The Efficacy of Neem (Azadirachta indica) and Kafur (*Eucalyptus camaldulensis*) extract on the control of Sinoxylon senegalense Karsch in (*Acacia seyal* Del).Wood

By

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Dedication

To the memory of my dear father, may his soul rest in peace .Special dedication to my beloved mother who shared my worries and hopes.

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ABSTRACT

This study was carried out to evaluate the effect of neem seed kernel powder (NSKP), neem oil (NO), neem leaf powder (NLP), and *Eucalyptus camaldulensis* leaves oil (EO) on controlling *Sinoxylon.senegalense* infestation on *A.seyal* wood. Eighty freshly cut logs of A.seyal 30cm in length and with diameters ranging from 15 to25cm. Every 5logs were treated with NO at (0,10,15,and20%), Eo at (0,10,15and20%), NSKP at(0,30,40and50%)and NLP at (0,30,40and50%).This experiment was carried out in summer and repeated in winter . Mode of infestation, number of complete pores were determined and recorded daily. Weight Ioss due to infestation was also calculated by subtracting the weight after infestation by *S. seneglense* for 2.5 and 3 months in summer and winter, respectively from initial weight of each log. The results showed that infestation and weight loss were significantly reduced by all botanical applications compared with control in both summer and winter. No significant difference was found in reduction of infestation and weight loss in winter between NO (10,15 and20%). In addition to result show no

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significant difference between EO dose in reducing weight loss in winter. But a significant difference between EO doses at (10,15and 20%) in reducing infestation in winter. Also the results showed a significant difference in reducing both infestation and weight loss in winter between NLP (30,40,and50%), NSKP (30,40and 50%). There was a significant deference between NO (10,15and20%), Eo, NLP (30,40and50%), NSKP (30,40and 50%) in reducing infestation in summer. But the study showed no significant deference between NLP (30,40and50%), NSKP, (30,40and50%) NO (10,15and20%), EO concentration in reducing weight loss in summer

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The effects of botanicals whether are dose dependent or not dose dependent depending on the type and concentration of botanical tested.

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Chapter One

1-Introduction

Eucalyptus spp.and Neem are popular and well-known plants in Sudan. All parts of Neem tree are usable. The wood is strong and durable, the leaves contain many compounds which can protect our crops and our health; the seeds provide the cheapest oil available which is used for soap and energy and the cake is available manure and good cattle feed. *Eucalyptus* has been traditional source of timber cellulose- related products and essential oils from the leaves.

Recent studies encouraged the use of simple formulation of locally available plant material to control insect pests .The above mentioned plants specially Neem are not toxic to warm blooded animals or humans. They may be slightly harmful to natural enemies of pest such as predators and parasites.

1-1Problems of pesticides use:

The use of chemical pesticides causes pollution and has harmful target effects and may stimulate resistance in pests. The likelihood of insect pests developing resistance against plant derivatives, comprising an array of chemicals is much less than using an insecticide based on a single chemical ingredient. Another problem associated with pesticides use is their short term and long term health effect. However, in many cases people applying the pesticides are unaware of how they work and what precautions should be used in their application. In many parts of the world small subsistence farmers are unsophisticated and many even lack the ability to read the labels on the packages.

Consequently, deaths from the misuse of pesticides occur constantly. However, for most people critical health problems to pesticide use relate to on advertent exposure to very small quantities of pesticides. Many pesticides have proven to cause mutation produce cancers, or cause abnormal birth in experimental animals. There are questions about the effect of the chronic, mute exposure to pesticides residue in food or through contamination of the environment. Although the risks are to some degree small, many people find them unacceptable and seek to prohibit the sale and use of such pesticides.

For example, the United States. Environmental protection agency (EPA) banned the use of dinoseb herbicide because tests by German chemical company Hoechst AG indicated that dinoseb cause birth defects in rabbits. Other study indicates that dinoseb causes sterility in rats (Whitaker1972).

1.2 Objective of the present study: -

1-To test the efficacy of some botanical s in controlling or minimizing damage by *Sinoxylon senegalense* on A. *seyal logs*.

2-To determine the impact of these botanicals on infestation and weight loss of *Acacia seyal* logs.

3-To propose possible control measure.

1.3 Justification of the study: -

- *Sinoxylon senegalense* beetles are the most serious pests, attacking timber few days after felling and reducing it to dust. This needs quick solution.
- At present, chemical pesticides provide the best protection, but these materials are expensive and their use can generate additional problems such as residues on food crops and environmental contamination.

Chapter Two

Literature Review

2-1 background:

Acacia seyal Del. (family leguminosae, subfamily mimosoideae) is one of over 60African acacias .The species usually reaches 9-10m in height at maturity and in well-formed individuals a flat –topped crown develops. There are two varieties, differing primarily in whether or not pseudo –galls (“ant gall’’) develop and in bark colour. In *var. Seyal* there are no pseudo –galls and reddish bark color prevails, although periodic bark exfoliation exposes apale powdery surface which darkens slowly .In *var. fistula* pseudo –galls are present and the powdery bark typically remains whitish or greenish -yellow .The two varieties differ markedly in their ranges var. *seyal* westwards from central Sudan and north of latitude 18N^{o} and var. fistula extends south of latitude 10s^{o} (John 1994).

2-2 Economic Importance:--

Var.*seyal*, especially, is an important source of rural energy as both firewood and charcoal. (John, 1993). The fire –wood produced is not of good quality, the thermal value is low and can not be stored for it is readily attacked by insects and fungi. However the tree is considered to produce excellent charcoal in Sudan. Elatta &Obeid (2001) reported that new and quick methods for conversion and drying of wood from *A.seyal* should be adopted since stacking in the open for months resulted in losses of 50%of wood material and 20%of the calorific value of

charcoal. If stacking of the logs in the open is unavoidable, then they should be positioned in away that provides maximum exposure to direct sunlight such as a horizontal North-south position.

The tree has high tannin content (21-24%).The leaves, young branches, flowers and pods of talih are grazed by domestic and wild animals especially in dry season. Pods contain more than 20% protein and are very nourishing. In Sudan the wood of *A. seyal* is used to make aromatic smoke and fumes over which women smoke themselves. This also protects them against cold and fever especially after childbirth (Elsheikh, 1982) .*A.seyal* is one of the gum producing trees of the Sudan It contrasts with gum dexatorotatory Arabic in several significant respects, being strongly, of high molecular weight and low in nitrogen (0.06-24%) and rhamonose (<4% sugar composition). (John, 1993).

