بسم الله الرحمن الرحيم

Sudan University of Science and Technology

College of Agricultural Studies

Department of Plant Protection

Effect of Damas(*Conocarpus lancifolius*)extract and NeemAzal-T/S against Cotton Mealy Bug (*Phenacoccus solenopsis*)

أثر مستخلص الدمس و مبيد النيمازال على حشرة البق الدقيقى فى القطن

A graduation project submitted in partial fulfillment of the requirements for the degree of B.Sc. Agric. in Plant Protection**.**

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الآيـة

بسم الله الرحمن الرحيم

قال تعالي:

(إِنَّ فِي خَلْقِالسَّمَاوَاتِ وَالأَرْضِ وَاخْتِلافِ اللَّيْلِ وَالنَّهَارِ وَالْفُلْكِ الَّتِيتَجْرِي فِي الْبَحْرِ بِمَا يَنفَعُ النَّاسَ وَمَا أَنزَلَ اللَّهُ مِنَالسَّمَاء مِن مَّاء فَأَحْيَا بِهِ الأَرْضَ بَعْدَ مَوْتِهَا وَبَثَّ فِيهَا مِنكُلِّ دَابَّةٍ وَتَصْرِيفِ الرِّيَاحِ وَالسَّحَابِ الْمُسَخَّرِ بَيْنَ السَّمَاءوَالأَرْضِ لآيَاتٍ لِّقَوْمٍ يَعْقِلُونَ)

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صدق الله العظيم

DEDICATION

I would like to dedicate

This work to my family, all friends and to those who helped me

In this research

Thank you all

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All my thanks and prays to "Allah", who gave me strength and Patience to complete this research.

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Abstract

Experiment was conducted in the Laboratory of Entomology and Zoology, Department of Plant Protection, College of Agricultural Studies (Shambat), Sudan University of Science and Technology (SUST) in the period of April-May 2016.

The main aim of this research is to study the effect of damas acetone extract and NeemAzal-T/S against the adults of cotton mealy bug (*Phenacoccus solenopsis*).

Three concentrations of damas extract (2, 1 and 0.5 ml/liter) and one concentration (1 ml/liter) of NeemAzal-T/S were used in this experiment.

The results showed that there are no significant difference between all concentrations of damas extract and control, while NeemAzal T/S gave highly significant difference when compared to the control.

The higher concentration (2 ml/l) of damas extract gave only 10% mortality after 3 days post treatment, while a half of this concentration (1 ml/l) of NeemAzal T/S caused 78% mortality after the same period of exposure. These results revealed that damas acetone extract have a little effect against the adults of *P. solenopsis*. In contrast NeemAzal T/S induces a significant effect against this pest.

From above mentioned results we conclude that NeemAzal-T/S was effective against cotton mealy bug, and it could be used as alternative bio-pesticides against this pest in the future.

ملخص البحث

أجريت هذه التجربة بمعمل الحشرات والحيوان الزراعي بقسم وقاية النبات ،كلية الدراسات الزراعية - شمبات، جامعة السودان للعلوم والتكنولوجيا في الفترة من ابريل - مايو 2016م.

الهدف من البحث هو دراسة تأثير وفعالية مستخلص نبات الدمس الأستوني ومبيد -NeemAzal T/S على حشرة البق الدقيقى فى القطن (*Phenacoccus solenopsis*)

تم إستخدام ثلاثة تراكيزات من مستخلص الدمس الاستونى هي (2، 1 و0.5 مل / ليتر) مقارنة مع تركيز(1مل / لتر) من المبيد .

أوضحت النتائج انه لا توجد فروقات معنوية بين جميع التركيزات لمستخلص الدمس مقارنة بالشاهد، بينما نجد أن هنالك فروقات معنوية واضحة بين مبيد النيمازال والشاهد. أعلي تركيز من مستخلص الدمس (2مل/ لتر) أعطي فقط نسبة موت 10% بعد ثلاثة أيام من المعاملة بينما تركيز1مل / لترمن مبيد النيمازال أعطي نسبة موت 78% بعد نفس الوقت.

