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Sudan University of Science and Technology

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Department of plant protection

Effect of Arrak *(Salvadora Persica)* Leaves water extract against Hibiscus mealy bug *(phenacoccus hirsutus)*

infecting Okra fruits

أثر مستخلص أوراق الأراك المائي على البق الدقيقي في ثمار البامية

A graduation research project submitted in partial fulfillment of the requirements for the degree of B.Sc (Honour).Agric in plant protection

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الأية

قال تعالى:

(فَأَعْرَضُوا فَأَرْسَلْنَا عَلَيْهِمْ سَيْلَ الْعَرِمِ وَبَدَّلْنَاهُمْ بِجَنَّتَيْهِمْ جَنَّتَيْنِ ذَوَاتَيْ أُكُلٍ خَمْطٍ وَأَثْلٍ وَشَيْءٍ مِنْ سِدْرٍ قَلِيلٍ)

صدق اللة العظيم

سورة سبأ الاية (16)

DEDICATION

To my loved mother, father

ACKNOWLEDGEMENTS

Thanks firstly and lastly to Allah Al mighty for giving me patience and strength to complete this research.

I With to express my sincere gratitude and appreciation to my Supervisor Dr:SaifEldin Mohammed Kheir for his invaluable help. Special thanks are also due to staff members of the department of agriculture Studies, Sudan University for sciences and technology for their assistance. Sincere thanks are extended to all my colleagues who were motivated and help me in different ways.

ABSTRACT

The experminent was carried out in the laboratory of insects and agricultural zoology at the faculty of agricultural studies at the university of sudan for science and technology to evaluate the deadly effect of the water extract of the leaves of the arak plant against the mealy bugs which gave the death rate compared to the witness after 24-48-72-hours of treatment and the last reading after a week of treatment.

الملخص

اجريت التجربة بعمل الحشرات و الحيوان الزراعي بكلية الدراسات الزراعية بجامعة السودان للعلوم والتكنولوجيا لتقييم الاثر القاتل للمستخلص المائي لأوراق نبات الاراك ضد حشرة البق الدقيقي و التي اعطت نسبة موت مقارنة بالشاهد بعد 24-48-72-ساعة من المعاملة. القراءة الاخيرة كانت بعد اسبوع .

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CHAPTER ONE

INTRODUCTION

The hibiscus mealy bug (HMB] *maconellicoccus hirsutus* green (Hemiptera: pseudococcidae) was accidentally introduced in to the Caribbean in the early 1990. it was first reported in Grenada in 1994 after which it rapidly spread through countries in the Caribbean ,becoming one of the most important species.Iinitial measures to control the pest chemically and culturally were costly ,difficult to implement and or ineffective (PPPollard 1997;Sagrra and Peterkin, 1990).

As an exotic pest. HMB was a good target for classical biological control and efforts to achieve this were initiated in 1995 in Grenada through a technical cooperation project of the food and agriculture organization (FAO)of the United Nation and executed by CABI bioscienc.This led to the introduction of the parasitoid *Anagyrus kamali* Moursi (Hymenoptera :Encyrtidae).Subsequently,and as the pest spread to other countries, other agencies become involved and more natural enemies were introduced, most notably *crytolaemus montrouzieri* Mulsant (Coleoptera :Cccinellidae).What happened next was the dream of any biological control practitioner . With in a short space of time pest populations ware brought under control and the results were replicated in each country which became infested. With few exceptions much of the information arising from this programmed has only been reported in local or region at publications.

Objectives:

1. To evaluate the lethal effect of water extract of the arak *(Salvadora persica)* against adult stage of mealy bug *(Phenacoccus hirsutus).*
2. To test the toxic effect of the arak (*Soulvadora persica*) against adult stage of mealy bug *(Phenacoccus hirsutus)*.

CHAPTER TWO

LITREATURE REVIEW

2.1 Hibiscus mealy bug (Phenacoccus hirsutus)

2.1.1 Classification:

Domain: Eukaryota

Kindom: Metazoa

Phylum: Arthropoda

Subphylum: Uniramia

Class: Insecta

Orded: Hemiptera

Suborder: Sternorrhyncha

Super Famaly: Coccidea

Family: Pseadococcidae

Genus: *Phenacoccas*

Species: *Phenacoccas hirsutus*

2.1.2 Description:

Female ovate, slightly elongate, covered with sparse mealy secretion 2-3.5mm long. Well defined marginal appendages absent, secretion on the posterior extremity of the body somewhat more pronounced than on the margin- Antennae and legs well developed, female mobile till oviposition.