2-3 Pests and injuries:-

Over 40 species of insects are reported associated with *A.seyal*. These include 10species of bruchid beetles, which may damage high proportion of stored seeds. Beetles of various other families attack the wood, the bostrychid *Sinoxylon senegalense* being the most notorious and swiftly locating and infesting freshly cut wood, especially if lying on the ground. Attacks are much reduced if the bark is removed and the cut stems stacked (John, 1994). *S. Seneglense* Karsch (Coleoptera, Bostrychidae) which is commonly known as the talih porer was found to infest a variety of hard wood species, in particular *A.seyal*, *A.nilotica*, *Terminalia* sp and *Albizzia* sp. **(**Bushara, 1979). In the Sudan**,** Peake (1953) and Bushara (1981) reported *S. senegalense* as the most serious powder –post beetles that attack the wood of *A.seyal* (Obied, 1998). The moisture content of the logs

has a significant effect on infestation. Freshly cut log (36.03 %) were most heavily attacked by *S.senegalense* (42 porers on average in two months), whereas infestation was very little in very dry logs (10.11 %) 0.2porers (on average) and water soaked logs (47.2 %) were completely un-infested, through out the year. Gnanaharan *et al* (1985) who found that debarked cashew logs before stacking, suffer less damage by S.anale. Debarking of logs before stacking may have accelerated rabid reduction in wood moisture content to levels that the beetles were unable to attacked them.

2.4 The biology of insect: -

Bushara (1981) studied the beetle s biology in detail. The adult is about 6mm in length and 3mm in width black cylindrical and abruptly truncated posteriorly It has characteristic pair of posterior spines and three bladed antennae that make it easily recognized. The adult beetle attacks freshly cut logs making rounded entrance holes (2-4mm) and the bore dust is pushed out through these holes .The beetle is reported as viviparous (Peake1953, Bushara1981) The larvae, which are vermiform and coiled posteriority, are usually found 7to 12days after infestation They bore into the sides of the mother tunnels making tunnels parallel to the wood grain, radiating from the initial mother tunnels. The larval stage is spent completely inside the log. (Obeid,1998) pupae are also white in colour but gradually turned into dark brown they were obtect and has 3visible blanded antennae and legs under its thin skin ,they were seen after 8-12 weeks and their duration 3-4 weeks .New adults emerge after 11-16 weeks dark brown or black in colour ,have cylindrical body and length ranges between 3.4-6.2 mm ,the female adult beetle was larger than the male.

2-5 Some measures of control: -

A. Seyal logs must be debarked, dried, or water soaked, and stacked under direct sunlight, in mixture with wood from other tree species and where possible to stack the smallest diameter logs in order to minimize infestation (Elatta, 2001). Monthly

or fortnightly application of HCH at 0.5 %or borax-boric acid (2%boric acid equivalent) to exposed surface of the stacks did not give adequate protection against the pests however, debarking the billets before stacking gave satisfactory protection against *B.rufomaculata* and reduced infestation by *X.similis.* More frequent prophylactic application of insecticide is recommended to reduce the chances of attack by *S.anale. (*Gnanaharan, - R *et al* 1985).

2-6 The control of insect pest by natural plant Extracts: -

Asingle treatment with pine oil on logs of spruce against attack of *Trypodendron lineatum* gave complete protection for nearly on week during beetle flight. Logs treated twice were kept free from attack for nearly 3weeks. A reduction in beetles attack of 90% or more could be maintained for seven weeks if pine oil was sprayed directly on the log surface, and for nearly four weeks if applied in dispenser after few weeks exposure to flying beetles, both kinds of application showed 85% reduction of attack compared to controls, which were heavily infested (395 bark holes/m) (Dubble, 1992). Osmani *et al*., (1974).Schoonhoven (1987) found that vegetable oil such as cotton seed oil, maize, Soya bean, coconut and African palm to increase adult mortality and reduce aoviposition by Bruchid *Zabrotes subjaciatus.* Leaf extracts of vilex negundol, Synadenium grantii Hook.f.and Prosopis juliflora (sw) Dc., and cake of *Azadirachta indica* A.juss. were evaluated for their efficiency in reducing the population of the green leaf hopper, *Nephotettix virescens* (Distant), and its transmission of rice tungro virus under field conditions in Tamil Nadu. All four-plant species tested reduced the population of the vector

significantly in both the nursery and main field. The lowest population the vector was recorded with application of neem cake at 5kg/0.032ha of nursery, followed by foliar spray of neem seed kernel extract at 5% in the main field (Rajappan, k., *et al* 2000.) Manipueira, aliquid extract from cassava roots, was tested against *Polyphagotar sonemus latus.* This by –product was diluted in water (1:3) and sprayed 3 times at weekly intervals on highly infested pawpaw plant, 100%control was observed Baghrewal (1999) tested *E.globulus* (in an emulsifier base) initially against developmental stages and adults of *Hyalomma anatolicum* by placing them on filter paper impregnated with a 1:4dilution of the preparation .The average mortality of the unfed larvae, nymphs and adults was 100,89.2,respectivly. There were 100% inhibition of egg laying and hatchabiliity and engorged female ticks.

2-7 Neem (*Azadirachta indica*) Extracts: -

Neem products have insecticidal, behavioral and physiological actions against insect pest. Neem effect may be repellent, antifeedent, and growth regulatory or insecticidal effect (Heyde *ET al.*, 1983;Gilland Lewis, 1971 Rembold *et al*., 1986; Chavan, 1983**).**

2.7.1 Neem oil (NO): -

Neem oil contains so many compounds some of them had already affected adult stages of pests and caused effective control such as azadirachtin. (Isman *et al.*, (1990) Azadirachtin is the most active substance separated from *Azadirachta indica* .It acts destructively on numerous species of insects and mites

(Wawrzyniak, M., wrzesinska, D2000.) Other compounds are also present such as Epoxyazadiraclione, Azadirone, Azadiradione, Azadirone, zepoxyacityle gedanin and Gedunin (Asher, 1986.) Neem oil and pongamia (pinnata) oil (both 4%) are recommended for the control of planococcus citrion guava; they caused 93.23 and 89.39% mortality of the pest, respectively (Hussain *etal.*, 1996). (Ahmed, 1995) spraying third instar nymphs of *Schistocerca gregaria* (Kept in cages) with neem oil at 0.25-2.0ml/m, caused increased mortality, delayed nymphal development, and morphogenetic defects in the antennae, eyes, legs and wings (Nicol, 1993). Neem oil had good repellent effect for mosquitoes (Sharma et al., 1993) and was used as antifeedent, repellent, ovicide and growth regulator of many insects (Rovesti and Deseo, 1990). Neem oil did not reduce the oviposition of *C. serratus*, but at higher doses (2.5and5ml/ kg) caused 95% egg mortality and 92.2%mortality of immature stages of *C. serratus* and 95%egg mortality and 100% mortality of immature stages of *Bruchidius uberatus* (Ahmed, 1995).

