the plants. To avoid frost damage, it is best to wait until the winter is definitely over before sowing Light intensity affects the color of the leave, fruit set and fruit color. Water stress and long dry periods will cause buds and flowers to drop off and the fruits to split .However, if rains are too heavy and humidity too high, the growth of mould will increase and the fruit will rot. Cloudy skies will slow down the ripening of tomato. However, adapted cultivars are available .Tomato grows well on most mineral soil that have proper water holding capacity and aeration and are free of salt .It prefers deep, well drained and sandy loam soils. Soil depth of 15 to20 cm is needed to grow a healthy crop (Naika *et al*., 2005).

2-2-4-Nutritional value of tomato:

This for red tomato, raw (per 100 g (3.5.oz).Energy 74 KJ, Carbohydrates 3.9 g, Fat 0.2g, Protein 0.9 g, Vitamins 5% and Trace metals 3%.There also other constituents such as Water 94.5 g and Lycopene 2573 µg (Naika *et al.*, 2005).

2-3–*Jatropha curcas* (Linnaeus):

Jatropha curcas belong to the family Euphorbiaceae in thus closely related to other important cultivated plant like rubber tree and caster etc. The plant is believed to be a native of South America and Africa but late spread to other continent of the world by the Portuguese settlers (Gubitz *et al*., 1999).The genus Jatropha consists of between 165 and 175 species, distinguished two sub genera, ten sections and ten sub section. There are two genotypes of *J.curcas*, a toxic and nontoxic one .The later genotype is found in Mexico only. Jatrophaa diploid species with 2n-22 chromosomes (Dehgan and Webster, 1979).

2-3-1-Toxonomy:

Kingdom: Planate.

Division:Tracheophyta.

Class:Magnoliopsida.

Super class:Rosanae.

Order: Malpiphiales.

Family: Euphorbiceae.

Genus: Jatropha.

Spesies: curcas

2-3-2- Botanical description:

Jatropha has green leaves with a length and width of 6-15cm.The branches contains white, sticky latex that leaves browns and which are hard to wash out. The root system is well developed; with roots growing both laterally and vertically into deeper soil layers. The plant is monoecious, with male and female flowers on the same plant. The fruit contain 3seeds. The seeds look like black beans and are on average 18mm long and 12mm wide and 10mm thick. The plant produces seed with high oil content. The seeds are toxic and in principle non-edible (Heller, 1996).

The plant regarded as a shrubs/small tree with height generally ranging from 3-4 meter (m) .It has been estimated that life of the plant is up to 50 year. Different varieties of the plant can found which are generally: Cape Verde, Nicaragua, Life –Nigeria and non-toxic Mexico (The Biomas project, 2000).

2-3- 3-Geographical distribution:

Jatropha historically originated from Central America and the northern parts of South America. Jatropha has been distributed to other tropical regions by European seafarers and explorers from the 16 century onwards .Presently it grows in tropical areas worldwide (sub-Saharan African Countries, Southeast Asia and India) (Heller, 1996).

2-3-4- Cultivation:

Jatropha curcas can be grown potentially over west land which requires re-vegetation *J.curcas* is a well growing hardy plant well adapted to acid and most moisture demand and can come up strong, gravelly, or silo and even calcareous soils (Radish, 2004). It can be grown over a wide range of arid or semi-arid climate condition. For the emergence of seed, hot and humid climate is preferred. There, for fairly warm summer with rain beneficial for proper germination of seed. The flowering is inducing in rainy season with reduction in temperature and plant bear fruits in winter. The plan can be cultivated with success in areas with scanty to heavy rainfall. The lands should be ploughed once or twice depending on nature of soil. Tow seed should be dibbled at each spot at spacing indicated below (Gubitz *et al*., 1999).The seedling are susceptible to competition from weeds during their early development. Therefore weed control, either mechanical or with herbicide, is required during the establishment phase. Satisfactory planting width are 2×2 m, 2.5×2.5m and 3×3m.This is equivalent to crop densities of 2500, 1600 and 1111plants /ha, respectively in open filed (Orwa *et al*., 2009).

2-3-5-Chemistry:

The analysis of *Jatropha curcas* seeds show that it contains; moisture 6.62, protein 18.2, fat 38.0, carbohydrates 17.30, fiber 15.50 and ash 4.5%.The oil content is 35 to 40% in the seed and 50 to 60% in the kernel. The oil contains 21% Saturated fatty acids and 70% unsaturated fatty acid. It is also been stated that technologies are now available, whereby it could be possible to convert jatropha oil into edible oil which could prove to be a boon for developing countries .The oil is obtained from decorticates seed by expression or solvent extraction and is known in trade as Jatropha .In general, the oil is reported to be mixed with groundnut oil for adulteration .This indicates the possibilities of obtaining edible oil from Jatropha oil base (Gubitz *et al*., 1999).The oil extracted from seed presents toxic compounds as diterpenes with applications such as pesticides insecticides, bactericides, nematicide and fungicides (Devappa *et al*.,2010).Among the main toxin substances presented in Jatropha are curcin and phorbol ester12–deoxy-16-hidroxiforbol (Beltrao and Oliveira,2008).

2-3-6-Economic importance:

Jatropha uses in different purpose .It uses as energy like diesel oil, making soap in some countries, wool spinning, protein used in raw material and ashes of root and branches are used in cooking salt. Beside this it can use as organic manure for soil, feed stoke for fusser silk worm and the seed oil of Jatropha contains a toxin curcin and croton resin (Gubitz *et al*., 1999). *J. curcas* leaves were effective in controlling *Sclerotium spp* and Azolla fungal pathogen (Orwa *et al*., 2009).

2-3-7- Medical uses:

Jatropha potential as medicinal plant. The tender twinges used for cleaning teeth. The juice is reported to relive toothache and strengthen gum. The leaf juice is used as external application for piles. It is also applied for inflammation of the tongue in babies. The twigs sap is considered styptic and used for dressing wounds and ulcers. An emulsion of the sap with benzyl benzoate, it cans effective against scabies, wet eczema and dermaties. A decoction of leaves and root is given for diarrhea. The root contains yellow oil with strong anti limintic action. The root bank is used for sore .A decoction of the bark is given for rheumatism and leprosy. Similarly, root are also reported to be used as antidote for snake bite (Gubitz *et al*., 1999).The seeds have purging oil from them is a drastic purgative. The resemble groundnut, in flavor and 15 -20 seed will cause griping, purging and vomiting for 30 minutes. The oil is widely usfor skin diseases and to soothe pain such as that caused by rheumatism. The oil is used to stimulate hair growth. The seeds are also used in the treatment of Syphilis. (Orwa *et al*., 2009).

Plate (2) **Jatropha *curcas* plant (Heller. 1996)**

Plate (3)*J.curcas* leaves. **Plate (4)*J. curcas* seeds.**

CHAPTER THERE

3- MATERIALS AND METHODS

This study was carried out a survey in forty and half fedans about *T. Absoluta* in summer tomato (variety GS) where cultivated in four agricultural schemes in Khartoum State. These schemes were in different areas (Soba in southern, Elfaki hashim and Wad ramly in northern and Salyate in eastern of Khartoum State. The areas were twenty fedan in West Soba which possessed to Magrapi Company, nine fedan in South Salyate, seven fedan in El faki hashim and four and half fedan in Wad ramly (Plate 5).

They used the pheromone trapTUA-100N (Plate 8) for monitoring and control of *T.absoluta*. Russel l PM, (2009b) product, develops a new long lasting pheromone lure, TUA-100N for desert climate .The pheromone TUA -100 N can be used to capture *T. absoluta* for the up to 100 nights without losing efficacy. It is specially designed for open field tomato cultivation in hot desert climate (WWW.russellipm.com).The survey was applied from the nurseries stage of summer tomato until the mature stage (plates 6 and 7). It took three months July, august and September in 2014.

