Indian Journal of Ecology (2021) 48 Special Issue (15): 160-164

Manuscript Number: S-617
NAAS Rating: 5.79

Evaluation of Plants Extracts on Mortality and Development of Saw- toothed Grain Beetle, *Oryzaephilus surinamensis* L. (Coleoptera: Silvanidae)

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Abstract: This study was conducted to evaluate the effect of extracts of *Conyza dioscoridis*, *Cymbopogon citratus and Moringa oleifera* on the mortality rate of *O. surinamensis*. The ethanolic extract of *C. citratus* caused maximum mortality (89.62%), followed by M. *oleifera* (79.26%). The concentration of 4% the resulted in maximum mortality (88.5%) while in 1% conc. mortality was 77.05%. The hexane extract showed low mortality both. These results indicate negative effect on the number of F1 and reduction of progeny in ethanol and hexane extracts. The study show that extracts, have a good repellent against O. *surinamensis*, with the exception of hexane extract of *M. oleifera.*

Keywords: Biological aspect, *Oryzaephilus surinamensis*, Plant extracts

The saw-toothed grain beetle *Oryzaephilus surinamensis* L. (Coleoptera: Silvanidae) is one of the most important stored grain pest (Hashem et al 2012) and different stored product commodities (Vanzyle et al 2006) Various strategies are implemented to control such as chemical insecticides .Fumigants are mostly used against stored grains insect pests because of their broad activity spectrum as well as their penetrating power on the treated products such as methyl bromide and phosphine used long period of time and now many problem are associated with the use including development of resistant, environmental pollution, toxicity to non-target organisms and pesticide residues (Benhalima et al 2004, Jovanovic et al 2007). The use of different of plants extract is considered as one of the options to reduce the loss and many plant extracts may be used for protection of stored product pest (Kim et al 2004, Rahman et al 2016). Secondary compounds extracted from different plants include alkaloids, phenolic, flavonoid, terpenoids, limonoids and other chemicals might affect pests by acting as growth inhibitor, feeding deterrents, reduced fecundity and disrupt major metabolic pathway and may cause death (Sarmamy et al 2011). Alternative strategies included the search for new types of pesticides of botanical origin, which are often effective against a limited number of specific target species are biodegradable into nontoxic products and suitable for use integrated pest management program. Earlier studies concluded that plant extracts have insecticidal properties which are relatively cheaper than synthetic insecticides. The use of plant extracts as insecticides is very promising due to their diverse advantages like high effectivity, cheap and safe for human and the environment (Ivbijaro 2012). The aim of this study is to evaluate the efficacy of organic solvent extraction of *Conyza dioscoridis*, *Cymbopogon citratus* and *Moringa oleifera* on the mortality and repellency of saw-toothed grain beetle insect from the grain

MATERIAL AND METHODS

Collection, identification and rearing of *O. surinamensis* L: Saw-toothed grain beetles *O. surinamensis* was collected from different locations at Basrah province, particularly seeds store. The identification was done Dr. Kadhim Al-Hadlag in insect's taxonomy research laboratory , Basrah University. The grain beetle was reared in 2 kg capacity glass jars with adequate mixture of wheat and yeast in ratio of 1:5:5 respectively after sterilization by keeping at freezing temperature in oats (Aref and Valizadegan 2015). In each jar about 50 insects (male and female) were introduced and kept in incubator at 27±2 ^{0}C and 60±10% RH

Plant collection and identification: Leaves of the plant *Conyza dioscoridis* (family: Asteracae), *Cymbopogon citratus* (family: poacaece) and *Moringa oleifera* (family: Morngacae), were collected from different parts of Basrah province. The plant was identified by Prof. Dr. Taha Alidani, Plant Protection Department Basrah University. Leaves were washed with tap water, then dried under laboratory condition, then crushed using J-sonic jermany machine then kept in jars till use.

Extraction preparation: Plant extract was prepared by using polar and non-polar organic solvents, namely ethanol as a polar solvent, and hexane as a non-polar solvent. Twenty mg of leaves powder of each plant was placed separately in the Thimble in the Soxhlet extractor, using 200 ml of organic solvents mentioned above. Extraction was carried out at a temperature of 40°C for 24 hours, samples were dried with a rotary evaporator, then the gel extract was collected, and the concentrations 1, 2 and 4% were prepared. One gm of the gel extract was dissolved in 5 ml of the solvent according to the type of extraction, then completed with 100 ml distilled water, after which, 1 ml of liquid paraffin was added as an adhesive and two drops of tween 80 as a diffuser to become get concentration of 1%. However, same method followed with the comparison treatment, with excluding the plant extraction.