2-7.2 Neem seeds kernel powder (NSKP): -

Two percent (W/W) of deoiled NSKP completely inhibited larval development, deformed adults and caused poor adult emergence (Parmer, 1986). The number of larvae of Yponomeutid plutella was significantly reduced by application of neem seed kernel water extracts (25or 30g NSKP/liter of water) (Klemm and Schmutterer, 1993). Aqueous extracts from seed at 40 or 50g /liter and neem cake (15g/liter) reduced oviposition of sweet potato White fly, Bemisia tabaci Genn .Due to a repellent effect on adults(Serra and Schmutterer,1993) Siddig (1991)

studied the effect of Neem seed kernel powder on the insect pests of okra and Potato in Sudan.He used 1/kg NSKP in 40,50,60,70and zero liter water).Neem seed water extract at a concentration of 1kg NSKP in 40liters water was always the best effective treatment and significantly controlled the okra and Potato pests .Neem seed kernel extracts were effective in mosquito control(Zebitz,1987;Rao,1987). Neem seed extract inhibited growth and development of larvae of Lymantria dispar when treated with 0.10% and 1.00% neem (Shapiro *et al*; 1994) .The results showed that NSKP at 3and 5% had significant effect on adult mortality on *A. seyal* seeds while it had significant effect on adult mortality only at 5% on *A. nilotica* seeds (El Sheikh 1999).

2.7.3 Neem leaf Powder (NLP): -

Neem leaf powder (NLP) was evaluated togather with other plant products against *Trogderma granarium* everts in stored wheat. NLP completely prevented damage by the introduced larval population of insect .NLP did not produce any adverse effect on nutritional composition of the treated wheat (Jood *et al*, 1993). Leuschner (1972) extracted leaves of *A. ndica* with methanol and applied the extract topically to the 5^{th}-stage nymph of ashield bug, Antisiopsis orbitalis Bechuana (Kirk). The treatment produced morphological effects, and Leushner (1972) postulated that the active material might be an ecdysone analog.

(El Sheikh 1999) NLP at all doses had no significant effect on adult mortality of *C. serratus* on both kinds of seeds. The most prominent insecticidal constituent of neem seed kernels and neem leaves is the tetranortriterpenoid azadirachtin and

related structures When 40 mg powdered leaves in (1:1) were applied to food plants of 4th instar nymphs they decreased the daily consumption of the grass hoppers by 22% (significant reduction compared to untreated control) and caused significant reduction in longevity to individuals fed on untreated folige at highest neem concentration of 0.0001% (100gm in1-liter water) daily consumption was reduced by 77%(Joshi, 2000) .The effects of preparations or compounds isolated from neem are many e.g. reduction of life span of different stages and partial or complete reduction or inhibition of fecundity (Ascher,1993;Rovest;and Deseo,1990). Neem leaf and neem seed powder at W/W each caused 85-90%mortality in 72 hrs to adults of *callosobruchus maculatus* in stored cowpeas in the laboratory.

2-8 *Eucalyptus* oil (EO): -

Among the species of this genus (*Eucalyptus*) investigated to date production of volatile oils appears to be the major feature. Fresh leaves contain from 3 to 5%of volatile oils .The oil contains a bitter principle which has not been investigated and several resins one of which is crystalline (Wallis, 1960).

2.8.1 *Eucalyptus* oils for controlling pests

In field trials, Eucalyptus oils were tested for the control of broomrape (*Orobanche cernua*) in tobacco. The oils were applied to young, unflowered the oils effectively killed the parasitic shoots. Broom rape shoots at 1-5drops/shoot with adropper. The

optimum dosages being 1drop/ shoot .It took one drop of Eucalyptus oil to kill the buds of broomrape (Krishnamunrthy and Chari, 1991).

The result indicated that EO at 10,50,and 100% had increased adult mortality of *C. serratus* significantly ($P<0.001$) on both kinds of seeds compared to control (Elshek 1999). Essential oils of some plants and eucalypts were good Protestants against the pluse beetle, *C.chinensis*. Essential oils of basil and geranium had the greatest insecticidal effect. (Richa *et al*., 1993) Aromatic essential oils of *E.globulus* and other plant caused mortality at different rates to *A.obtectus* on Phseolus vulgaris. Oils caused the most mortality from the laminaceae family (Regnault and Hamraoui, 1993). Crude oil of *E.camaldulensis* and two of its fraction caused inhibition on the germination (allopathic effect) of wheat, sorghum and cotton (Bashir, 1996).

Chapter Three

3 -Materials and Methods

3-1 Preparation of different materials used in the experiments

3-1-1 Neem seed kernel powder (NSKP) preparation: -

Yellow ripe seeds and overripe neem fruits (Berries) were collected from under trees during June-July and soaked in water for 6 hours .The outer skin was removed by pressing the berries inside a backet full of water. The slimy tissue covering the seeds was rubbed out between hands in water. Seeds were then spread over a paper and left under shade for a week. A table fan was used to accelerate the process of drying. Seeds were hit slightly by a stone to break the seed coat. Broken seed coats were separated from the broken kernel by winnowing. The kernels were then powdered using an electric blender. The method was according to Siddig (1991).

3.1.2 Neem seed kernel powder concentrations: -

Neem seed kernel powder was suspended in distilled water .It was prepared as 30%, 4%0 and 50% (w/v) using distilled water as a diluting agent.

3-1-3Neem oil extraction: -

The oil used in this study was extracted by a asoxhlet extraction method A hundred eighty grams of crushed neem seed kernels were subjected to continuous extraction

with petroleum ether (60-80%) in a asoxhlet apparatus for 16 hours as described in British pharmacopoeia (1980).

3.1.4 Neem oil concentration: -

Three concentrations of neem oil were prepared in this study, these were N010%, NO15%, NO20% V/V) using petroleum ether as a diluting agent.

3-1-5 *Eucalyptus* oil extraction: -

Crude volatile oil was extracted from fresh and dried leaves of *E.camaldulensis* by water distillation Prior to distillation, the leaves were cut into small pieces. Leaves were dried by direct exposure to dry air in a dark room for three days. Three hundred gm of leaf material were placed into 5litre rounded bottom flask. Three liters of distilled water was added. Water was boiled and distillation was carried out for two hours after boiling until no further increase in the crude oil yield. The volume of oil was then measured (v/w). After cooling at room temperature, the oil was collected and dried over anhydrous sodium sulphate and kept in brown bottles in a refrigerator for further use method according to British pharmacopoeia (1980).