There was also two laboratory experiments were conducted at Entomology, Department of Plant Protection, College of Agricultural Studies, Sudan University of Science and Technology (SUST). The first study was to evaluate the lethal effect of seeds ethanolic extract of *Jatropha curca* against the second larvae of Tomato leaf miner *T.absoluta (plate 9)* and the second was to investigate the preference of second larvae of *T. absoluta* to five vegetables plants: Tomato, Potato, Eggplant, Pepper, from family Solanaceae and Cucumber from the family Cucurbitaceae (plate 10).

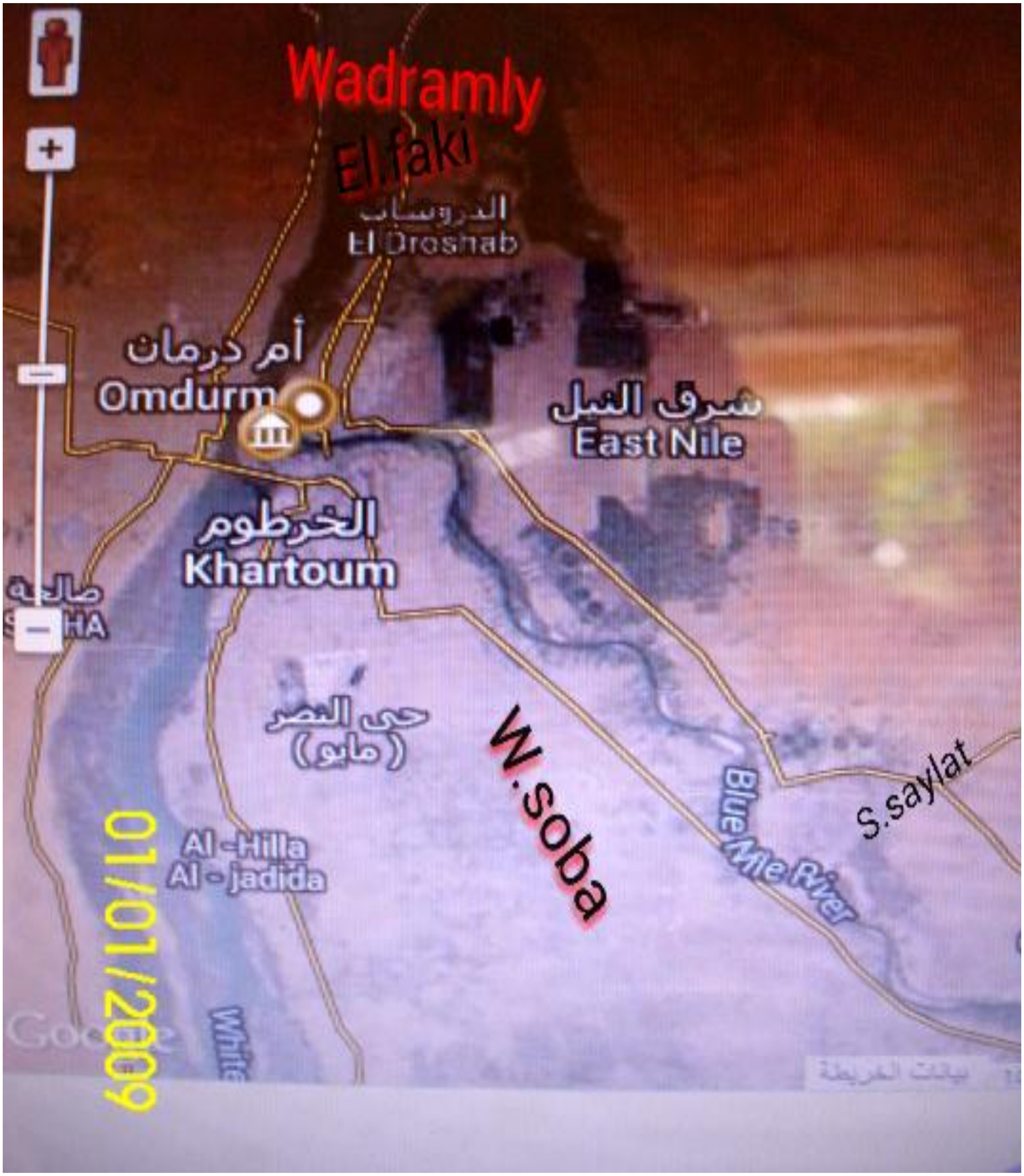


Plate (5)The map of the four agricultural schemes (West Soba, South Salyat,Elfaki hashim and Wad ramly) of summer tomato in Khartoum State.

Plate (6) Field of summer tomato on (flowering stage) with a pheromone trap (TUA-N100) of Tomato leaf miner in West Soba agricultural scheme.

Plate (7) Field of summer tomato on (fruits stage) in Wad ramly agricultural scheme.

Plate (8) Types of TUA-100N pheromone raps of Tomato leaf miner.

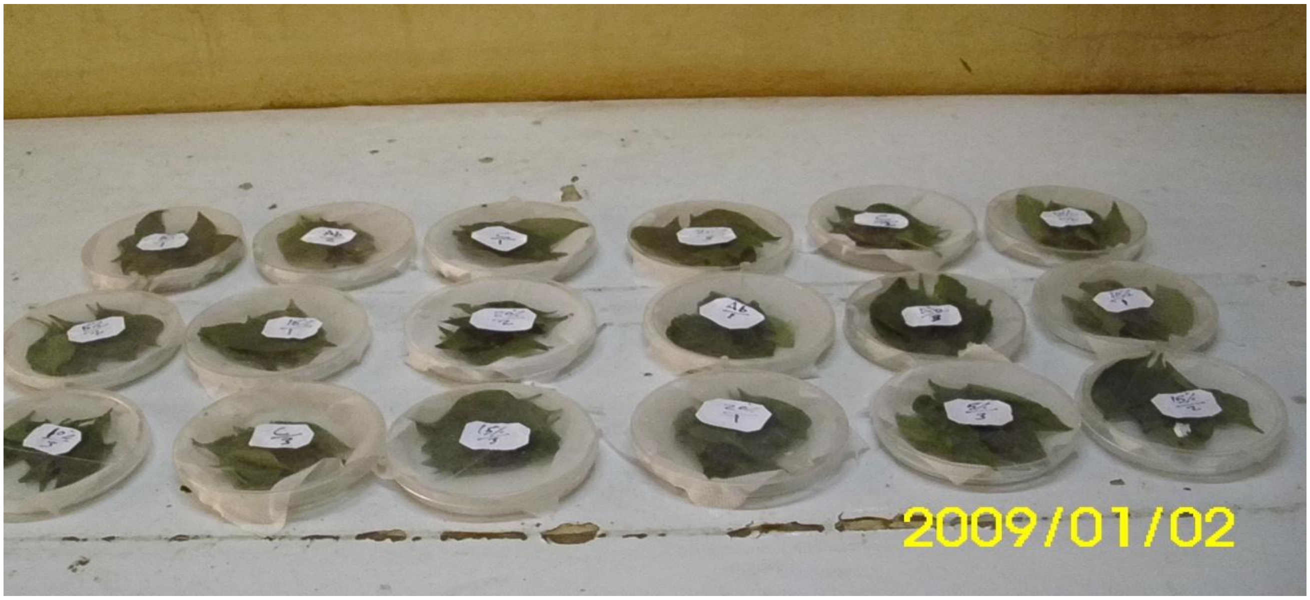


Plate (9) The experiment design of Jatropha curcas against *T.absoluta*.

Plate (10)The cages of the vegetables which preferences by *T.absoluta*.

3-1-Equipments:

1. Camera.
2. Hand lens.
3. Plastic cages.
4. Bruch.
5. Hand sprayer.
6. Sensitive balance.
7. Masks.
8. Electronic blender.
9. Soxhlet extracts apparatus.
10. Rotary evaporator.
11. Petri-dishes.
12. Marker pen.
13. Registration form.
14. Pencil.
15. Gloves.
16. Scales.