Effect of organic solvent extracts on the mortality of *O. surinamensis:* Ten insects, 5 males and 5 females, of 1-2 weeks' age were taken and placed in a small petri dish, sprayed with 0.5 ml of ethanol and hexane extracts of different concentration (1, 2 and 4%) separately, for the plants of the present studied, and left for 30 seconds, after which insects were removed, and put them in a 100 ml plastic container, containing 5 gms of sterile wheat, and cover with a piece of fine cloth. All petri dishes were incubated at 27 ± 2°C and 60%± 10 R.H. three replicates. Data was collected after 3, 7 and 10 days of treatment and then calculated percentages of corrected consumptions using an Abbot equation (Abbott 1925).

$$\text{Percent mortality} = \frac{\text{Per cent of dead insect in treatment} - \text{Per cent of dead of insect in control}}{\text{100-dead of insect in control}} \times 100$$

Effect of organic solvent extraction in the F1 of *O. surinamensis:* From above experiment, all live insects were collected, and kept at 27±2 °C and 60±10 R.H for 40 days after which F1 was calculated, percentage of reduction was counted according to El-lakwah et al (1996):

$$\text{Percent reduction of F1} = \frac{\text{No. of adult in control-} \text{No. of adult in treatment}}{\text{No. of adult in control}} \times 100$$

Repellant effect of solvent extracts: Naworth (1973) method was adopted with some modifications for evaluation of repellency of extracts of *C. dioscoridis, C. citratus* and *M. oleifera* to *O. surinamensis.* Two petri dishes, a large one with a dimeter of 11.5 cm and of 2.2 cm height and a small one with a dimeter of 6.8 cm and of 1 cm heigh, which fixed in the middle of the large one (Fig. 1). Three gms of wheat variety ABA 99 treated with organic solvent ethanol and hexane extracts separately, after treating with 1 ml of each plant extract at a concentration of 4% and leaving the grain to dry

Fig. 1. Repellency of insect

for two hours. Then 50 insects *O. surinamensis* were introduced to each plant extract in three replications and the Petri dish were covered, then under normal laboratory conditions. Number of insects out of the small Petri dish was recorded after 24 hours of treatment. Following equation was applied to calculate the response index :

Response index (R.I) = NP – NK / Np + Nk

NP, NK= number of insects inside the small dish and outside the small dish

Statistical analysis: Statistical analysis of variance was carried out with Statistical Gen stat using a factorial completely randomized design.

RESULT AND DISCUSSION

Effect of ethanol plant extracts on the mortality of *O. surinamensis* adults: *C. citratus* extract resulted in the highest mortality 89.62 followed by *M. oleifera* extract (79.26%) (Table 1). There was significant difference of extract concentrations on adult mortality. The 4% concentration caused maximum mortality (88.51%) as compared to 1% (77.04%). The morality after 10 day was 88.89%, while in 3-days period was 69.62 % with significant differences The mortality of adults at the 2% concentration extracts of *C. citratus* and *M. oleifera*, was significantly better with mortality of 91.11and 84.44%, respectively. *C. dioscoridis* caused low mortality (66.66.The differences in mortality may be due to a difference in the quality and quantity of the active compounds present in them which may affect the work of the enzymes responsible for the important biological processes causing the metabolism to stop die (Adedire and Akinneye 2004).

Effect of hexane extracts on the Mortality *O. surinamensis* adults: There were significant difference between the effects of hexane plant extract of the plants. In *C. citratus* and *C. dioscoridis* adult mortality was 34.48 and 34.07 %, respectively, while *M. oleifera* extract recorded

lowest mortality (17.04%). There was significant difference between the different concentrations. The 4 and 2 % concentrations are caused 35.93 and 31.89% while 1% concentration the lowest mortality (17.77%) with significant differences. The mortality in ten days period mortality rate was 34.44% while in three days' 22.59%. The interaction between the extract and concentration caused an increase in mortality of adults. The 4% and 2% concentration extracts of *C. dioscoridis* and *C. citratus* got superiority on the average of mortality with 46.67% and 40% respectively while the *M. oleifera* was the lowest mortality of 21.11%. The differences were significant among the plant extract, concentration and time period. Khateeb et al (2017) mentioned that aqueous extracts of *Acacia cyanophylla, Eucalyptus gomphocephala* and *Nerium* oleander at 9% caused 85, 90 and 95 % mortality of O. *surinamensis.*

Effect of plant extracts (ethanol) on reduction of the first generation (F1) adult's *O. surinamensis:* There were significant differences between the ethanol plant extract and control on the number of adults after 40 days being 0.33,

Table 1. Effect of ethanol plant extracts on mortality of *O. surinamensis* adults

Plant extracts	Concentration. (%)	Mortality days after spray (%)			Average mortality (%) *conc.
		3	7	10	
C. dioscoridis	1	66.67	66.67	66.67	66.67
	2	63.33	63.33	73.33	66.66
	4	90	90	90	90
C.citratus	1	60	100	100	86.67
	2	73.33	100	100	91.11
	4	73.33	100	100	91.11
M. oleifera	1	63.33	83.33	86.67	77.78
	2	63.33	73.33	90	75.55
	4	73.33	86. 67	93.33	84.44
Control		0	0	0	
Mean		69.62	84.81	88.89	

L.S.D (p=0.05) ; Plant extract =5.1, Time =5.1, Concentration.=5.1,
Plant extracts*conc.=8.2, Plant extract *conc. *time =14.2, Conc.*time =8.2
Plant extract *time =8.2

Table 2. Effect of plant extracts (hexane) on the mortality *of O. surinamensis adult*