هذه النتائج أظهرت أن مستخلص الدمس له أثر وفعالية ضعيفة على حشرة بق القطن الدقيقي بينما أظهر مبيد النيمازال فعالية جيدة علي هذه الآفة.

من هذه الدراسة نخلص الي أن مبيد النيمازال يمكن أن يستخدم كمبيد حيوي فعال ضد حشرة بق القطن الدقيقي مستقبلاً.

CHAPTER ONE

INTRODUCTION

The mealy bugs are mostly polyphagous insects, affecting huge number of vegetables, fruits, ornamentals and many other field crops (Sinacor, 1995). They reproduce sexually as well as parthenogenesis. More than 160 mealy bug species have been identified as pests worldwide and most of them are invasive species (Miller and Miller, 2002). Mealy bugs have short period of 30 days life cycle in tropical areas (Buss and Turner, 2010). They are sucking insect pests and often observed in high numbers with aggressive population trend. It does not only destroy the host plant by depleting the plant sap but they are also responsible for transmitting viral diseases (Bertin *et al.*, 2006.). Furthermore, their excreted honeydew on plant surfaces provides medium for growth of black sooty mold (Buss and Turner, 1992.) which also disturb the photosynthesis process of plant (Williams and Willink , 1992.).

Mealy bugs in the past were classified as minor pest, but recently many species of mealy bugs was found to be a serious pest of many valuable corps in Sudan.

The prolonged application of chemical insecticides for controlling insect pest cause many problems such as pest resistance, environmental and food contamination and toxicity to non-target organisms (Pimentel *et al*., 2009). Therefore the scientists made a lot off efforts to find an alternative control measures against agricultural and medical insect pests.

Plants produce secondary metabolites many for which can have insecticidal properties, as an alternative to synthetic insecticides (Potenza *et al*., 2004).

The objective of this study is to investigate through laboratory screening the activity of Damas (*Conocarpus lancifolius*) and NeemAzal-T/S against the adults of cotton mealy bug (*Phenacoccus solenopsis*) .

CHAPTER TWO

LITERATURE REVIEW

2.1 Cotton mealy bug

2.1.1 Classification `

Class: Insecta

Order: Homoptera

Family: Pseudococcidae

Genus: Phenacoccus

Species: *Phenacoccus solenopsis*

Hodgson *et al*. (2008)

2.1.2 Description

P. solenopsis is a bisexual species with multiple generations annually. Like other mealy bugs, this species is distinguished by the morphology of the adult female. Adult females are covered with a powdery, waxy secretion with six pairs of transverse, dark bands that are located across the pro- to meta-thoracic segments. A series of waxy filaments extend from around the margin of the body with the pair of terminal filaments longest. The ovisac is composed of fluffy, loose-textured wax strands (Mckenzie, 1967 and Kosztarab, 1996). Adult females range from 2 to 5 mm long and 2 to 4 mm wide. Slide-mounted females are distinguished ventrally by the presence of nine-segmented antennae, five-segmented legs.

2.1.3 Distribution and dispersal

The occurrence of *P. solenopsis* is widespread with the species damaging plants in a variety of habitats ranging from dry arid areas to tropical regions (Dhawan *et al.*, 2009) reported that the population density of this invasive

pest varied on cotton (*Gossypium* spp.) in surveyed regions in Pakistan. The first instars or crawlers are the main dispersal stage of the solenopsis mealy bug. The waxy strands covering the body serve a variety of functions including allowing the specimens to be transported by wind or water to new locations. The crawlers are commonly dispersed by wind for distances ranging from a few meters to several kilometers.

Infested host material that is transported from one area to another is an important source of distribution for the mealy bug. The waxy test covering the body can adhere to passing animals or the clothes of people, allowing individuals specimens to be transported extended distances from the original infestation site before becoming dislodged in new, previously un infested sites. (Hodgson *et al*., 2008).

2.1.4 Ecology

This mealy bug has been reported to be capable of surviving in temperatures ranging from 0-45°C, throughout the year (Sharma, 2007). The location on the plant appears to be influenced by humidity as (Hodgson *et al.* 2008) concluded that *P. solenopsis* occurred more commonly on the roots, stems and foliage close to the soil line in dry climates compared to settling on the upper foliage of the plant in more humid areas. All stages of development were documented to occur on the stems of three *Ambrosia* spp. in the arid San Sedro region in southern California, USA (Goeden and Ricker, 1976).