3-2-Material:

1. Leaves and Fruits of the following vegetable:
   - Tomato
   - Potato
   - Eggplant
   - Pepper
   - Cucumber
2. Jatropha seeds.
3. Ethanol 90%.
4. Distilled water.
5. *Tuta .absoluta* pheromone traps TUA-100 N.
6. Soap.
7. U HU.
8. Muslin cloths.
9. Sand.
10. Abamectin.
11. Beakear.

3-3-Method of field's survey experiment:

The aim of survey was to evaluate the infestation of Tomato leaf miner *Tuta absoluta* of summer tomato in open fields on areas (forty and half fedan) in Khartoum State. The survey was applied in four agricultural schemes in Khartoum State. The areas which were covered by every survey three fedans in each scheme, each fedan as a replicate (3 replicate).The survey was conducted for three months, two survey were conducted on 1st July and the second on 15th July, the survey repeated for August and September. The survey for the target insect of tomato include: leaves, stems, fruits and also a pheromone traps (TUA-100N). At the same time other pests found in tomato or pheromone traps were recorded. The data was collected according to the guide line of (NAPPO, 2012).

3-4-Laboratary extract experiment:

3-4 -1-Collection of the target insect:

Infested leaves of tomato by tomato leaf miner were collected from unsprayed Greenhouse in west Omdurman area and then brought to the laboratory for rearing. They were reared in plastic cages 31×20×19 cm and covered with muslin cloth .The bottom of these cages were filled with sand 2cm in height .Each plastic cage was supplied with fresh tomato leaves and a beaker filled with sugar solution and a pieces of cotton soaked into it for adult feeding. The insects left to multiply .Every day before replacement of fresh leaves, the leaves were examined thoroughly well for eggs. Leaves which contain eggs were transferred to other rearing cages.

3-4-2-Egg preservation:

The leaves which content eggs are selected and kept in plastic cages size 19cm in diameter covered with muslin cloth containing moistened sand 2 cm in height.

3-4-3-larvae rearing:

After hatching, the new larvae which infested the leaf were transferred and kept in other plastic cages size 25×17×16 cm covered with muslin cloth. The bottom of each cage were filled with sand and moistened daily, also supplied the cages with fresh tomato leaves for feeding.

3-4-4-Pupae preservation:

The pupal stage was transferred by brush to cages 31×20×19 cm which content beaker filled with sugar solution on pieces of cotton and supplies by fresh leaves of tomato for the adult emerge. So the rearing continued until taken sufficient number of larvae was produced for the experiment.

3-5-Collection and preparation of plant materials:

Jatropha curcas seeds were taken from the storage seeds of Administration of Horticulture Sector, Khartoum-Mogran (AHS) and then the seeds were cleaned, de-shelled, sub sequent the kernel and hull are separated manually. After complete dryness of seeds in shade. The sample crushed separately by an electric blender to obtain the powder for the extraction processes.

3-5-1- Extraction methods:

The extraction processes were conducted at the chemistry laboratory, College of Agriculture Studies, Sudan University of Science and Technology. Sixty gram of seeds prepared powder. The powder of seeds was placed in a thimble and it was placed in an extraction chamber of a Soxhlet extraction apparatus and then extracted with 600ml ethanol 90%.The extraction continued for six hour and the ethanol solvent was removed off the crude extract by Rotary evaporator. The obtain crude material were weighted and carefully stored for the experiment.

3-5-2- Preparation of concentrations:

According to volumetric law 5%, 10%, 15% and 20%.Cocentrations were prepared from extract by dilution from crude extract. The recommended dose of abamectin 1, 8% ES (0.113 liter/fedan) was used as standard insecticide in this study.

3-5-3-Bioassay procedure:

The second larval instar of tomato leaf miner was used in this study. Eighteen Petri dish (9 cm diameter) line with sterile filter papers .Then 2ml of each concentration were added to each Petri dish and rotated in such a way that an even distribution was achieved. For each Petri dish ten larvae were used for each treatment of the seeds ethanolic of *Jatropha curcas* and each treatment was replicated three times in completely randomized block design. The four treatment of concentrations were applied in addition, thirty larvae were treated with the recommended dose of abamectin (1,8% ES) (0.113 liter/fedan) as standard .Also thirty larvae were used as control and only sprayed with distilled water..The temperature of the laboratory range 25-32 ºC.The mortality was recorded after 24, 48 and 72 hours of application.

3-6- Laboratory preferences experiments:

3-6-1-Collection of vegetables:

Fresh quantity fruits of tomato (green) *Lycopersicon esculentum* (Mill), potato *Solanum tuberosum* L, Eggplant *Solanum melongena*.L,pepper *Capsicum annuum*L, and cucumber *Cucumis sativus* were collected from Omdurman vegetables market and untreated leaves of these five vegetables were collected from open fields and greenhouses of Administration of Horticultural Sector (AHS)-Khartoum Mogran. Both the fruits and the leaves were cleaned with distilled water before the experiment application. This study to evaluate the preferences of the second larvae instar of Tomato leaf miner *T. absoluta* to these five vegetable which were mentioned above.

3-6-2- Preference experiment:

The plastic cages size 31×20×19 cm was used in this study. The bottom of these cages was filled with sand 2 cm in height and moistened daily with water by hand sprayer. Each cage supplied with five fruits from each vegetable of tomato, potato, eggplant, pepper and cucumber (total 25 fruits in one cage) and also supplied with ten fresh leaves from each one of these five vegetables above (50 leaves in one cage), also each cage supplied beaker filled with sugar solution and apiece of cotton soaked into it for adult feeding. Ten insects (5 males and 5femles) were used in each one cage. The insects left multiplied until the infestation of leaves and fruits. The experiment was replicated three times. The laboratory temperature range 24-32 ºC, the infestation counts were recorded after 72 hours of the emergency of the larvae and continued for 10 days.

3-7-Experimental design:

These experiments were designed in a Complete Randomized Design.

3-8-Statstical analysis: The data obtained was statistically analyzed according to analysis of variance (ANOVA) where Duncan s Multiple Range Tests was used for means separation.

CHAPTER FOUR

RESULTS

Field survey experiment:

As seen in table (1), figure (1) and appendices (1), (2) and (3) no infestation were found in summer tomato by the target insect *Tuta absoluta* at all areas during the three months July, August and September. However other pests were found in July as the leaf miner was the most abundant followed by mealy bug and boll worm? In August and September leaf miner (58.8 and 48.1) abundant followed by leaf curl (51.8 and47.7), boll worm (46.5 and 37.1) and mealy bug (12.5 and 16.7) respectively. The only area infested by mealy bug was El faki hashim agricultural scheme. The big rate of the infestation of the pests in all areas was happened in August then declined in September. As seen in table (2), figure (2) and appendices (1), (2) and (3). The most area which infested by the four pests was El faki hashim (leaf miner 198.3, Boll worm 135, Mealy bug 125and Leaf curl 166.7), Wad ramly (108.3, 23.3 and 69), South Salyate (80.3, 40.6 and 90.3) and West Soba (84.4, 28.3 and 48.3) respectively.

Laboratory extracts experiment:

As seen in table (3), figure (3) and appendices (4),(5) and (6) all the concentrations of seeds ethanolic extract of *Jatropha curcas* gave significantly higher mortality percentage than the control after 24 hrs of exposure. Additionally, all the concentrations of the extract were accompanied with an increase in mortality percentage. The concentrations which were used in this experiment were 5%, 10%, 15% and 20%.The mortality percentage of larval after 24 hrs of exposure was 46%, 65 %, 86 % and 89%. The mortality percentage of larval after 48 hrs of exposure was 68%, 76.6%, 87.6% and 90%. The mortality percentage of larval after 72 hrs of exposure was 68%, 79%, 89%

and 100%.Only the concentration 20% was comparable and not significantly lower than the mortality caused by the recommended dose of abamectin.