3-1-6 *Eucalyptus* oil Concentration: -

Crude oil was diluted to10, 15 and 20% (V/V) using petroleum ether as a diluting agent.

3-1-7 Neem leaf preparation: -

Fresh green leaves of Neem tree *Azadirachta indica* were randomly collected from some standing trees at Shambat .The leaves were air dried for two weeks .The

dried green leaves were then finely powdered by mortaring and kept in polythene bags in a refrigerator for further use.

3-1-8 Neem leaves concentration: -

Neem leaves powder was suspended in distilled water .It was prepared as 30,40 and 50% (w/v) using distilled water as a diluting agent.

3-2 The effect of Neem oil on infestation: -

Twenty freshly cut logs of *A. seyal*, 30cm in length and with diameters ranging from 15 to 25 cm were prepared. Each 5logs were stacked horizontally under partial shade of *E. microtheca* at Shambat University of Khartoum. Every 5logs were treated with neem oil at 0%, 10%, 15%, 20% (V/V) respectively. The fresh cut logs moisture content % was determined, by using disc shaped sample two cm in thickness from the middle of the logs by Saw. Using oven dry method. The moisture content determined after infestation also each log was weighed before and after infestation, then by weight subtraction, the loss percentage in weight was calculated. This experiment was carried out in summer and repeated in winter. Mode of infestation, number of complete pores were determined and recorded daily. Weight Ioss due to infestation was also calculated by subtracting the weight after infestation by *S. seneglense* for 2.5 and 3 months in summer and winter, respectively from initial weight of each log.

3-3 Effect of *Eucalyptus* oil(EO) on infestation : -

Logs of *A. seyal* measuring 15 to 25 cm in diameter and 30cm in length were used in the following trials:

Twenty cut logs of *A. seyal* were divided to four groups of 5 logs. The logs Were treated with *Eucalyptus* oil at 0%, 20%, 15%, 10% (V / V), respectively and stacked horizontally under partial shade. Five logs were treated at every oil concentration. These logs were checked daily and the number of beetle's holes were counted for 2.5 and 3months in summer and winter, respectively.

The borers hole count was used as an indicator to infestation. The fresh cut logs moisture content % was determined, by using disc shaped sample two cm in thickness from the middle of the logs by Saw. Using oven dry method. The moisture content determined after infestation also. Weight loss due to infestation was also calculated by subtracting the weight after infestation by S.senegalense for 2.5 and 3months in summer and winter respectively from initial weight of each log.

3-4 Effect of neem seeds kernel powder (NSKP) on infestation: -

Twenty freshly cut logs of *A. seyal* 15-25 cm in diameter and 30cm in length were treated with (NSKP) at four concentrations (0%, 30%, 40%, 50% The logs were stacked horizontally under the partial shade. These logs were checked daily and the number of the beetles bore holes were counted daily for 2.5and 3months .The bore holes count was used as an indicator to the frequency of infestation. . The fresh cut logs moisture content % was determined, by using disc shaped sample two cm in thickness from the middle of the logs by Saw. Using oven dry method. The moisture content determined after infestation also Weight loss due to

infestation was also calculated by subtracting the weight after infestation by *S.senegalense* for 2.5and 3 months from the initial weight of each log.

3-5 Effect of neem leaves powder(NLP) on infestation: -

Twenty freshly cut logs of *A. seyal* 15to25cm in diameter and 30cm in length were treated with neem leaves powder as suspension at four concentrations 0% 30% 40% 50%. The logs were stacked horizontally under partial shade. These logs were checked daily and numbers of the beetles bore holes were counted for 2.5and 3month respectively.

The bores holes count was used as an indicator to infestation. The fresh cut logs moisture content % was determined, by using disc shaped sample two cm in thickness from the middle of the logs by Saw. Using oven dry method. The moisture content determined after infestation also. Weight loss due to infestation was also calculated by subtracting the weight after infestation by S.senegalense for 2.5and 3 month respectively from the initial weight of each log. The experiment was replicated in summer and winter. Statistical analysis was carried out using ANOVA in a SAS computer package.

Chapter 4

Results

4-1 Effect of different botanicals on infestation in winter

Infestation was significantly (P=0.0001) reduced by all botanicals application compared with control (Table 1). The maximum reduction occurred at NSKP50%(0.00 entrance holes), EO20% (0.00 entrance holes) EO15% (0.0 entrance holes) NO20 % (2.4 entrance holes), NO15 % (5 entrance holes) and NSKP40% (13.8 entrance holes). The medium reduction occurred at NO%10% (28.6 entrance holes), and the minimum reduction occurred at EO10% (56.6 entrance holes), NSKP30% (59.4 entrance holes), NLP50% (59.6 bores), NLP40% (77 bores) and NLP30%(92.6 entrance holes) in a descending order (Table 2,plate1).

4-2 The effect of different botanicals on *A. seyal* weight loss in winter

Treatment of *A.. seyal* logs with different botanicals significantly (P=0.0001) reduced weight loss by *S.senegalense* compared with control (Table 3). The maximum reduction occurred at No20%(12.1g), EO20% (22.4 g), NO15% (22.96 g), Eo15% (25.8g), NSKP50% (27.6 g), NO10% (43.6 g), NSKP40% (78g) and EO10% (93.6g). The medium reduction occurred at NSKP30% (124.8 g) and NLP50% (182.4 g). The minimum reduction occurred at NLP40% (260 g) and NLP30% (318 g) in a descending order (Table 4).

4-3Effect of different botanical on infestation in summer

Infestation was significantly (P= 0.0001) reduced by all botanical application compared with control Table (5) The maximum reduction occurred at Eo20%(1.6 entrance holes), No20% (6 entrance holes) EO15%(8.2 entrance holes), The medium reduction occurred at NO15% (25 entrance holes), NO10% (27.2 entrance holes), NSKP50% (31.8 entrance holes) this followed by EO10% (48.2 entrance holes) and NLP50% (53.6 entrance holes) The minimum reduction occurred at NLP40% (78.6 entrance holes), NSKP40% (96.2 entrance holes), followed by NSKP30% (105.6 entrance holes), and NLP30% (113.8 entrance holes), in descending order (Table 6 ,Plate2).

4-4The effect of different botanicals on *A. seyal* weight loss in summer

Treatment of *A.seyal* logs with different botanical significantly (P=0.0001) reduced weight loss by S.senegalense compared with control. (Table 7) The maximum reduction occurred at EO 20% (15.4g), NO 20% (47.5g EO15% (52g), NO15%(102.8g), NSKP50%(110.2g), NO10%(116.6g), EO10% (1930g), NSKP40% (205.3g), and NSKP30%(469.0g) The minimum reduction occurred at NLP50%(711.1g), NLP30%(721.3g) and NLP40% (721.9g) in descending order (Table 8).