2.1.5 Host plants

The cotton mealy bug has been recorded on 202 host plant species representing 55 families with a distribution in Africa, Asia, North America and South America and Oceanic regions including the Caribbean nations. Those include field crops, ornamentals, trees and vegetables. In Pakistan, *P. solenopsis* obtained the status of a serious pest on a wide host range. In a

field survey, Arif *et al.* (2009) identified the mealy bug from 154 plant species, the majority of which belong to the families Malvaceae, Solanaceae, Asteraceae, Euphorbiaceae, Amaranthaceae and Cucurbitaceae. Significant economic damage was determined to occur on cotton *(Gossypium spp.)*, brinjal (*Solanum melongena*), okra (Abelmoschusesculentus), tomato (*Solanum lycopersicum)*, sesame (*Sesamum indicum*), sun flower(*Helianthus annuus*) and China rose (*Hibiscus rosa-sinensis*) (Sharma, 2007; Arif *et al*., 2009 and Jagadish *et al*., 2009).

2.1.6 Biology and life cycle

Females of this bisexual species have been reported as capable of producing from 150 to 600 eggs, protected within a waxy ovisac Upon hatching, females undergo three immature stages prior to reaching adulthood, whereas males undergo first, second, pre pupa and pupa stages prior to adulthood. The period of development from crawler to adult stage is approximately 25-30 days, depending upon the weather and temperature. This species is capable of producing multiple generations annually (Lu *et al*., 2008).

2.1.7 Economic importance and damage

The mealy bug is an important plant pest worldwide (Williams and Willink, 1992 and Hodgson *et al*., 2008).They feed on the plant by extracting sap from cells in the leaves or stems. The sap contains soluble sugars, phenols, proteins and other potential nutrients. Mealy bug-infested leaves produce high quantities of sugars and proteins compared to the amounts produced in un-infested leaves (Jagadish *et al*., 2009). Heavy clustering of mealy bugs can be seen under leaf surface giving the appearance of a thick mat with waxy secretion. Severe infestations resemble patches of cotton all over the plant. They excrete copious amount of honey dew that attracts ants and help in development of black sooty mould which inhibits the plants ability to

manufacture food. Both nymphs and adults suck the sap from leaves causing withering and yellowing of leaves. Fruit may drop prematurely on crop plants. Heavy infestation can cause defoliation and even death of the plant. Mealy bugs also affect the development of flowers and stems (Tanwar, *et al.*, 2007)

2.1.8 Control

2.1.8.1 Mechanical and cultural control

Small populations of mealy bugs can be controlled by inspection of plants, removing loose bark where they might be difficult to observe and hand picking the specimens from newly-infested plants. Soap applications are often effective against targeted, small populations of the mealy bug. (CAB I, 2016

It is important to prune or cut infested stems or branches from plants and destroy the infested plant material. Also stalks and crop residue in infested field sites should be removed and destroyed as such residue left in the field can harbor mealy bugs, which can survive to invade the new crop. Attention should be given to the field borders for plants that can serve as an alternate host for the mealy bug. Such plants should be removed to prevent the mealy bugs from overwintering and infesting crops in the future. Trap plants may be planted that initially attract the mealy bugs and can be targeted for control treatments to protect the primary crop. (CAB I, 2016)

2.1.8.2 Biological control

Biological control is considered the most effective long-term solution to the mealy bug infestation because the parasites and predators are self perpetuating, persist even when the mealy bug is at low population densities, and they continue to attack the mealy bugs, keeping populations below economic injury levels. The coccinellid beetles such as *Cheilomenes*

sexmaculata, Rodolia fumida, *Scymnus coccivora* and *Nephus regularis* are important predators of mealy bug nymphs. Biological control by release of natural enemies has proved very successful. Among the biological control agents introduction of *Cryptolaemus montrouzieri* (Australian Ladybird), *Anagyrus pseudococci*, *Leptomastix dactylopii*, *Hypoaspis* sp., *Verticillium lecanii* and *Beauveria bassiana* are effective in managing the infestation. *Hypoaspis* is a small mite that feeds on crawlers (CAB I, 2016) .