Laboratory preferences experiments:

Tables (4), (5), figures (4),(5) and appendices (7),(8),(9) and (10) showed the preference percentage of the second larval instar of Tomato leaf miner *T. absoluta* in the five vegetables on their leaves and fruits gave significantly higher preferences percentage than the control after five and ten days. After five days of exposure the larvae only preferred the leaves of tomato (86%) and potato (20%) while their preference in fruits was zero. After ten days of exposure the larvae preferred the leaves of potato (20%), tomato (13.3%), eggplant (10%) and pepper (6.6%).On fruits the larvae preferred tomato (33%) and potato (3.3%).

Table (1) Infestation of pests during three months on summer tomato (taken from plants) in the agric schemes (W.Soba, S.Salyate,El faki h and W.Ramly) in Khartoum State .

Pests	July	August	September
L.miner.	11.2 (3.3) a	58.8 (6.5) a	48.1(6.5) a
B.worm.	0(0.7) b	46.5 (5.7) a	37.1(5.7) a
M.bug.	2.1 (1.3) b	12.5 (2.5) b	16.7(2.5) b
Tuta	0(0.7) b	0(0.7) b	0(0.7) b
L .curl	1.7 (1.1) b	51.8(6.6) a	47.7(6.6) a
Lsd	1.5	2.5	2.0
C.V %	22.5	33.41	27.60

Means followed by the same letter(s) are not significant different at ($p<0.05$).

Means between brackets are transformed according to$\sqrt{x+.0.5}$.

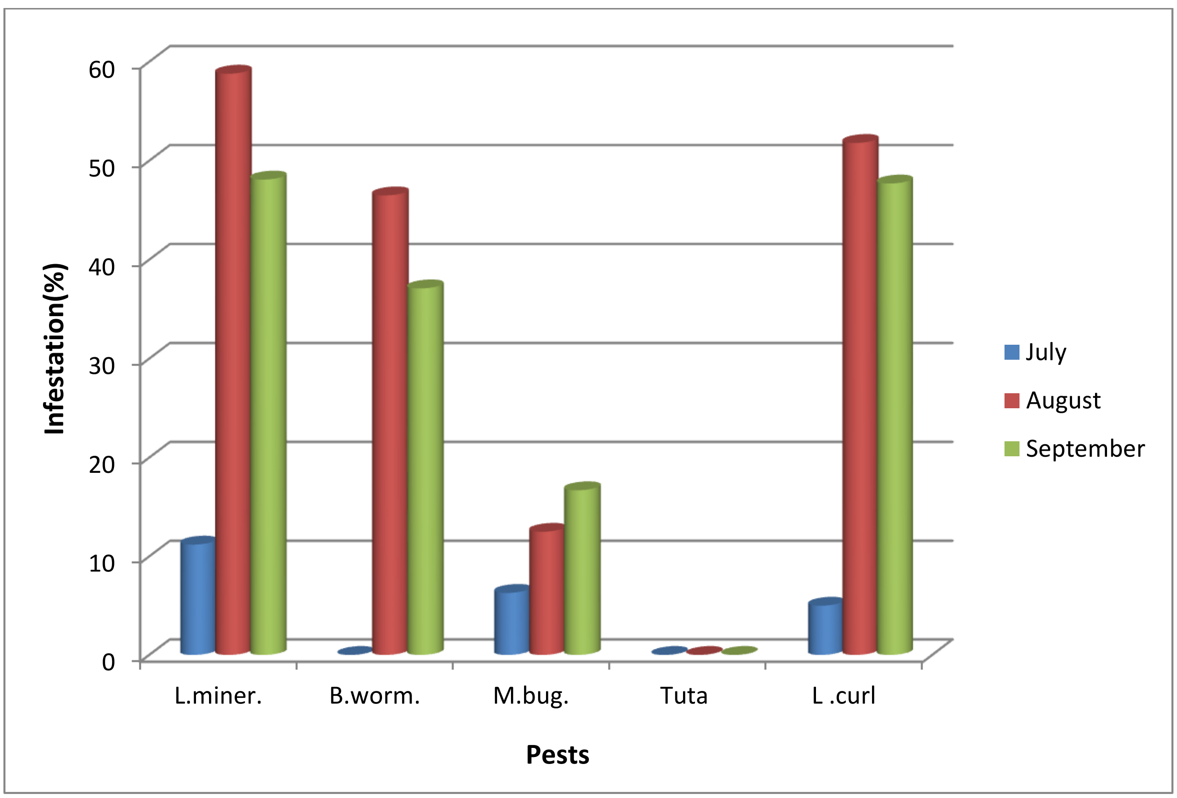


Figure (1) Infestation of pests during three months on summer tomato (taken from plants) in the agric schemes (W.Soba, S.Salyate , El faki h and W.Ramly) in Khartoum State.

Table (2) Infestation of pests on summer tomato in the four areas during July, August and September in Khartoum State.

Pests	W.Soba	S.Salyate	El fai h	W.ramly
L.miner	84.4(9.2)	80.30(8.9)	198.3(14.1)	108.3(10.4)
B.worm	28.3(5.3)	40.60(6.4)	135(11.6)	23.3(4.8)
M .bug	0(0.7)	0(0.7)	125(11.2)	0(0.7)
Tuta	0(0.7)	0(0.7)	0(0.7)	0(0.7)
L .curl	48.3(6.9)	90.30(12.9)	166.7(12.9)	69(8.3)