4-5 Effect of botanical concentration on infestation of *A. seyal* in winter.

There was no significant difference between all NO doses at (10,15 and 20%)used. The mean number of pores was 28.6, 5 and2 borers, respectively. But result showed that a significant deference between E O doses at (10,15and20), The mean number of pores was 56.6, 0.00, 0.00 borers respectively. Also results

showed a significant difference between NLP doses at (30, 40 and 50%) where the mean number of pores was 92.2,77,59.6 borers, respectively. But there was no significant deference betweenNLP40% and NLP50%, also a significant deference between NLP40% and NLP30%. Also the results indicated a significant difference between NSKP doses at (30,40and50%). The mean number of pores was 59, 13, 0.00 borers, respectively (Figer1)

4-6 Effect of botanical concentration on weight loss in winter

The results of present study showed that there was a significant deference between NLP doses at (30, 40 and 50%), where the mean weight loss was 318, 260 and 182 g respectively. But there was no significant deference between NLP40% and NLP50%, a significant deference between NLPa40% and NLP30% In addition the results showed that there was no significant deference between NO doses at (10, 15 and 20%), the mean weight loss were 43, 22 and 12 g respectively. In addition the results showed there was no significant deference between EO doses at (10,15and 20%) the mean weight losses were 93.6, 25.8 and 22.4g respectively. But there was a significant deference between NSKP doses at (30, 40 and 50%) where the mean weight loss was 124.8,78 and 27g respectively. But there was no significant deference between NSKP40% and NSKP30%, and no significant deference between NSKP50% and NSKP40% (Figer2)

4-7Effect of different concentration on infestation in summer

The results of the present study showed that there was significant deference between NO doses at (10,15and20%), the mean number of pores was 27.2, 25 and

6 borers respectively. In addition these results showed that there was a significant deference between EO doses at (10, 15and 20%), the mean number of borers were 48.2, 8.2 and1.6borers respectively. But there was no significant deference between EO20% and EO15%. Also the results showed that there was a significant deference between NLP doses (30, 40 and 50%) the mean number of pores was 113.8,78.6 and 53.6 borers respectively. The results indicated that there was a significant deference between NSKP doses at (30,40and50%) the mean number of pores was 105.6,96.2 and 31.8 borers respectively. But there was no significant deference between NSKP40% and NSKP30%, (Figer3).

4-8 Effect of different concentrations on weight loss in summer

The result of present study showed that there was no significant deference between NLP doses (30,40and50%), the mean weight loss was 721.9,721.3and 711.1g respectively .In addition the results showed that there was no significant deference between NO doses (10, 15 and 20%), where the mean weight loss were 116.6, 102.8 and 47.5g respectively. Also the results showed that there was no significant deference between EO doses 10,15and 20%) where the mean weight loss was 193, 52 and 15g respectively. The result indicated that there was no significant deference between NSKP doses at (30 ,40 and 50%)where the mean weight loss was 469,205.3,and 110.2g respectively (Figer4)

Table 1. Effect of different botanicals on infestation of *A.seyal* **by** *S. senegalense* **in winter ANOVA**

Source	D.F	S.S	MS	F	P
Treat	12	114316.9	9526.4	24.85	0.0001
Error	52	19932.8	383.32		
Total	64	1342449.7			

Table 2.Effect of different botanicals on infestation on *A. seyal* in winter

Treatment	Means
Control	137.2 a
NLP30%	92.6 b
NLP40%	77 bc
NLP50%	59.6c
NSKP30%	59.4c
EO10%	56.6c
NO10%	28.6d
NSKP40%	13.8de
NO15%	5 de
NO20%	2.4de
EO15%	0.000 e
EO20%	0.00 e
NSKP50%	0.00 e

Means followed by the same letters are not significantly different

Table 3.Effect of different botanicals on A. seyal **weight loss infested by** *S. senegalense* **in winter ANOVA**

Source.	D.F	S.S	M.S	F	P
Treat	12	1266379.4	165531.6	24.65	0.0001
Error	52	2222589.0	4280.6		
Total	64	1488968.4			

Table4. Effect of different botanicals in weight loss on A.seyal **in winter**

Treatment	Means
Control	488a
NLP30%	318.6 b
NLP40%	260.4 bc
NLP50%	182.4 cd
NSKP30%	124.8 de
EO10%	93.6 ef
NSKP40%	78 ef
NO10%	43.6 f
NSKP50%	27.6 f
EO15%	25.8 f
NO15%	22.96 f
EO20%	22. f
NO20%	12.1 f

Table 5.Effect of different botanicals on *A. seyal* infestation in summer ANOVA

Source	DF	SS	MS	F	P
Treat	12	184058.1	15338.17	66.12	0.0001
Error	52	12062.4	231.96		
Total	64	1961205			

Table6. Effect of different botanical on infestation in *A. seyal* in summer

Treatments	Means
Control	193.8a
NLP30%	113.8b
NSKP30%	105.6b
NSKP40%	96.2bc
NLP40%	78.6c
NLP50%	53.6d
EO10%	48.2de
NSKP50%	31.8ef
NO10%	27.2fg
NO15%	25fgh
EO15%	8.2ghi
NO20%	6hi
EO20%	1.6I

Means with the same litters are not significant

Table 7.Effect of different botanicals on A seyal **weight loss in summer ANOVA**

Source	DF	S.S	MS	F	P
Treat	12	7710265.9	642522.16	5.51	0.0001
Error	52	6064347.5	116622.06		
Total	64	13774613.5			

Table8. Effect of different botanicals on A.seyal weight loss in summer

Treatments	Means
Control	1131.4a
NLP40%	721.9ab
NLP30%	721.3ab
NLP50%	711.1ab
NSKP30%	469cb
NSK40%	205.3c
EO10%	193.0c
NO10%	116.6c
NSKP50%	110.2c
NO15%	102.8c
EO15%	52.0c
NO20%	47.5c
EO20%	15.4c