Ovisac elongate, white, about twice as long as broad.

Male pinkish, about 1.2-1.5mm long. Head with 4 ocelli and well developed antennae fore wings hraline iridescent, hindwing (halters) very small. Legs slender with numerous hairs. Abdomen distinctly segmented, with two very long apical, white filaments. (john L.Nickl,1974)

2.1.3 Distribution:

The Species is wideIy distributed in Southern, Southeastern, and eastern Asia (India East Pakistan, MaIaysia, Burma, ThaiIand, PhiIppines,New Guinea Formosa). In Africa it has been recorded, from the NiIe VaaIIey (U. A. R Sudan) and from Zanzibar.In the Sudan,the Hibscus meaIy bug is common in the irrigated areas of Northern, Khartoum, bIue NiIe and KassaIa Provinces.it was observed in Wadii HaIfa.Shendi,Zeidab, Atbara, Khartoum,Wad Medani, Sennar, Tokar and some IocaIites in the South.(DE.ENANS, 1969)

2.1.4 HostpIant:

Damage and economic importance. M. hirsutus is PoIyphagous and attacks anumber of crops and ornamentaI pIants in the Sudan,for instance, different Species of Citrus, Hibiscus, mango, guava and grape. The infestation resuIts in CrinkIing of the Ieaves and stunting of shoots, the damage to young pIant can be severe. Even afew insscts are capabIe of causing typicaI injury to the hostpInt. NeverthIess, the Species is in generaI,onIy amin or pest in the Sudan.In the past it was much more dreaded due to its abiIity to infest cotton.In the U. A. R (Egypt) and in rare cases, also in Sudan, the mealy bug sometimes attacks cotton. Especially in areas where

in feasted perennial plants are nearby. Other host plants in both countries belong to the genera of Acacia, Albizzia, Robinia, Banbina, Ceiba, Cajanus, Ceratonia, Erythrina, Cassia, Grevillea, Morus, and Zizyphus.

2.1.5 Life history and bionomics:

The female crawls for a few days after copulation, sometimes covering long distances in search of a suitable place for oviposition. The egg lagging period lasts about a week during which 150-300 pinkish eggs are deposited in the ovisac. After completing this female shrivels and dies. The young nymphs hatch after a few days migrate to tender shoots and sale in colonies preferably near the growing point. During their development.

The mealy bugs inject toxic substances into the host plant which are responsible for the subsequent curling of leaves and stunting of shoots. In the U. A. R (Egypt) the life cycle is 5 weeks under summer conditions. It is most probable that several generations occur per year in the Sudan, as the temperatures in this country are higher than in the northern Nile valley. The females outnumber the males.

2.1.6 Natural enemies:

Numerous parasites and predators, mainly Hymenopterous insects and ladybirds, hare been stated to be enemies of M. hirsute in Egypt. None of them has been recorded so far from the Sudan. (john L.Nickl,1974)

2.1.7 Damage:

The life cycle from egg to adult takes approximately 60 days, depending on temperature and host plant. The primary means by which mealy bug crawlers 12 disperse within a green house or interiorscape are wind or air

currents, workers handling infested plants and inadvertently transferring mealy bugs to uninfested plants, watering equipment, plant leaves touching that allow crawlers to move among plants, introduction of infested plant material, and ants transporting crawlers among plants. The lateral waxy protrusions help protect mealy bugs from natural enemies (e.g., parasitoids and predators) and promote the spacing of individuals in a colony. Mealy bugs seem almost invisible during early stages of infestation, and then suddenly populations become noticeable, resulting in outbreaks.

It is usually too late then to implement an effective management strategy.

Mealy bugs cause direct plant injury by feeding on plant fluids or sap in the vascular tissues—primarily the phloem or mesophyll or both—with their piercingsucking mouthparts. They may also inject a toxin. This may cause leaf yellowing, plant stunting, and wilting. In addition, mealy bugs excrete a clear sticky liquid called honeydew, which serves as a growing medium for black sooty mold fungi.

Mealy bugs are also capable of transmitting diseases, including viruses. Mealy bugs tend to congregate in large numbers at leaf junctures where the petiole meets the stem, on leaf undersides, on stem tips, and under the leaf sheaths of certain plants such as orchids and the prayer plant (*Maranta leuconeura*) Raymond(2011).