2.1.8.3 Chemical control

The insecticide application requires careful observation on status of natural enemies and the distribution and density of mealy bug colonies. Need based application of insecticides is recommended to suppress the outbreak of mealy bug population. The systemic insecticides are more effective against mealy bug crawlers. Foliar spray of profenophos 50 EC @ 2 ml/liter or chlorpyriphos 20 EC @ 2 ml/liter or imidacloprid 17.6 SL @ 0.4 ml/liter or thiamethoxam 25 SG @ 0.4 g/liter water is recommended for management of mealy bug. The control of ants which help the mealy bug colonies to grow and spread by soil application of chlorpyriphos 20 EC @ 2 ml/litre or malathion dust 5% @ 25kg/ha restricts the mealy bug crawlers to spread to non-infested plants (Popular Kheti , 2014).

2.1.8.4 Integrated Pest Management (IPM)

Preparing the land and weeding in and around fields should be done on time. Mealy bugs at initial stage appear in small pockets, therefore, recommended insecticide are applied only in the infested spot, not in the entire crop. Recommended doses of insecticides of carbamate (carbaryl 50 WP @2.5 kg/ha or thiodicarb 75 WP @ 625 gm/ha) and organophosphate (profenofos 50 EC @ 1,250 ml/ha, quinalphos 25 EC @ 2,000 ml/ha, acephate 75 SP @ 2,000 gm/ha or chlorpyriphos 25 EC @ 5l/ha) could be sprayed rotation-

wise in consecutive sprays. Sufficient quantity of water should be used for spray so as to drench the whole plant. Soil around the stem must be sprayed. Also using soap oil or fish oil resin soap twice at an interval of 15–20 days. Most affected plants should be uprooted and burnt. This pest mostly spreads in other areas of field during the picking time, therefore, cotton pickers should be guided accordingly. Encourage the activity of predators like *C. sexmaculata, B. suturalis,S. coccivora* and C. *montrouzieri* (CAB I, 2016) .

2.2 Damas (*Conocarpus lancifolius*)

Conocarpus lancifolius Engle is one of the most important trees in the family Combretaceae. This family contains about 20genera and about 600species found in tropical and sub-tropical regions of the world, the family has few genera with great economic value, an useful timber is obtained from some species belong to it and other species have medicinal importance (Pandey and Misra, 2008).

2.2.1 Classification

Kingdom: Plantae

Phylum: Tracheophyta

Class: Magnoliopsida

Order: Myrtales

Family: Combretaceae

Genus: *Conocarpus*

Species: *lancifolius*

S.N*: Conocarpus lancifolius*

2.2.2 Plant description

Damas is an evergreen tree that grows up to 20m in height and 60-250 cm or more in diameter. It is usually a multi-branched tree in its natural habitat. Flowers are yellow-green, in round heads on branched stalks, slightly fragrant and it is fruit exist in dry, round, greenish heads, cone-like containing tiny, scale-like hard seeds (Bein *et al*., 1996).

2.2.3 Geographical distribution

Natural stand of damas are found beside intermittent water courses of northern Somalia and in the south west part of the Arabian Peninsula. Some

of these streams are salty and some sulphurous .The tree is also cultivated in Somalia, Djibouti, Sudan, Kenya, North and South Yamen, and Pakistan. A small plantation has been established in the Sudan in Khashm Elgirba arboretum and about 10000 trees have been planted successfully in lime stone near Mombasa, Kenya (NAS, 1983).

2.2.4 Economic importance

C. lancifolius is multipurpose; wood which is the main product which is used domestically for house construction, fire wood and excellent charcoal. Commercially timber was more useful formerly, it was cut and exported from Somalia to Arabia for dhow construction, other potential uses include wood based board, and bark may be a useful source of tannins (Booth and wickens, 1993).