Means with the same litters are not significant

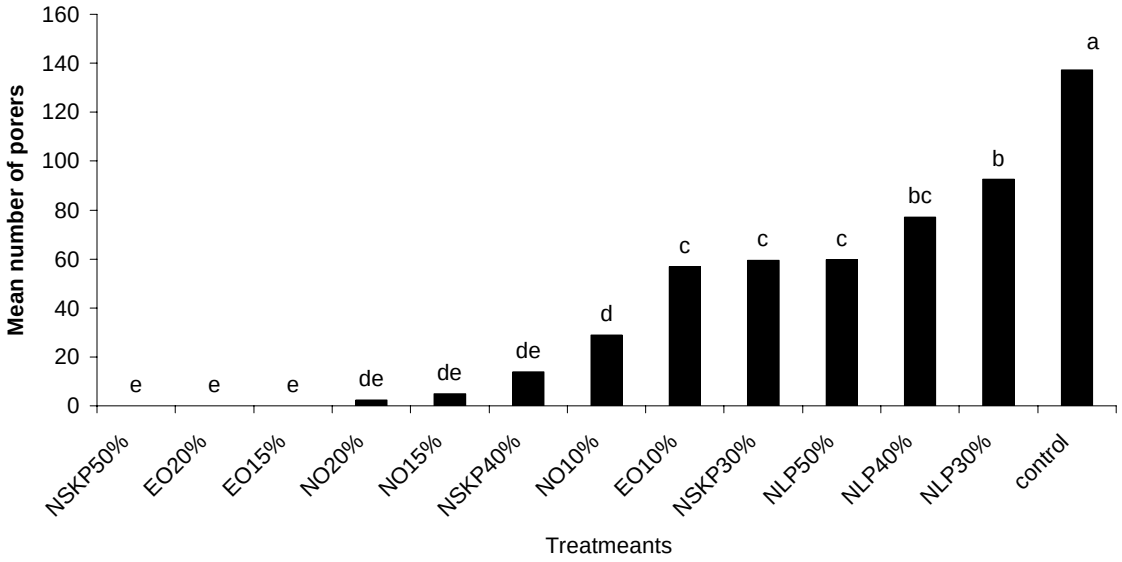

Fig1: Effect of botanicals on infestation of *A.seyal* in winter

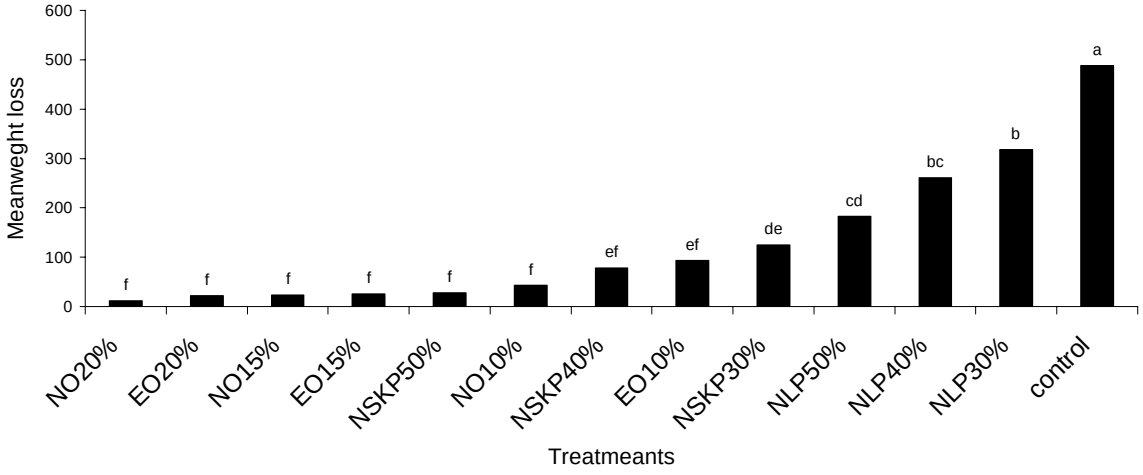

Fig2: Effect of botanicals on weight loss of A.Seya**l in Winter**

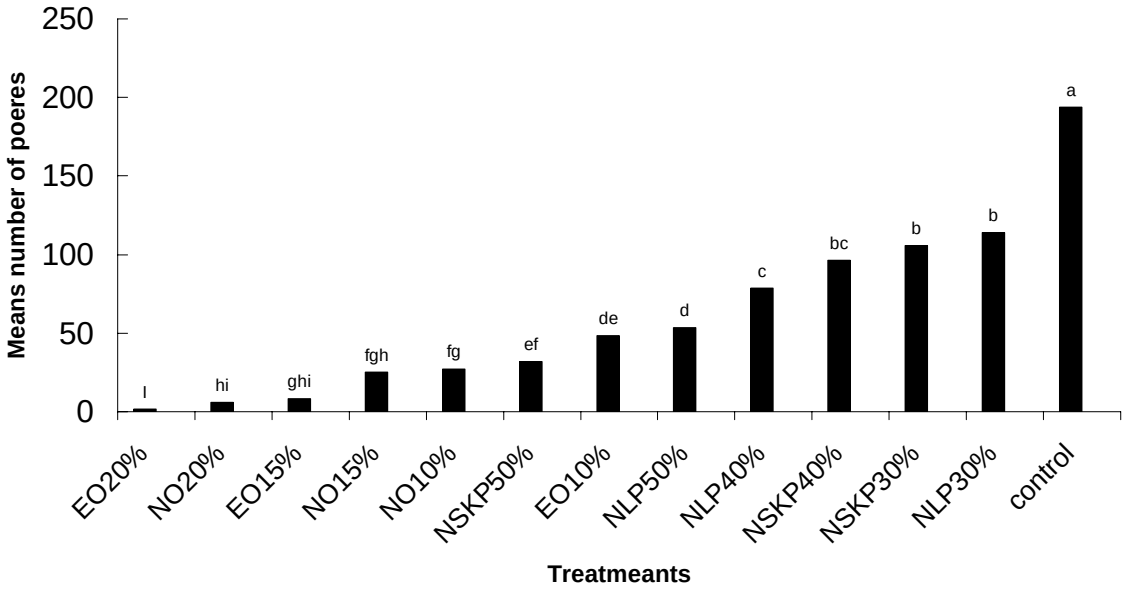

Fig3: Effect of botanicals on infestation of A.seyal in summer

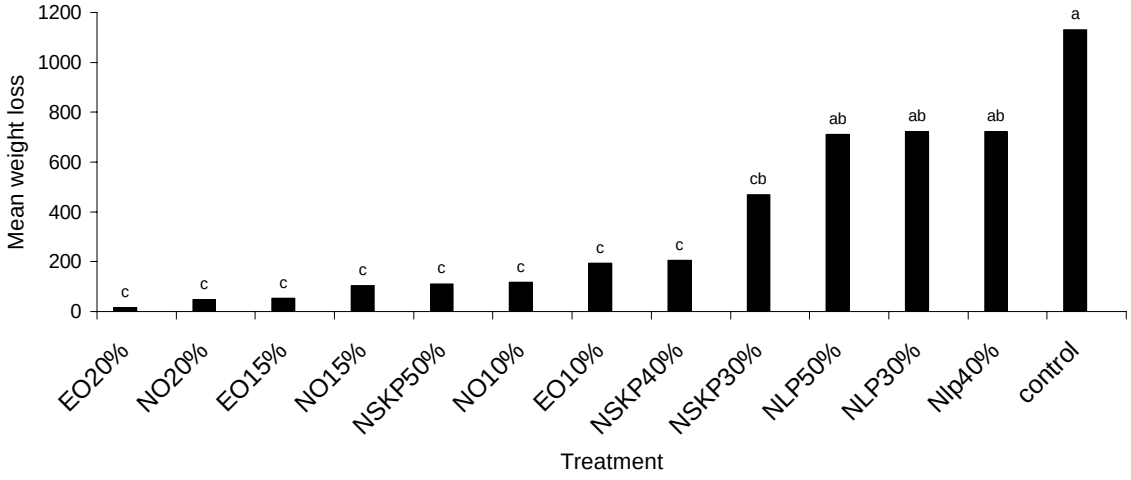

Fig 4: Effect of botanicalson weight loss in summer


Eucalyptus oil20%


control

CHAPTER FIVE

Discussion

The present study indicated that NSKP50% and NSKP40% are as efficient as NO20%, EO20%, NO15%, NO10%, and EO10% in controlling *S.senegalense.* This might be attributed to the odour(s) released from NSKP50% and NSKP40%, which might have confused S.senegalense in correctly recognizing Talih logs. This finding is in agreement with (Obeid1998) who reported that Talih logs were heavily attacked when stacked separately as compared to stacking in mixture with logs from other species. S.senegalense might due to specific odour(s)released by Talih logs that made them easily recognize. This result also agreed with Ross *et al* (1982). These odours might be in the form of pheromones in general and kairomones in particular. Kairomones include a tremendous array of odours and other substances produced by plants that aid phytophagous insects in recognizing their correct host plant .The present study showed no significant difference between NLP doses at (30%, 40% and 50%) in reducing weight loss in summer. This might be attributed to lower azadirachtin contained in NLP at all doses. This finding is in agreement with Seck *et al. (*1991). Seed powders were more effective than leaf powders (Ascher, 1993). Other tissues of *A. indica* known to contain these compounds at lower levels are the bark, leaves and heartwood. Seeds of neem tree contain the highest concentration of azadirachtin and all other

biologically active chemical compounds present in *A. indica.* (Jacobson, 1989; Koul, 1990; Schmutterer, 1990). Siddig (1991) reported that NLP at 0.25-2.0g/50g seeds reduced damage by *Trogoderma granarium* on wheat by approximately 50% compared to the control, but the effect was not comparable to the seed powder at the lowest doses (0.25g/50seeds). The present study showed no significant difference between NO doses and EO doses in both numbers of pores and weight loss in summer. This might be due to the fact that Eucalyptus oil and neem oil provided homogeneous coverage on the logs According to El Sheikh (1998), *Eucalyptus* oil might have provided homogeneous coverage on the smooth seed coat compared to NSKP or NLP. Thorsel *et al*. (1998) tested extracts of oils from Eucalyptus and *Achillea millefolium* (yarrow) in the laboratory and in the field .The laboratory tests showed that yarrow extract exhibited similar repellency to *Aedes aegypti.* Agood repelling effect against *Aedes* aegypti was also obtained with the oils of Eucalyptus .The field tests revealed that the extracts and oil were effective against *Aedes aegypti A. communis* and *A.cinereus.* The results of the present study are in agreement with (Ahmed 1995) who reported that Neem oil has affected the immature stages of *C. serratus* and 100% mortality of immature stage occurred at the lowest doses. Only one pupa of *C. serratus* developed at 1.25ml/kg dose, the adult failed to emerge from the pupae which indicated the growth regulatory effect of neem oil. (Heyde et al., 1993) The brown plant hopper *Nilaparata inugens* (Stal) alighting and orientation was significantly reduced by neem oil and its odour in treated plants when compared with control. (Osmani *et*