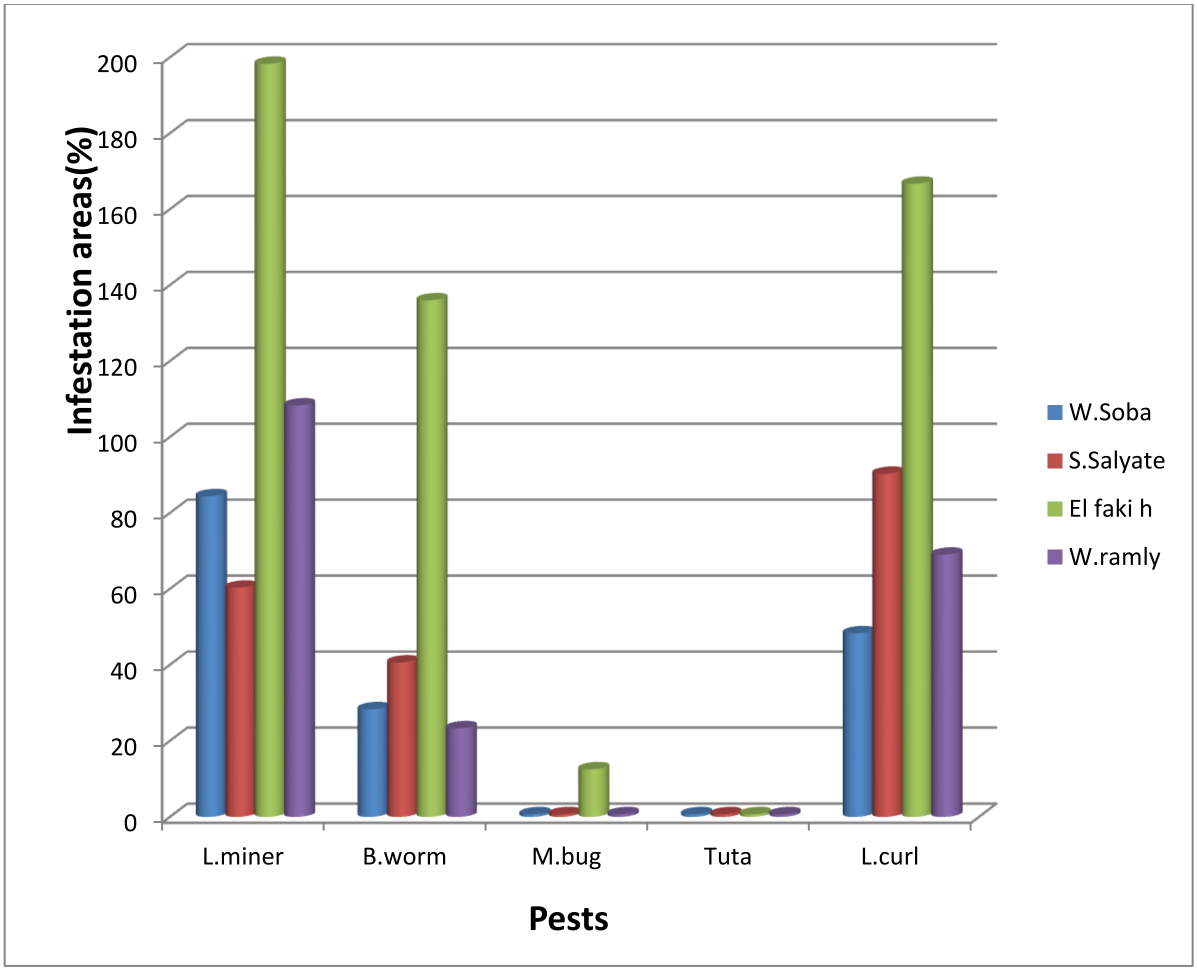


Figure (2) Infestation of pests on summer tomato in the four areas during July, August and September in Khartoum State.

Table (3) Effect of seeds ethanolic extract of *Jatropha curcas* on mortality of second larval instar of Tomato leaf miner.

Conc(%)	**Mortality (%)**		
	Exposure time (hrs.)		
	24	48	72
5	46(6.8) d	68 (8.2) d	68 (8.3) d
10	65 (8.1) c	76.6(8.8) c	79 (8.9) c
15	86(9.3) b	87.7(9.4) b	89(9.5) b
20	89(9.4) b	90 (9.5) b	100(10.0) a
Abamectin	100(10.0) a	100(10.0) a	100(10.0) a
Control	0 (0.7) e	0(0.7) e	0(0.7) e
SE±	0.77	0.78	0.79
CV (%)	2.7	2.03	1.3

Means followed by the same letter(s) are not significant different at ($p<0.05$).

Means between brackets are transf

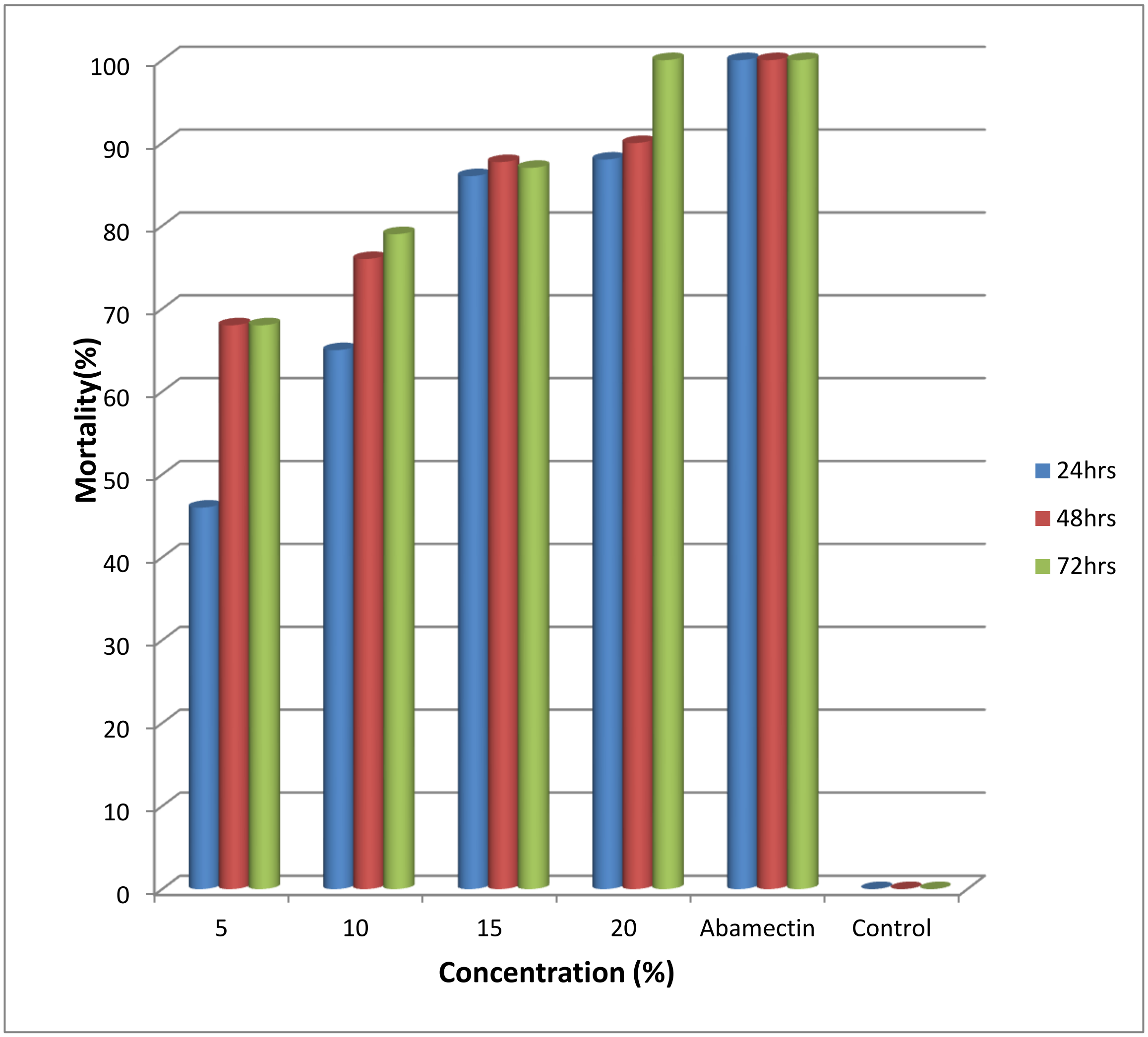


Figure (3) Effect of seeds ethanolic extract of *Jatropha curcas* on mortality of second larval instar of Tomato leaf miner.

Table (4) Preferences of second larval instar of Tomato leaf miner on vegetables after five days.

Vegetables	Preferences (%) Exposure time (5days)	
	leaves	fruits
Tomato.	86.7(9.3) a	0(0.7)
Potato	20(4.4) b	0(0.7)
Eggplant.	0(0.7) c	0(0.7)
Pepper	0(0.7) c	0(0.7)
Cucumber	0(0.7) c	0(0.7)
SE±	0.92	0
LSD	1.151	0
CV %	20.01	0