2.2.5 Bioactive properties and phytochemical screening

Abdulrahaman and Gumgumjee (2013) reported that *Conocarpus* ethanolic extracts have a strong antibacterial activity against both gram positive and gram negative bacteria. Phytochemical screening of *Conocarpus* plant revealed that sterols, triterpenes, flavone aglycones, emodols (anthracenosides aglycones), coumarins, coumarin lactone derivatives, tannins (gallic), reducing compounds, anthrocenosides, sterols glycosides, cardenolides, saponins and sapogenins are present in the plant (Jagessar *et al*., 2010).

2.3 NeemAzal-T/S

2.3.1 Introduction

NeemAzal is a trademark of Trifolio-M GmbtH, Lahnau, Germany, NZ trademark of sustain - Ability Ltd, Motueka. NeemAzal is a broad spectrum botanical insecticide derived from the Neem seed kernel; it contains 10g/litre azadirachtin in the form of an emulsifable concentrate (EC). Neem tree is considered to be one of the most promising trees of the 21 century. It has great potential in the field of pest management, environment protection and medicine. In Sudan (Siddig, 1993) reported that Neem seed water extracts at1Kg/1Liter of water repelled foliage pest of potato including *B. tabaci*, *Aphis gossypii* and *J. lybica* and yield increased to 5 ton/ ha. (Mohammed, 2002) Singh (1993) reported that 0.001% concentration of neem seed kernel extract caused absolute feeding detergency against the desert locust *Schistocerca gregaria*. While 0.05% concentration was needed for some effects on the migratory locust *Locusta migratoria*. The larvicidal activity of different fraction of neem leaves showed that two fractions of 1% petroleum either extract NPZI and NPZII produced respectively 100% and 80% mortality in 24 hour on the fifth instar larvae of mosquito (Sharmma, 1993). (Goudegnon, *et al*., 2000) studied the comparative effects of deltamethirn and neem kernel solution treatment on Diamond back moth. The moth populations were 10 times larger in deltamethrin plots, than in neem plots after treatment. The neem extracts could influence over 200 species of insects, many of which are resistant to synthetic pesticides; these include

insects from order Diptera, Coleoptera, Lepidoptera, Orthoptera (Dhawan and Patniaik, 1993).(Soliman, 2005) reported remarkable effect of NeemAzal –T/S® on survival of the greater wax moth larvae. Also Elawad (2006) found that NeemAzal T/S® was more effective against 2^{nd} and 4^{th} larvae of African bollworm (*Helicoverpa armigera*).Neem seed contains a number of chemical compounds the most important of which are Azadirachtin and Salannin in the triterpenoid fraction (Siddig, 1991) Other active compounds contained in the seed kernel are Salannin 4-epoxyazaradion,Gedunin, Nimbinen and Dimethyl nimbinen (Jones *et al*., 1989).Azadirachtin was first isolated in 1968, and is thought to be the most bioactive ingredient found in the neem tree; however, such speculation may be due to it having been investigated more thoroughly than the other compounds. Azadirachtin, one of the more than 70 compounds produced by the neem tree, acts mainly as an insect growth regulator, but also has anti-feedant and oviposition (egg-laying) deterrent properties (Quarles, 1994 and Thacker, 2002). There is evidence that other compounds found in neem have insecticidal attributes (Stark and Walter, 1995).

2.3.2 The Efficacy of Neemazal -T/S for controlling insects pests

The efficacy of NeemAzal-T/S was tested against more than 120 species of insects and mites from Acarina , Coleoptera , Diptera ,Heteroptera Hymenoptera ,Lepidoptera ,and Thysanoptera .The results show ,that NeemAzal is effective against free feeding sucking and biting pests , such as caterpillars , beetles, mealy bugs , aphid , whitefly , leaf miners , thrips , and spider mites. (Ahmed, 2001) reported that NeemAzal increased the yield of okra and obtained significant reduction of number of aphids, whitefly, bollworms and flea beetles. On tomato NeemAzal increased the yield by 38% over the control. It reduced the number of leaf miner and whitefly

significantly, while it reduced the number of aphids by only 10% under the control. On onion, the product increased the weight of onion by 15% over the control, a reduction by (21%-26%) of the number of thrips was also recorded. Neem formulations with rich azadirachtin contents such as NeemAzal were more effective than low azadirachtin formulations in suppressing bollworms incidence and also was more effective than the conventional insecticide endosulfan, and increasing yield of seed cotton (Gupta, 2002).