2.2 Control:

2.2.1 Cultural Management

This involves implementing practices such as weed removal, proper fertility, and old plant material disposal. Favorable environmental conditions (e.g., temperature) and plant growth may increase the mealy bug population. For example, plants irrigated frequently that receive high concentrations of a nitrogen-based fertilizer tend to be more susceptible to mealy bugs. Water-stressed plants may also be more susceptible to mealy bugs. Furthermore, mealy bug females feeding on plants receiving high concentrations of a nitrogen-based fertilizer may lay more eggs than usual. It is also important to immediately discard heavily infested plants, especially those that have been around for several years ("grandmother plants"), which tend to harbor mealy bug populations. If feasible, a forceful or high-pressure water spray, conducted regularly (e.g., twice per week) is effective in dislodging or removing all life stages (eggs, crawlers, and adults) quickly,thus preventing outbreaks from occurring. Raymond(2011). There is little information concerning the chemical control of this pest in the Sudan. According to the trials in other countries with this and allied mealy bugs satisfactory results may be obtained by repeated spraying with dimethoate (Rogor etc), diazinon, parathion and malathion. Ant control can be carried out with dieldrin or Aldrin**.**

2.2.2 Chemical control

(Mani,1989) mention that Sticky banding such as tangIefoot; has been used in India to Protect grape bunches from infestation by M. hirsutus. Pesticide Sprays tend to be of Iimited effectiveness against M. hirsutus because of its

habits of hiding in Crevices, and waxy Covering of its body (wiIIiams, 1996) : Systemic insecticides one more IikeIy to be effective (mani ,1989) States that most granuIar insecticides are ineffective aganst M. hirsute any pesticide used against M.hirsutus ShoaId be CarefuIIy Selected to avoid injury to its naturau enemies, because they are IikeIy to be important in heIping to keep popuIations at Iow Ieveis in the Iong term.The first-inster Stage is most SusceptibIe to pesticide treatments (persad Khan,2000) : however, the same study found that Aii the pesticides tested were highIy toxic to the main bioIogicaI controI agent, Anagyrus KemaIi.

In India, there is some evidence of pesticide resistance developing (Mani, 1989) so pesticides are only used to control heavy infestations of the mealy bug population are subsequently maintained at low levels by biological control.

In organic oil emulsion sprays gave good control of M. hirsutus on guava in Tamil Nadu, India (IaIuddin and Sadakath uIIa,1998). Anitha et at (1999) tested the aIkaIoid,on M. hirsutus and found evidence that abrine couId have a orastic effect on the popuIation density of the meaIy bug.

2.2.3 IPM Programmers:

In India the main biological control agents used to regulate dactyIopii and the predators Submenus Coccivora and S. gratuitous, as part of an integrated pest man agent regime involving pesticide use if the mealy bug population reach a high IeveI (mani, 1989).In India, integrated pest management using both CoccineIIid beetle predators and pesticides (ChIorpyrifos) has been achieved on grapes (mani, 1989).The M.hirsutus invasion of the Caribbean including strung thening of plant quarantine,

development of taxonomic expertise in the region, development of export protocols development of a capacity for the m. hirsultus invasion of the Caribbean region has resulted in several long-term benefits, including strengthening of plant quarantine, development of taxonomic expertise in the region, development of export protocols, development of a capacity for biologic ales control and reduction in the use of toxic pesticide, creating a suitable environment for the development of integrated pest management (Kairo *et al* 2000).

2.2.4 Phytosanitary measues:

Garland (1998) recommends a fuming ant greenhouse in Canada since its appearance in the Caribbean region in 1994-1995; M. hirsutus is regarded as of high quarantine importance by the CPPC if regulation is regutus, planting material of host-plant free of infestation. A phytosanitary certificate should guarantee absence of the pest from consignments of either planting material of produce.

Amy shipments of fresh plant material from an infested country to one that is not yet infested but could be should be examined thoroughly to detect M. hirsutus.

2.2.5 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

Cheilomenessexmaculata,Rodoliafumida,Scymnuscoccivora and

Nephusregularisare important predators of mealy bug nymphs .Biological control by release of natural enemies has proved very successful . Among the biological control agents introduction of Ciyptolaemusmontrouzieri (Australian Ladybird) Anagyruspseudococci, Leptomastixdactylopii ,Hypoaspissp ,Verticillium iecanii and Beauveriabassiana are effective in managing the infestation . Hypoaspisis

a small mite that feeds on crawlers (CAB 1,2016).