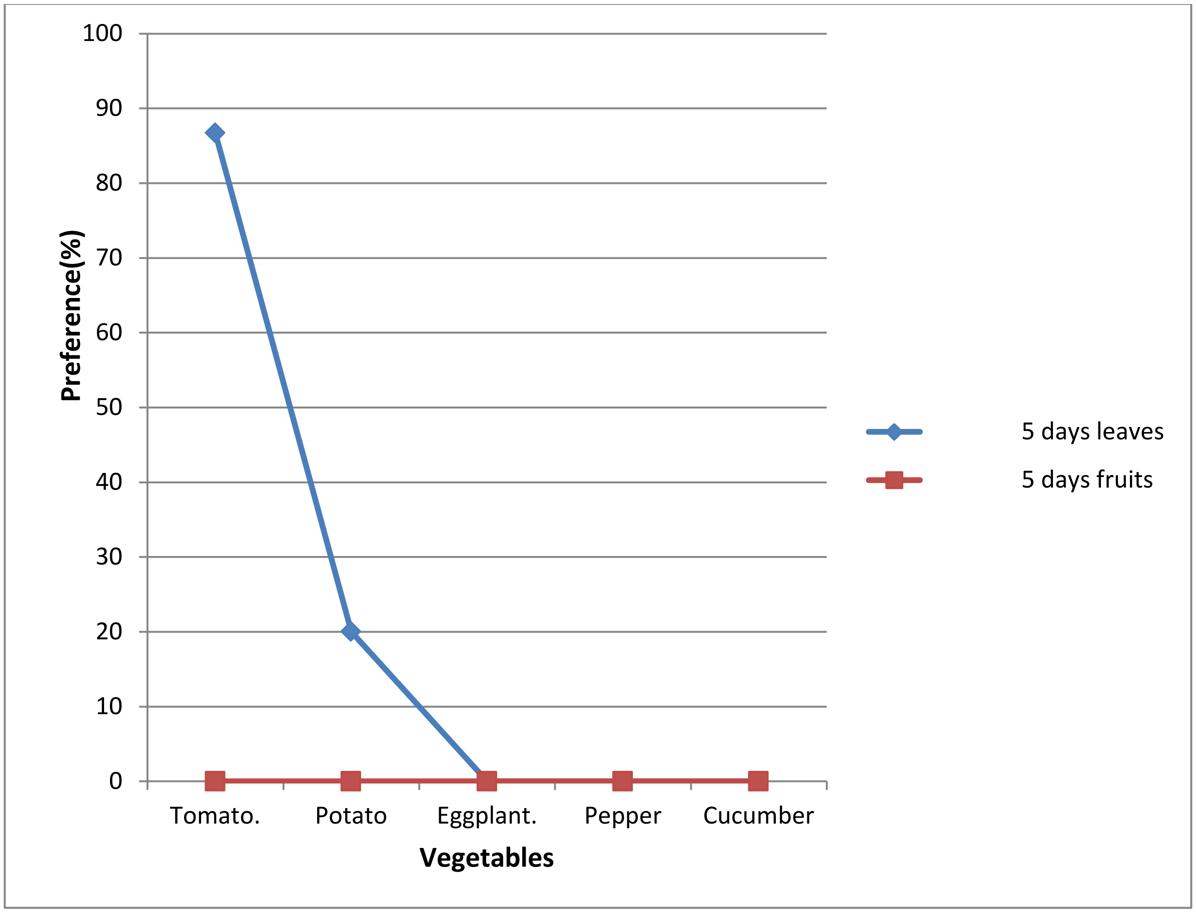
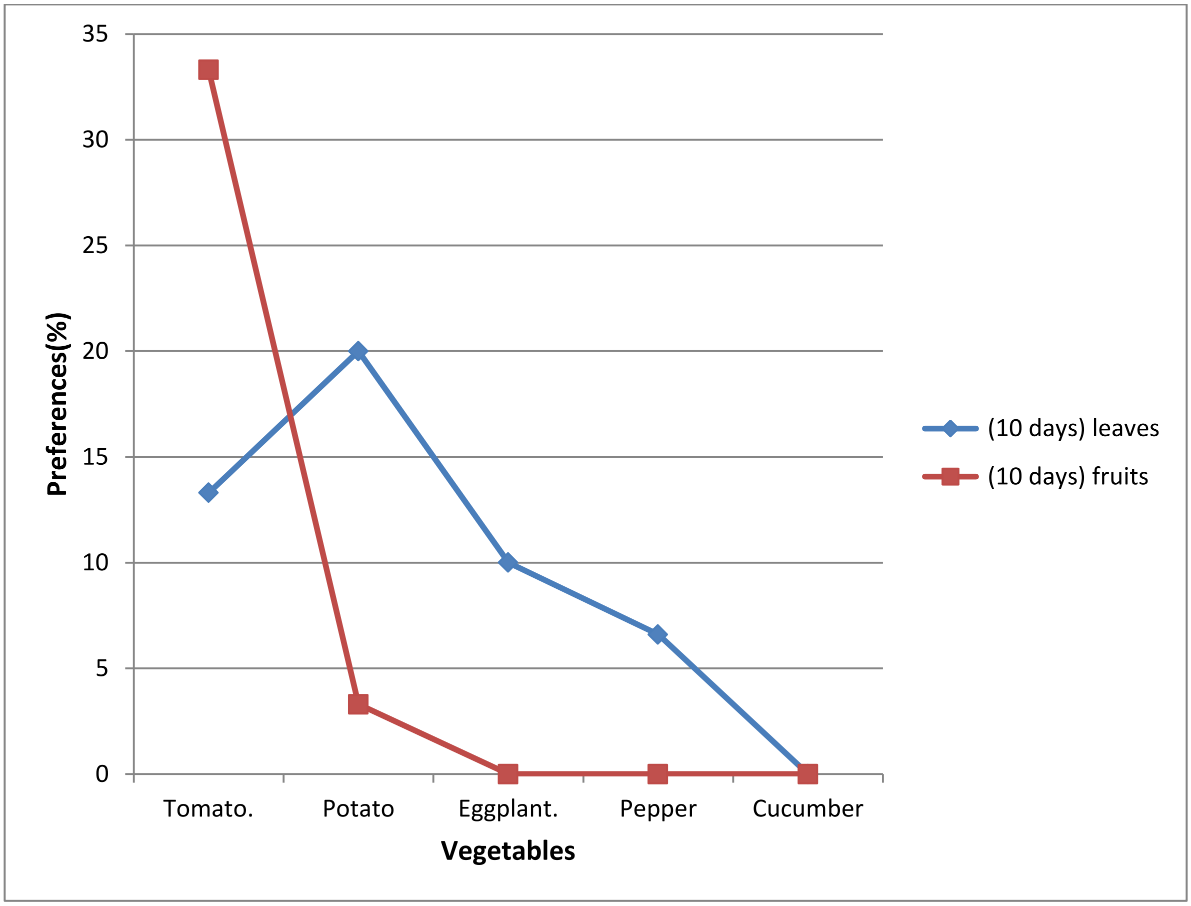


Figure (4) Preferences of second larval instar of Tomato leaf miner on vegetables after five days.

Table (5) Preferences of second larval instar of Tomato leaf miner on vegetables after ten days.

Vegetables	Preferences (%) Exposure time (10days)	
	leaves	**fruits**
Tomato.	13.3(3.7) b	33.3(5.8) a
Potato	20(4.5) a	3.3 (1.9) b
Eggplant.	10(3.2) c	0(0.7) c
Pepper	6.6(2.6) d	0(0.7) c
Cucumber	0(0.7) e	0(0.7) c
SE±	0.34	0.53
LSD	0.23	0.25
CV %	4.27	7.02



Figure(5) Preferences of second larval instar of Tomato leaf miner on vegetables after ten days.

CHAPTER FIVE

DISCUSSION

The tomato leaf miner *Tuta aboluta* (Lepidoptera:Gelechiidae) is a pest of great economic importance in several countries in and Mediterranean basin .It is primary host is tomato ,although potato ,aborigine, common bean, physalis and various wild solanaceous plants are also suitable hosts (Clark,1962).*T. absoluta* is characterized by a higher production potential .Each female may lay up to 300 creamy colored egg and 10-20 generation can be produced each year .In tomato it can attacked any plant part at any crop stage and can cause up to 100% crop destruction, although the larvae prefer apical buds, tender new leaflet and flower a green fruit (Povoly,1964).This pest crossing borders and devastating tomato production in both protected and open fields (IRAC,2011*).T. absoluta* appeared first time in Sudan in the year 2011 on greenhouses in Khartoum State. The damage of *T.absoluta* in Sudan was reported from Khartoum, Gezira, White Nile, Kassala, River Nile State and Northern causing 60-100% of tomato crop loss (Mohamed and Mohamed, 2013).