2.3.3 Mode of action and toxicological properties of NeemAzal-T/S

NeemAzal is a slow acting, naturally based anti-feeding insecticide, it leads to feeding inhibition (after some hours), reduction of molting (after some days), fecundity and breeding ability reduction (after days, or weeks) Thus, assessments should be done with respect to decrease in damage of the target crop rather than the mortality of the insects .NeemAzal degrade in aqueous systems to half-life within a few days. In addition to the very favorable toxicological properties the rapid degradation of the active ingredient assures the safety of the consumer due to the lack of residues , non - toxic to micro-organisms , aquatic organisms , beneficial , warm blooded animals and etc.(Kleeberg, 2001).

2.3.4 Compatibility of Neemazal -T/S with other bio-pesticides

Cornale (2001) reviewed that NeemAzal-T/S has a limit effect when it was used alone. The efficacy achieved by NeemAzal alone has been found to be from (54% 68%), but when it was tank-mixed with other bio-pesticides such as natural pyrethrum and/or a commercial product based on *Beauveria bassiana* (Naturalis) the efficacy achieved was 90% and above . Also (Elawad, 2006) reported that the combination of Bt. and NeemAzal caused 100% mortality against both 2^{nd} and 4^{th} instars larvae of African bollworm

H. armigera, while NeemAzal alone gave (97-87%) in same instars, respectively. These results showed that NeemAzal –T/S was effective and highly compatible with many bio-pesticides.

CHAPTER THREE

MATERIALS AND METHODS

3.1 Study location

The experiment was conducted in Entomology and Zoology Laboratory, Department of Plant Protection, College of Agricultural Studies (Shambat), Sudan University of Science and Technology, during February - April, 2016.The average of temperature and relative humidity is 30°C and 25%, respectively.

3.2 Insects rearing

The mealy bugs (*P. solenopsis*.) were obtained from infested cotton and okra fruits found in field near AL- Salha area (South Omdurman).The insects was reared in plastic cages covered with muslin cloth(Plate 2).The insects were fed with okra fruits brought from the local market (Plate 3) . The culture was kept under laboratory condition till experiment.

3. 3 Collection and preparing of plant materials

C. lancifolius leaves were collected from trees (Plate 4) grown in the College of Agricultural Studies-Shambat, Sudan University of Science and Technology. The plant materials were brought to the laboratory of the Entomology where they were cleaned and shad-dried for 7-10 days. After complete dryness the leaves were crushed separately by an electronic

blender to obtain the powder which were kept in plastic bags until they used (Plate 6)

3.4 Extraction method

One hundred of damas leaf powder was mixed with 100ml of acetone in flask (500 ml) and then shacked for 15 minutes and left for 24 hours. The mixture was filtrated and the solvent was removed by using rotary evaporator. Residues were re-dissolved in 10 ml of acetone. From this crude extract standard solution was prepared. Three concentrations (0.5 ml/l, 1 ml/l and 2 ml/l) were used in this experiment.

3.5 Bioassay test

Three concentrations of damas acetone extract were used in this experiment (0.5 %, 1 % and 2 % ml/l) and 1ml/l of NeemAzal-T/S was also used for comparison. Twenty adults (male and female) of *P. solenopsis* were placed in treated filter paper inside each petri dish. Each treatment was replicated three times **(**Plate 8). One day post treatment the insects provided with fresh okra fruits for feeding. The mortality data were recorded after 1day, 2 days and 3days. Sixty adults were placed in three untreated petri dishes each contains 20 adults as control.

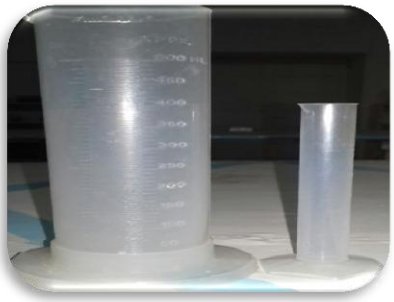
3.6 Statistical analysis and experiment design

The experiment was designed in a Complete Randomized Design (CRD) and the data was statistically analyzed according to analysis of variance (ANOVA) using Statistix-8program. LSD test was used for means separation.