Okra (Abelmoschus esculentus)

classification

kingdom:Planatae

(unranked):Angiosperms)

(unranked) : Audicots

(unanksd) : Rosids

Order : Malvales

Family : Malvaceae

Genus : Abelmoschus

Species : esculentus

Binonmial name : Abelmoschus esculentus (L.) Moench Okra (Abelmoschus esculentus) ,known in many English _speaking countries as ladies' fingers,bhindi,bamia,ochro or gumpo, is a flowering plant in the mallow family. It is valued for its edible green seed pods. The geographical origin of okra is disputed, with supporters of West African, Ethiopian, and South Asian origin. The plant is cultivated in tropical, subtropical and warm temperate regions around the world(National Research Council, N.R.C.2006).

2.2.6 Structure and physiology:

the species is an annual and perennial, growing to 2 m tall. It is related to such species as cotton, cocoa, and hibiscus. the leaves are10-20 cm long and broad ,palmately lobed with 5-7 lobes .The flowers are 4-8 cm in diameter ,with five white to yellow petals ,often a red or purple spot at the base of each petal .the fruit is a capsule up to 18cm long , containing numerous seeds . *Abelmoschus esculentus* is cultivated throughout the tropical and warm temperate regions of the world for its fibrous frits or pods containing round, white seeds. It is among the most –and drought-tolerant vegetable species in the world and will tolerate soils with heavy clay and intermittent moisture, but frost can damage the pods. In compound farms in the rainforest of southeastern Nigeria (Okafor and fernander ,1986),farmers have developed a mnlti –crop system that a diversified and continuous production of food, comdining species with different maturity periods such as yams, cassava ,cocoyams ,bananas ,plantain ,maize , okra ,

pumpkin ,melon, leafy vegetables and a variety of tres and shrubs, 60 of which provides foot products . This ensures a balanced diet but also reduces the need for storage in an area where post-harvest losses are high .okra seed. Retrieved (2012).

In cultivation, tge seeds are soaked overnight prior to planting to a depth of 1-2cm. Germination occurs between six days (soaked seeds) and three weeks.

Seeding require ample water. The seed pods rapidly become fibrous and woody, and, to be edible, must be harvested within a week of the fruit having been pollinated .the fruits ar harvested when immature and eaten as a vegetable

The most common disease afficting the plant is verticillium wilt, often causing wilting of the leaves .Other diseases include powdery mildew in dry tropical regions, leaf spots, and root-knot nematodes(Gueensland,2012).

plant okra

2.2.7 Origin and distribution

Okra is an allopolyploid of uncertain parentage (proposed parents include Abelmoschus ficulneus, A. tuberculatus and a reported “diploid” forme of okra).

Trualy wild (as opposed to naturalized) populations are not known with certainty and the species may be a cultigen.The geographical origin of okra is disputed, with supporters of south Asian, Ethiopian and West Aforigins.Supporters of a South Asian origin point to the presence of its proposed parents in the region. Supporters of a West African origin to the greater diversity of okra in that region. Tge Egyptians and moors of 12^{th} and 13^{th} centuries used the Arabic word for the plant, bamya, suggesting it had come from east. The plant may have entred southwest Asia across the Red Sea or the Bab-el-Mandeb strait to the Arabian Peninsula, rather than north across the Sahara, or from India. One of the earliest accounts is by the locals who ate the tender, young pods with meal Retrieved (2012). From Arabia, the plant spread around the shores of the Mediterranean Sea and eastward. The plant was introduced to the Americas by ships plying the Atlantic slave trade Milliken and Feniger (1996) by 1658,when its presence was recorded in Brazil .It was further document in Suriname in 1686.Okra may have been introduced to southeastern North America From Africa in the early 18th century. By 1748, it was being grown as far north as Philadelphia. Thomas Jefferson noted the it was well established in Virginia by 1781.It was commonplace throughout the southern United States by 1800,and the first mention of different cultivars was in the products of the plant are mucilaginous, resulting in the characteristic ”goo” or slime when the seed pods are mucilaginous ,resulting in contains a