Plant extracts	Extract Conc. (%)	Mortality days after spray (%)			Average	Average of mortality plant extracts
		3	7	10		
C. dioscoridis	1	13.33	23.33	30	22.22	34.07
	2	33.33	33.33	33.33	33.33	
	4	40	50	50	46.67	
C.citratus	1	13.33	20	36.67	23.32	34.48
	2	30	43.33	50	40.11	
	4	30	40	53.33	40	
M. oleifera	1	3.33	10	10	7.78	17.04
	2	20	23.33	23.33	22.22	
	4	20	20	23.33	21.11	
Control		0	0	0		
Mean		22.59	29.26	34.44		

LSD (p=0.05) Plant extracts = 6 Plant extracts* conc.*time =18
Plant extracts* conc. = 10.4
Time = 6 Conc. = 6
Plant extracts* time. =10.4 Cconc. *time = 10.4
The average mortality was 17.77, 31.89 and 35.93 percent in 1, 2 and 4 % concentration

0.56, 0.78 and 9.67 individual / female in plants extract *C. dioscoridis*, *C. citratus* and *M. oleifera* respectively with percent reduction 96.7, 94.5 and 92.1 The emerged adults were 0.44, 0.67, 0.56 / female (Table 3).

Effect of plants extract (hexane) on reduction of the F1 of saw-toothed *O. surinamensis*: There was no significant differences between the effect of different plants extract in number of emerged adults after 40 days of treatment which was 0.11, 0.11, 0.22 individual /female for the plant extracts *C. dioscoridis*, *C. citratus*, *M. oleifera* respectively (Table 4). There were no significant differences among the different concentration of the three plants, in the mean number of emerged adults. The interaction was also non-significant. In addition, result also not significant differences $p<0.05$ among the plants extract reached percentage reduction F1 progony 98.95 98.95 and 97.91% in the *C. dioscoridis*, *C. citratus*, *M. oleifera* respectively.

Repellant effect of on *O. surinamensis:* The repellant effect of organic solvent of was significant with the highest repellency of 78 and 80 % in the plant extracts *C. citratus* and *C. dioscoridis* and the response index was - 0 .24 and - 0.96 in the *C. citratus* extract in both solvents, ethanol and hexane,

Table 3. Effect of ethanol plants extract on the reduction of the first generation of adults O. *surinamensis*

Plant extracts	Average adult after 40 days			Average adults emerge	Reduction in F1 /conc.			Average reduction
	1 %	2 %	4 %		1 %	2 %	4 %	
C. dioscoridis	0.67	0.67	0	0.33	96.6	93.4	100	96.7
C.citratus	1	1	0	0.56	93.4	90	100	94.5
M. oleifera	0.33	0.33	1.67	0.78	96.6	96.6	83.1	92.1
Control	9.67	9.67	9.67					
Mean	0.44	0.67	0.56		95. 5	93.3	94.4	
L.S.D (p=0.05) Plant extracts for emerged =0.8 Plant extracts * conc. = 1.4 Conc. = 0.7					L.S.D(p=0.05) Plant extracts for reduction =8.8 Plant extracts * conc. 15.3 Conc. = 8.8			

Table 4. Effect of plants extract (hexane) on reduction of the first generation of saw-toothed *O. surinamensis*

Plant extracts	No. of emerged adult after 40			Mean emergence	Reduction in F1			Mean
	1%	2%	4%		1%	2%	4%	
C. dioscoridis	0.33	0	0	0.11	96.86	100	100	98.95
C.citratus	0	0.33	0	0.11	100	96. 86	100	98.95
M. oleifera	0.33	0	0.33	0.22	96.86	100	96.86	97.91
Control	9.67	9.67	97.91					
Mean of conc.	0.11	0.11	0.22		97.91	98.95	98.95	
L.S.D (p=0.05) Plant extracts for emerged =04 Plant extracts * conc. = 0.7 Conc.= 0.4					L.S.D (p=0.05) Plant extracts for reduction =3.6 Plant extracts * conc. 6.4 Conc. = 3.6			

Table 5. Repellant effect of plant extracts in *O. surinamensis*

Plant extracts	Conc (%)	Solvent	Mean No of insect repelled	Response index	Percentage of plant extract's effect	Percentage of the effect of solvent on insect repellent
C. *dioscoridis*	4	Ethanol	66	-0.32	78	63
	4	Hexane	90	-0.8		77.33
C. citratus	4	Ethanol	62	-0.24	80	
	4	Hexane	98	-0.96		
M. oleifera	4	Ethanol	61	-0.21	52	
	4	Hexane	44	+0.25		

L.S.D. (p=0.05) Plant extracts = 9, Solvent =7.3, Plant extracts * type of solvent = 12.7

respectively while in C. *dioscoridis* response index was0.23 and – 0.8, in the same solvents (Table 5). There was a significant difference between the types of solvent in the insect repellent, the best was hexane solvent for repellency of *O. surinamensis* (77.33%) followed by ethanol solvent (63 %).

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Received 12 March, 2021; Accepted 08 May, 2021