(a) Petri dish

(b) Brushes

(c) Plastic cage



(d) Cylinders

(e) Gloves

Plate1. The Equipments

Plate 2. Adult cage

Plate 3. Insects rearing

Plate 4. Damas tree

Plate 5. Damas leaves

(a) Sensitive balance

(b) Leaf powder

(c) Damas extract

(d) Shaker

(e) Final extract

Plate 6. Preparing of Damas extract

Plate 7. NeemAzal - T/S

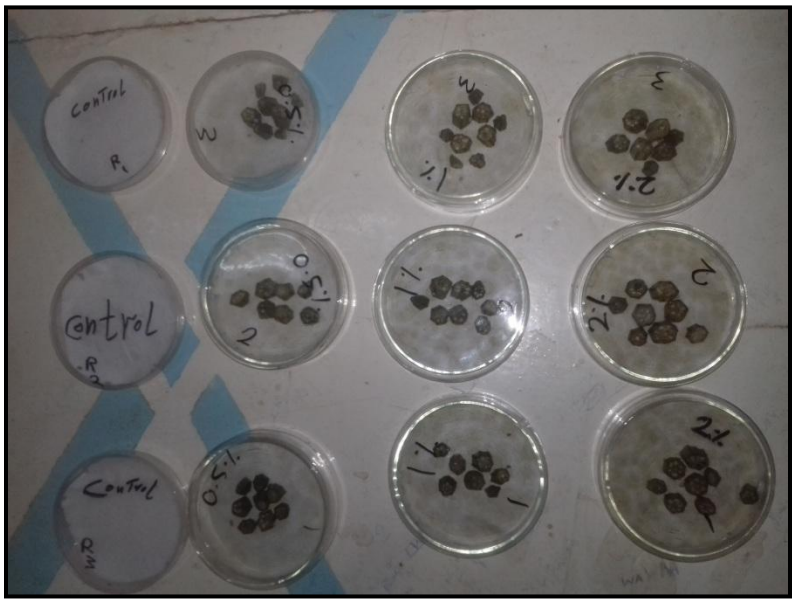


Plate 8. The Treatment

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1. Effect of damas (*C. lancifolius*) extract and NeemAzal-T/S against the mealy bug (*Phenacoccus solenopsis*)

Results in table (1) and figure (1) showed that there are no significant difference between all concentrations of damas acetone extract and control, while NeemAzal T/S gave highly significant difference when compared to the control. The higher concentration (2 ml/l) of damas extract gave only 10% mortality after 3 days post treatment, while a half of this concentration (1 ml/l) of NeemAzal T/S caused 78% mortality after the same period of

exposure. These results revealed that damas acetone extract have a little effect against the adults of *P. solenopsis*. In contrast NeemAzal T/S induces a significant effect against this pest.

Also we observed that treated okra fruits with NeemAzal-T/S showed a little number of eggs laid by the females when compared to those treated with damas acetone extract and untreated ones that mean NeemAzal-T/S reduce adult's fertility.

These results gave clear indication of bioactivity of NeemAzal-T/S as alternative method for control of *P. solenopsis.* These results agree with Elawad (2006) who found that NeemAzal T/S® was more effective against 2^{nd} and 4^{th} larvae of African bollworm (*Helicoverpa armigera).*Also agreed with Ahmed (2001) who reported that NeemAzal T/S was effective against different okra insect pests.