The main purpose of this study was to investigate the infestation percentage of tomato leaf miner *T.absoluta* on summer tomato (GS variety) which cultivated in summer in four agricultural schemes in Khartoum State. According to the results there was no infestation of *T.absoluta* seen *on* summer tomato in the four agricultural schemes in all the period of survey in July, August and September. The reason might be the unsuitable environmental conditions for *T.absoluat* during these months. The temperature average between 25-38 ºC in all the period time and the rainfall average in July was 46 (2) mm, August 75 (3) mm and September 25(1) mm (Khartoum climate, 2014).Both the degree and rate of temperature and rainfall are unsuitable environmental conditions for *T.absoluta* to infest the summer tomato. These facts confirmed by Barrientos *et al*, (1998) who reported *T.absoluta* can complete life in range 25-35 ºC.The minimum temperature for activity is19 ºC .In temperature higher than 35 ºC; the insect will have difficulty in completing it is life cycle, with high level of mortality. Also Zalom *et al*, (1983) mentioned that temperature has a direct influence on insect activity and rate of development. About the effect of the rainfall in *T.absolut*a the EPPO, (2005) reported that severely attacked of *T.absoluta* to tomato was reduced by the rainfall.

In Sudan Solanaceous crops are grown in different ecological zones of the country under open field and some of them in both open fields and greenhouses. The important cultivated species in Sudan include: tomato, eggplant and pepper (Said ahamed *et al*., 2003).The major insect pests of tomato in Sudan are: Whitefly *Bamesia tabaci*, American boll worm *Helimenthis armegera* and Cotton jassid *Urentius hystricellus*.They Controlled by uses of many synthetic insecticide such as Dimethoate,Endosulfan,Malathion,Diazinon and Carbaryl (Schmutterer,1969). In recent year observed that the used of synthetic insecticide in crop protection caused different problems include: pollution in environment, human health, ecosystem and so on .So it became necessary to search for the alternative means (Botanical) to control the pests crops (Prakash *et al*., 1990).There are many botanical insecticides used to manage the pests in rice, wheat, pulses and vegetables (Pendey *et al*., 1982).

In this study one of the aims was to evaluate the lethal effect of seed ethanolic extract of *Jatropha curcas* L., against the second larval isntar of tomato leaf miner *T.absoluta*. The highest concentrations of seeds ethanolic extract of J. cuurcas uses 20% gave a high mortality percentage of 100% and were not significantly different from the standard abamectin after 72 hrs of exposure. This result clearly demonstrates that the seeds ethanolic extract of *J. curcas* has lethal effect against tomato leaf miner. Sakhivadivel and Daniel,(2008) who found J.seeds extract kills the larval of mosquitoes species that causes malaria.Asmanizer *et al,* (2008) mentioned *J.cucas* seeds extract causes 97-100% mortality against stored product pest such as Stophlus weevils. Acda,(2009) reported that *J.cucas* seeds oil acts as a repellent against termite.

Another aim of this study was to examine the preference of second larval instar of tomato leaf miner *T.absoluta* on leaves and fruits of five vegetables. After five days of exposure the larvae of *T.absoluta* only preferred the leaves of tomato 86.7% and potato 20%, on fruits the preference was zero as the reason the larvae have not reached the 3^{rd} or 4^{th} instar stage. This method of preference was mentioned by Eatay *et al*,(2000) who reported *T.absoluta* females ovipositing preferencentially on leaves 73%.Also*T.absoluta* preferred tomato to potato as mentioned by Pereyra and Sanches,(2006) who obtained that the tomato the most suitable host plant for *T.absoluta.*This may be due to superior nutritional value of tomato to potato. After ten days of exposure, the larvae of *T.absoluta were* reached the 3^{rd} or 4^{th} instar stage. Their preference (infestation) on tomato leaves reached 100% so they turned their preference to the other leaves 20% on potato10% on eggplant and 6.6% on pepper respectively. This ordinary way of preference were similarly mentioned by NAPPO,(2012) they reported that the main host of *T.absoluta* is tomato. They also mentioned they feed on potato leaves and tuber, eggplant leaves and fruit and sweet pepper leaves. After ten days of exposure the preferences of larvae feed on fruits of tomato 33% and potato 3.3%, because the larvae stage reached $3^{rd}$and 4^{th} instar .According to the Eatay, 2000) who mentioned *T.absoluta* that the larvae (3^{rdand} 4^{th} instar) can feed on all parts of tomato.

CONCLUSION AND RECOMMENDATIONS

The study of survey about *Tuta absoluta* in summer tomato (GS) which was cultivated in four agricultural schemes (40, 5 fedan) in Khartoum State, demonstrated that no infestation on summer tomato can be happened by *T.absoluta* under the average temperature between 25-38 ºC and rainfall, 46 (2) mm, 75(3) mm and 25(1) mm. Based on the above mentioned result, *T.absoluta* cannot be activated under the environmental conditions of July, August and September. So it can be recommended to cultivate the summer tomato (GS) on these months safely.

The study of the lethal effect of seeds ethanolic extracts of *J.curcas* against the larvae of *T.absoluta* clearly demonstrated that they are effective to the larvae of *T.absoluta*. Based on the above mentioned results, seeds ethanolic extracts of *J.curcas* can be recommended to be used as a control agent for *T.absoluta.*

The study of preference of larvae of *T.absoluta* on five vegetables clearly demonstrated that the larvae of *T.absoluta* preferred the leaves of the four vegetables: tomato, potato, eggplant and pepper respectively, on fruits only tomato and potato respectively. Based on the above mentioned results. The recommendation can be avoiding cultivating other Solanaceae besides tomato.

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*Seen as abstract.

APPENDICES

Appendix (1) The infestation of pests on summer tomato in four areas (taken from plants) in July.

Areas	Pests	Fedan1	Fedan2	Fedan3	Mean
Soba	L.miner	9(3)	12(3.5)	1(3.7)	11.7(3.4)
	B.worm	0(0.7)	0(0.7)	0(0.7)	0(0.7)
	M.bug	0(0.7)	0(0.7)	0(0.7)	0(0.7)
	Tuta	0(0.7)	0(0.7)	0(0.7)	0(0.7)
	L.curl	0(0.7)	0(0.7)	0(0.7)	0(0.7)
Salyate					
	L.miner	15(3.9)	10(3.2)	9(3)	11.3(3.4)
	B.worm	0(0.7)	0(0.7)	0(0.7)	0(0.7)
	M.bug	0(0.7)	0(0.7)	0(0.7)	0(0.7)
	Tuta	0(0.7)	0(0.7)	0(0.7)	0(0.7)
	L.curl	0(0.7)	0(0.7)	0(0.7)	0(0.7)
El faki					
	L.miner	12(3.5)	13(3.6)	15(3.9)	13.3(3.6)
	B.worm	0(0.7)	0(0.7)	0(0.7)	0(0.7)
	M.bug	10(3.2)	5(2.3)	10(3.2)	8.3(2.9)
	Tuta	0(0.7)	0(0.7)	0(0.7)	0(0.7)
	L.curl	13(3.6)	5(2.3)	2(1.4)	6.7(2.6)
Ramly					
	L.miner	7(2.6)	10(3.2)	8(2.8)	8.3(2.9)
	B.worm	0(0.7)	0(0.7)	0(0.7)	0(0.7)
	M.bug	0(0.7)	0(0.7)	0(0.7)	0(0.7)
	Tuta	0(0.7)	0(0.7)	0(0.7)	0(0.7)
	L.curl	0(0.7)	0(0.7)	0(0.7)	0(0.7)

*No insects were found in the pheromone traps.

Appendix (2) The infestation of pests on summer tomato in four areas(taken from plants) in August.