usable form of soluble fiber. Some people cook okra this way, other prefer to minimize the sliminess; Keeping the pods intact, and brief cooking, for example stir-frying, help to achieve this. Cooking with acidic ingredients such as a few drops of lemon juice, tomatoes, or vinegar may also help. Alternatively, the pods can be sliced thinly and cooked for a long time so the mucilage dissolves, as in gumbo. The immature pods may be pickled. Okra leaves may be cooked in a similar way to the greens of beets or dandelions. Austin (1861) mention that since the entire plant is edible, the leaves are also eaten raw in salads. Okra seeds may be roasted and ground to from a caffeine-free substitute for coffee. When importation of coffee was disrupted by the American civil War in 1861, the Austin State Gazette said, An acre of okra will produce seed enough to furnish a plantation of fifty negroes with coffee in every way equal to that imported from Rio (Durauchelle, 2011), Okra is a popular health food due to its high fiber, vitamin C, and foliate content .Okra is also known for being high in antioxidants. Okra is also a good source of calcium and potassium(Derlin 2015).

2.2.8 Propagation:

Okra is typically propagated from seeds in water overnight prior to planting helps the plants to germinate. In the home garden, seeds should be sown at a depth of 2.5 cm (1 in) leaving 25-45 cm (10-18 in) between rows only after the soil has reached a temperature of 18C° (65f°).In commercial okra production, seeds are planted in rows spaced 0.65-1.0 m (26-40 in) apart. Okra seed commonly planed at a rate of 10 1b per acre but this quantity is vastly reduced by the use of precision planting methods. Seedlings are

thinned to a final spacing of 15.0-22.5 cm (6-9 in) when they are 4-6 weeks old to produce the final plant stand.

2.2.9 Harvesting

pods are usually ready for harvest 4 to 6 days after flowering and pods should be harvested every 2-3 days when they have reached 7.6-15.2 cm (3-5 in) in length. Pods can be removed from the plant by cutting with a sharp knife or by snapping from the plant.

2.3 Salvadora persica

2.3.1 Classification:

Kingdom: plantae

Clade: Angiosperms

Clade: Eudicods

Clade: Rosids

Order: Brassicales

Family: Salvadoraceae

Genus: Salvadora

Species: *Salvadora persica*

Arabic: Arrak Arraka, ElRak, Chaub.

2.3.2 Description:

Shrub or small tree up to 9-5 m high. Bark smooth light grayish green, smooth and, glabrous, branchlets terete. Leaves opposite entire, simple,

glucose green, lance olate to elliptic, mucronate, rounded to sub acute at base, 3-7 cm long, 1.5-3 cm broad rigidly chartaceous, grey when dry, glabrous, the few lateral nerves equally prominent on both sides, petiole nearly 1 cm long .Flowers in divaricate lax panicles, copiously produced from end of branchlets greenish white, 4- merous, calyx shallowly lobed, petals 1.5 mm long .stamens 4, ovary 1-celled. Fruits berries, subglobose, about 6mm in diameter about the size of a pea, translucent purple when fresh.

Leafing, flowering and fruiting: Flowers January – February – March.

2.3.3 Distribution:

In the northern Sahel into the central Sahara from the Atlantic to the Red Sea .Through Arabia to India , in East Africa, south Africa , Namibia .

Throughout the Sudan, common in the Red Sea Hills particularly Sinkat Where it is gregarious.Gedaref (Kassala) Aylmer 71 ; Dinder Alymer 68 ; Sinkat Sahni & Kamil 693 ; Port Sudan Littoral Sahni & Kamil 714 ; White Nile Broun 339 ; Kordofan Pfund 272.

2.3.4 Spot Characters:

Shrub or small tree with drooping branches. Bark smooth light grey, Leaves opposite, entire, lanceolate-elliptic, mucronate. Flowers small greenish white copiously produced in lax panicles.

Fruits size of a small pea. Translucent purple.

(Sahni 1968).

2.3.5 Uses:

The wood is used for firewood and charcoal, while the small branches and roots are used for cleaning teeth, the tree provides fodder for goats and the fruit is cooked and eaten.

Important as medicinal plant for treating fever, liver ailments , rheumatism gonorrhea , bronchitis , asthma etc, as a diuretic and for dental care (fine shoots are chewed).From wood and leaf- ashes a kitchen-salt is produced which is a regional trade commodity . leaves and the end of shoots are browsed all over the year by cattle, sheep , goats and camels .The nutrient value of the leaves is as follows (Sahni 1968).