al., 1974) *Rose granarium* oil was a good repellent and lemmon grass oil also caused the insect knocking down.(Schultz, 1986). Bruchids are very susceptible to fumigation by volatile oils extracted from Bystropogen *sp*. at 25Cat 75%R.H in an air tight jar (Heyde et al., 1993) Cow pea seeds were treated with ground neem seed. Such seeds carried viable eggs of *C.macutatus*, but no adults have emerged, only dead larvae were found inside them when softened and dissected (Ivbijar, 1983). Neem fruit dust at 1g/20gm increased preimmaginal developmental period of *C.maculatus* to 41days versus 30days in control .At the higher doses development was prevented (Ivbijar,1986) Schmutterer (1990) noted antifeedent effects of azadirachtin to Japanese Beetle (*Popillia japonica*), a major pest of landscape plants in North America. Redfern *et al*.,(1980) reported that as little as 0.2 ppm of azadirachtin incorporated into the diet of the full army worm, *Spodoptera frugiperda* , had significant antifeedent effect on the first –instar larvae. Physiological changes that occurred in larvae of Lepidoptera following exposure to neem extracts and NSKO have toxic effect on *Choristoneura rosacceana* larvae and adults.

The present study showed no significant difference between NSKP doses in reducing weight loss in summer. This might be related to the thick layer made by NSKP which in turn confused S.senegalense in correctly recognizing Talih. This finding is in line with several investigators as mentioned before. The present study indicted a significant difference between NLP doses in reducing the number of pores in summer. The effect was doses dependent. This finding is in agreement

with Siddig (1991) who reported that NLP at 25-2.0g/50g seeds reduced damage by *Trogoderma granarium* in wheat by approximately 50% compared with control, but the effect was comparable to the seed powder at the lowest dose (0.25g/50g seed). The present study indicted no significant difference between NSKP30% and NSKP40% and there was significant difference between NSKP40and NSKP50% in reducing number of pores in summer, however, the effect was significantly less at NSKP30. %, and NSKP40% hence, the effect is dose dependent. The present study indicated that there was significant deference between EO10% and EO15%, and there was no significant deference between EO15% and EO20% in reducing number of pores in summer however, the effect was significantly less at EO10% hence, the effect is dose dependent Also on significant difference between NO10%and NO15%, NO15%andNO20% reducing number of pores in summer however, the effect was significantly less at NO10%, hence, the effect is dose dependent. The present study indicated that there was significant deference between all NLP doses at (30,40and 50 %) in both number of pores and weight loss in winter, but there was no significant deference between NLP30%and NLP40%also NLP50%and NLP40%in both number of pores and weight loss in winter. The effect was significantly less at NLP30%% hence, the effect is dose dependent. The present study indicated that there was no significant deference between EO doses in reducing weight loss in winter, but there was significant deference in reducing number of pores in winter. This result indicated that *S.senegalense* find their death in side logs and hence gave this result .The present

study indicated that there was no significant different between No doses at (10,15and20) in both number of pores and weight loss in winter. This result attributed to the homogenous cover made by NO. The present study showed that there was significant deference between NSKP doses at (30,40and50%) both in weight loss and number of pores in winter however, the effect was significantly less atNSKP30%both in weight loss and number of pores Hence, the effect is dose dependent.