Areas	Pests	Fedan1	Fedan2	Fedan3	Mean
Soba	L.miner	63(7.9)	40(6.3)	37(6.1)	46.6(6.8)
	B.worm	0(0.7)	0(0.7)	0(0.7)	0(0.7)
	M.bug	0(0.7)	0(0.7)	0(0.7)	0(0.7)
	Tuta	0(0.7)	0(0.7)	0(0.7)	0(0.7)
	L.url	53(7.3)	40(6.3)	42(6.5)	45(6.7)
Salyate					
	L.miner	50(7.1)	20(4.5)	60(7.7)	43.3(6.6)
	B.worm	100(1o.o)	83(9.1)	40(6.3)	74.3(8.6)
	M.bug	0(0.7)	0(0.7)	0(0.7)	0(0.7)
	Tuta	0(0.7)	0(0.7)	0(0.7)	0(0.7)
	L.curl	70(8.4)	55(7.4)	40(6.3)	55.3(7.4)
El faki					
	L.miner	105(10.2)	95(9.7)	55(7.4)	85(9.2)
	B.worm	43(6.6)	100(10.0)	62(7.9)	68.3(8.3)
	M.bug	80(8.9)	20(4.5)	50(7.1)	50(7.1)
	Tuta	0(0.7)	0(0.7)	0(0.7)	0(0.7)
	L.curl	27(5.2)	70(8.4)	103(10.1)	66.7(8.2)
Ramly					
	L.miner	90(9.5)	53(7.3)	37(6.1)	60(7.7)
	B.worm	30(5.5)	10(3.2)	90(9.5)	43.3(6.6)
	M.bug	0(0.7)	0(0.7)	0(0.7)	0(0.7)
	Tuta	0(0.7)	0(0.7)	0(0.7)	0(0.7)
	L.curl	42(6.5)	60(7.7)	18(4.2)	40(6.3)

*No insects were found in the pheromone traps.

Appendix (3) The infestation of pests on summer tomato in four areas (taken from plants) in September.

Areas	pests	Fedan1	Fedan2	Fedan3	Mean
	L.miner	48(6.9)	15(3.9)	17(4.1)	26.7(5.2)
Soba	B.worm	37(6.1)	22(4.7)	26(5.1)	28.3(5.3)
	M.bug	0(0.7)	0(0.7)	0(0.7)	0(0.7)
	Tuta	0(0.7)	0(0.7)	0(0.7)	0(0.7)
	L.curl	42(6.5)	33(5.7)	25(5.0)	33.3(5.8)
Salayte	L.miner	17(4.1)	40(6.3)	20(4.5)	25.7(5.1)
	B.worm	19(4.4)	73(8.5)	8(2.8)	33.3(5.8)
	M.bug	0(0.7)	0(0.7)	0(0.7)	0(0.7)
	Tuta	0(0.7)	0(0.7)	0(0.7)	0(0.7)
	L.curl	50(7.1)	18(4.2)	37(6.1)	35(5.9)
Elfaki	L.miner	93(9.6)	1o2(10.1)	105(10.2)	100(10.0)
	B.worm	100(10.0)	40(6.3)	60(7.7)	66.7(8.2)
	M.bug	37(6.1)	83(9.1)	80(8.9)	66.7(8.2)
	Tuta	0(0.7)	0(0.7)	0(0.7)	0(0.7)
	L.curl	100(10.0)	78(8.8)	102(10.1)	93.3(9.7)
Ramly	L.miner	16(4.0)	70(8.4)	34(5.8)	40(6.3)
	B.worm	23(4.8)	16(4.0)	21(4.6)	20(4.5)
	M.bug	0(0.7)	0(0.7)	0(0.7)	0(0.7)
	Tuta	0(0.7)	0(0.7)	0(0.7)	0(0.7)
	L.curl	18(4.2)	40(6.3)	29(5.4)	29(5.4)

*No insects were found in the pheromone traps

Appendix (4) Effect of seeds ethanolic extract of Jatropha *curcas* on mortality of second Larval instar of Tomato Leaf miner after 24 hour.

Conc (%)	Mortality (%)			
	R1	R2	R3	Mean
5	42(6.5)	47(6.9)	49(7.o)	46(6.8)
10	61(7.8)	69(8.3)	65(8.1)	65(8.1)
15	89(9.4)	82(9.1)	88(9.4)	86.3(9.3)
20	83(9.1)	90(9.5)	91(9.6)	88(9.5)
Abamectin	100(10.0)	100(10.0)	100(10.0)	100(10.0)
Control	0(0.7)	0(0.7)	0(0.7)	0(0.7)

Appendix (5) Effect of seeds ethanolic extract of *Jatropha curcas* on mortality of second larval instar of Tomato Leaf miner after 48 hours .

Conc(%)	Mortality (%)			
	R1	R2	R3	Mean
5	63(7.9)	68(8.2)	73(8.6)	68(8.2)
10	75(8.7)	76(8.7)	79(8.9)	76.7(8.8)
15	89(9.5)	86(9.3)	88(9.4)	87.7(9.4)
20	90(9.5)	89(9.5)	91(9.6)	90(9.5)
Abamectin	100(10.0)	100(10.0)	100(10.0)	100(10.0)
Control	0(0.7)	0(0.7)	0(0.7)	0(0.7)

Appendix (6) Effect of seeds ethanolic extract of *Jatropha curcas* on mortality of second larval instar of Tomato Leafminerafter72 hours.

Conc(%)	Mortality (%)			
	R1	R2	R3	Mean
5	66(8.2)	70(8.4)	68(8.3)	68(8.3)
10	79(8.9)	75(8.7)	83(9.1)	79(8.9)
15	87(9.4)	88(9.4)	92(9.6)	89(9.5)
20	100(10.0)	100(10.0)	100(10.0)	100(10.0)
Abamectin	100(10.0)	100(10.0)	100(10.0)	100(10.0)
Control	0(0.7)	0(0.7)	0(0.7)	0(0.7)

Appendix (7) The preferences of second larval instar of Tomato leaf miner on vegetable leaves after five days.

vegetables	Preferences (%)			
	R1	R2	R3	Mean
Tomato	90(9.5)	70(8.4)	100(10.0)	86.7(9.3)
Potato	10(3.2)	30(5.5)	20(4.5)	20(4.5)
Eggplant	0(0.7)	0(0.7)	0(0.7)	0(0.7)
Pepper	0(0.7)	0(0.7)	0(0.7)	0(0.7)
Cucumber	0(0.7)	0(0.7)	0(0.7)	0(0.7)

Appendix (8) The preferences of second larval instar of Tomato leaf miner on vegetable Fruits after five days.

Vegetables	Preferences (%)			
	R1	R2	R3	Mean
Tomato	0(0.7)	0(0.7)	0(0.7)	0(0.7)
Potato	0(0.7)	0(0.7)	0(0.7)	0(0.7)
Eggplant	0(0.7)	0(0.7)	0(0.7)	0(0.7)
Pepper	0(0.7)	0(0.7)	0(0.7)	0(0.7)
Cucumber	0(0.7)	0(0.7)	0(0.7)	0(0.7)

Appendix (9)The preference of second larval instar of Tomato leaf miner on vegetable leaves after ten days.

Vegetable	Preferences (%)			
	R1	R2	R3	Mean
Tomato	10(3.2)	10(3.2)	20(4.5)	13.3(3.6)
Potato	20(4.5)	30(5.5)	10(3.2)	20(4.5)
Eggplant	0(0.7)	10(3.2)	20(4.5)	10(3.2)
Pepper	10(3.2)	10(3.2)	0(0.7)	6.6(2.6)
Cucumber	0(0.7)	0(0.7)	0(0.7)	0(0.7)

Appendix (10) The preferences of second larval instar of tomato leaf miner on vegetable fruits after ten days.

Vegetables	Preferences (%)			
	R1	R2	R3	Mean
Tomato	20(4.5)	50(7.1)	30(5.5)	33.3(5.8)
Potato	10(3.2)	0(0.7)	0(0.7)	3.3(1.9)
Eggplant	0(0.7)	0(0.7)	0(0.7)	0(0.7)
Pepper	0(0.7)	0(0.7)	0(0.7)	0(0.7)
Cucumber	0(0.7)	0(0.7)	0(0.7)	0(0.7)