(Houerou 1980): Crude protein 13 % DM (10 – 17) ,Net energy 4.8 MJ Kg DM (3.2 – 6.0), Digestible protein / RU 137 (108 – 193) P.0.10 (0.08 – 0.13),Silica-free minerals 29% DM (20 – 36) |(El. Amin 1995).

Salt contained in the leaves influences the taste of milk, but leaves are said to increase Lactation of cows. The wood is used for saddles of donkeys and camels ,occasionally also as fuel and for charcoal. Fruits are said to be edible when cooked.

2.3.6 Site requirements:

On clay soils, saline soils, on the perimeter of waterholes , in valleys , on dunes , on termite Extremely well-adapted to aridity . Rainfall less than 200 mm.

CHAPTER THREE

MATERISLS AND METHODS

This study was conducted at the laboratory of the Entomology-Department of plant production –college of Agricultural Studies (Shambat) in the 11-2017, to evaluate the effect of arrak (*Salva- dora persica*) agent Hibiscus mealy bug

3.1 Equipment:

Plastic box

Soap

Class box

Hand sprayer

Brush

Gloves

Masks

Sensitive balance

Marker pen

Beakers

Fitter

Material:

Sand

Water

Honey is 50 %water

Okra

Flitter paper

3.2 Insect rearing:

Mealy bug

The infected tomatoes were collected from south slate project in Khartoum and brought to the laboratory where they were reared in plastic box. The bottom of these box were filled with sands 2-3 cm , then the water was sprinked over it in a small amount .

Okra is placed to feed the mealy bugs and is changed every 3 – 4 days added honey % water for additional feeding Temperature in the laboratorym was 26–28 c and HR 28 – 30 %

3.3 Plant material:

In this study araka leaves aqueous extracts was used leaves when collected from nursery of Medicinal and aromatic plants in Shambat area for a week and then crushed to a fine powder with electrical blinder .

3.4 Extraction method:

Concentration

The powder of arak leave was mixed with 1000 ml water and two points of the soap and oil (to make the emulsion to melt the outer layer of the mealy bugs).

3.5 Bioassay procedures and contact method:-

Three different concentration 5 % 10% 20 % of arak leave extracts were used to treat the mealy bug . Twelve boxes were chosen, ten insect were introduced in each box , four treatments including 5% - 10%-20% concentration of arak extract were used plus control , the

data of mortality of insects were recorded after 24,48,72, hours and a week.

3.6 Statictical analysis:

Data were subjected to analysis of variance (ANOVA) . Means were separated using least significant difference LSD

CHAPTER FOUR

RESULTS

This study was conducted at the laboratory of the Entomology-Department of plant production –college of Agricultural Studies (Shambat) in the 11-2017, to evaluate the effect of arrak (*Salva- dora persica*) agent Hibiscus mealy bug

N	Minimum	Meximum	Mean	S.D
5%	70	2.54	1.5825a	79785
10%	70	2.73	1.5575a	86110
20%	70	2.34	1.5950a	76861
control	70	2.73	1,5575a	86110

N	Minimum	Meximum	Mean	S,D
5%	70	2-12	1.6300a	.67022
10%	70	2-91	1.4725a	1.04427
20%	70	2-34	1.5325b	.72034
Control	70	1-87	9925b	.58500
N	Minimum	Meximum	Mean	S.D
5%	70	2.12	1,6300a	67022
10%	70	2.73	1.4275a	96234
20%	70	2.54	1.5150a	95657
Control	70	2.54	1.1600a	92000

Means between brackets transformed according to Root (x+0.5).

No significant diffirence was found between all treatments including control

CHAPTER FIVE

4.1 DISCATION

It have bean known that chemical pesticides have adverse effect on plants, beneficial insect, humans, wildlive and inviroment . There for botanicals were proposed for insect control in this study water extract of Arak plant was use against mealy bug (phenacoccuccus hirsutus).The present result revaeal that water extract of arrak gave better result than control .It means it was not very effective .No studies were found about the effect of arrak extrac against mealy bug .

4.2 CONCLUSION

All concentration of arrak water extract (5%- 10% - 20%-) have no effect on mealy bug (phenacoccus hirutus) mortality .

4.3 RECOMMENDATION

More studies are required to ascertain if there is adeadly effect of the plant arrak or not . Also mor studes are need to determine active ingredients .

Appendix

Araak leaves

Hand sprayer

Mstatc

Prushes

4.4 Reference:

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