In the present study all the botanicals were found to have a significant effect against *S.senegalense* in summer and winter, and reduced weight loss and infestation of *A.seyal* logs .The positive effect of No, Eo NSKP, NLP might be attributed mainly to the active ingredient(s) contained in them. The active ingredients isolated from neem seed kernel oil are epoxy azadiradione, azadiradione ,azadirone ,7-deacetylgedunin and gedunin (Ascher,1986) and azadirachtin (Isman *et al*.,1990) .According to Siddig(1991),the active ingredients in neem seeds were azadirachtin , solanin , salannol , salannol acetate, 3- deacetyle salannin , epazaradion, gedunin, niembinen and *Eucalyptus* deacetyle nimbinen. Varro *et al*. (1981) divided the major compounds of volatile oils into: - (I) oils for medical use which contain 75-85% cineol plus lesser amount of volatile aldehydes ,terpenes, sesquiterpenes , aromatic aldehydes and alcohols and phenols. (II). Oils intended for industrial pourposes with pipertone and /or phellendrene as the principal components. (III) oils in perfumery which are rich in geraniol, its esters and citronellal.Sanker and Rai (1993) reported that E.camaldulensis was found to

produce phenols and terpenes which were phytotoxic.Furthermore, Gupta *et al.,(*1990) and Zrira *et al*.(1991)

Reported that Eucalyptus spp. contain a wide variety of essential oils 1,8-cineole as the most predominant. Sanker and Rai (1993) reported that *E.camaldulensis* was found to produce phenols and terpenes, which were phytotoxic. Furthermore, Bignell *et* al (1998) stated that many species of Eucalyptus contained alphapinene (0-43%), beta-pinene (0-5.3%), 1,8-cineole {eucalyptol)(0.3-66.4%), P-cymene (0.2-22.6%).pinocarvone (0-8.4%),Btacaryophyllene(0-11.6%),aromadenrene (0- 19.4% ,transpinocarve (0.2-28.6%)and bicyclogermaccrene (0-19.4) as principle leaf oil component .All species of Eucalyptus contained torquatone (0.09-6.2%), lateriticone (1-isovaleryl-4-methoxy-3,5,5-trimethylcyclohex-3-en-2,6-dione)(0.1-0.5%) According to Muchori *al*.(1997), *E.camaldulensis* is rich in 1,8cineol (>70%).Tunc *et al*.(1998)found that vapours of essential oils extracted from *E.camaldulensis* were toxic to *Tetranychus cinnabarinus* and *Aphis gossypii*.The effect of NO, EO, NSKP and NLP in reducing weight loss maybe attributed to effect of all botanicals in immature stage .This finding is in agreement with Ahmed (1995)who reported that neem oil effect on immature stage of *B.uberatus* caused 100% killing of all immature stages of *B.uberatus* at all doses. Ivbijar (1986) reported NSKP to be larvicidal against *C.maculatus*. Redfern *et al*.,(1980) reported that as little as 0.2 ppm of azadirachtin incorporated into the diet of the full army worm, *Spodoptera .frugiperda*.had significant effect on first-instars larvae

CONCLUSIONS

1-The maximum reduction in infestation of A. seyal by *S. senegalense* in winter occurred at NSKP50% (0.00), EO20% (0.00) EO15% (2.4) NO20 % (2.4), NO15 % (5) and NSKP40% (13.8). The medium reduction occurred at NO%10% (28.6), and the minimum reduction occurred at Eo10% (56.6), NSKP30%(59.4), NLP50%59.6,NLP40%(77) and NLP30%(92.6) in a descending order.

2-The maximum reduction of weight loss of A. seyal logs infested by S. senegalense in winter occurred at No20 % (2.1%), EO 20% (4.2%), NO15% (.4%), Eo15% (4.6%) , NSKP50%(4.9%), NO10% (8.5%), NSKP40%(9.2) and EO10%(14.3%). The medium reduction occurred at NSKP30%(17.4) and NLP50%(22.1%). The minimum reduction occurred at NLP 40% (30.2%) and NLP 30% (38.8%) in a descending order.

3-The maximum reduction in infestation in summer occurred atEo20%(1.6), No20% (6) EO15%(8.2), The medium reduction occurred at NO15%(25), NO10%(27.2), NSKP50%(31.8) and this was followed byEO10%(48.2) and NLP50%(53.6) The minimum reduction occurred at NLP40% (78.6), NSKP40% (96.2), followed by NSKP30%(105.6), and NLP30%(113.8), in a descending order

The maximum reduction in weight loss in summer occurred at Eo20%(1.8%), No20% (3.2%) ,EO15% (4.8%) ,NO15%(5.5%), NSKP50% (5.5%) ,NO10% (8.3), EO10% (15.1%), NSKP40% (16.9%), and NSKP30%(32.5), The minimum reduction occurred at NLP50%(39.4%),NLP30%(56) and N P40%(721.9) in a descending order.

5- No significant difference was reported in reducing infestation and weight loss in winter between NO at all doses (10,15and 20%). In addition to no significant difference between EO doses at (10,15and20%) in reducing weight loss in winter But significant difference between EO doses(10,15and20%) in reducing infestation in winter. Also the results showed a significant difference in reducing both infestation and weight loss in winter between NLP (30,40,and 50%), NSKP (30,40 and 50%).

6- There was a significant deference between NO at all doses (10,15and20%), EO at all doses, NLP (30,40and50%), NSKP (30, 40 and 50%) in reducing infestation in summer. But there was no significant deference between NL P at (30,40 and 50%), NSKP at,(30,40and50%) NO at (10, 15 and20%),EO at(10,15and20%) in reducing weight loss in summer.

Recommendation

1. It is recommended to use neem seed powder kernel powder , Eucalyptus oil and neem oil at higher concentration to minimize infestation and weight loss of *A. seyal* logs infested by *S. senegalense* in summer and winter, because they are cheap to prepare and environmentally safe and friendly.

2. More research is needed in the area of natural and their suitability as substitutes to chemical pespicides.

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