Table. 1. Mortality (%) among the adults of *Phenacoccus solenopsis* treated with damas extract and NeemAzal-T/S

Concentration (ml/liter)	**Times after exposure**		
	1st day	**2nd day**	**3rd day**
Damas extract			
2	0.0 [a]	0.0 [a]	10.0 [a]
1	0.0 [a]	5.0 [a]	8.3 [a]
0.5	0.0 [a]	1.7 [a]	6.7 [a]

CV (%)	2.38	2.38	2.35
SE±	0.23	0.23	0.98
NeemAzal-T/S			
1	18.3 [a]	48.3 [a]	78 .3 [a]
Control	0.0 [b]	0.0 [b]	0.0 [b]
CV (%)	1.34	1.78	1.89
SE±	0.23	1.6	4.9

*** Means followed by the same letter(s) are not significantly different at P 0.05**

CV = Coefficient of Variation

SE = Standard Error

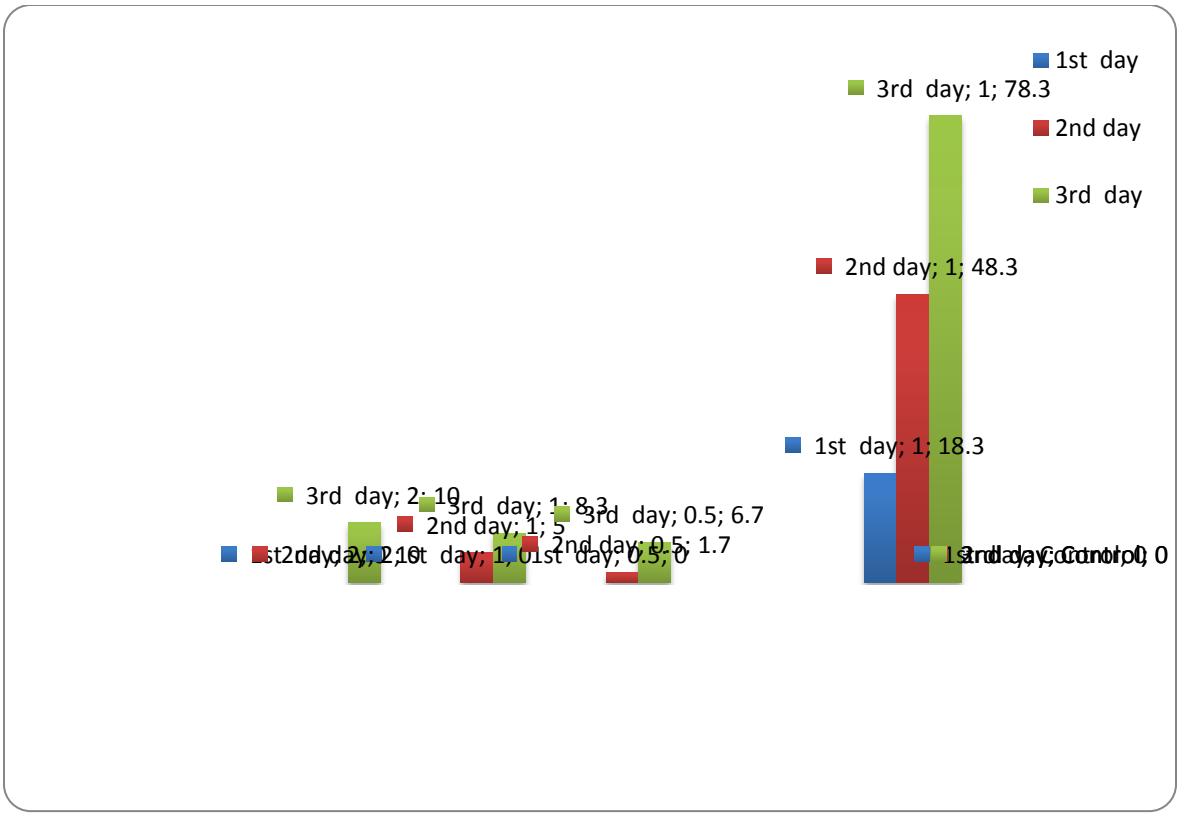


Fig.1. Mortality % among the adults of *Phenacoccus solenopsis* treated with damas extract and NeemAzal-T/S

CONCLUSION

From above mentioned results we conclude that NeemAzal -T/S was effective against *P. solenopsis*, and it could be one of the alternative bio-pesticides against this pest in the future.

RECOMMENDATIONS

1- The NeemAzal-T/S can be recommended to be used for controlling cotton mealy bug.

2- Further comparative studies should be conducted to evaluate the effect of NeemAzal-T/S against other insect pests.

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