

TOXICITY OF TOOTH PICK SEED (*Ammi visnaga* L.) EXTRACTS AGAINST THE LESSER GRAIN BORER, *Rhizopertha dominica*, F. (Bostrychidae: Coleoptera)

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Abstract

Laboratory evaluation were conducted on seeds of the tooth pick plant (*Ammi visnaga* L.) extracted by organic solvents of different polarities and tested for their toxic effect on *Rhizopertha dominica* infesting wheat grains. Toxicity of chloroform extract was the most potent, at both LC₅₀ LC₉₅ levels (i.e.534 and 874 ppm). Reproductive potential of treated insects were strangly affected as no progeny were obtained when treated with either LC₅₀ or LC₉₅ with *A. visnaga*. Extracts treatment at LC₉₅ level organic extract gave protection up to 5 weeks for petroleum ether and chloroform and 4 weeks when acetone was used for extraction. All tested extracts reduce grain germination at the end of 14 weeks storage period. Also, treated wheat grains with tooth pick extracts reduced the weight loss of grains.

INTRODUCTION

Wheat grains are subject to attack by several insects. The Lesser grain borer *Rhizopertha dominica* is the most common and cause a great loss.

The use of plant extract offers a hope for protection of stored grains from insect attack, because they are effective, safe and more economical than synthetic insecticides, which become a source of environmental pollution. Malik and Mujtaba (1984) found that some plants acts as toxic, repllents or antifedants for stored grain insects.

Other authors, i.e. Japial et al., 1984, Su, 1985, Mahgoub and Ahmed, 1996, El-Lakwah et al., 1997, El-Lakwah et al., 1998, Halawa, et al. 1998, Halawa 2004, Abdel-Latife,2004, Salwa Ahmed and Nadra Al-Moajel, 2005, and Mohamed and Abdel-Aziz, 2006.

MATERIALS AND METHODS

Test insects

Rhizopertha dominica, F. adults were taken from a Laboratory culture reared in Giza 172 wheat variety at 26C° and 60% RH. Adults of 1-2 weeks old were used to carry out the present work.

Preparation of *A. visnaga* seed extract

A weight of 500 gm. of tooth-pick seeds which were obtained from the Department of plant, Ministry of Agriculture. Dry seeds were cleaned thoroughly by removing any impurities, they were grounded to a fine powder by a high speed micro ml. the ground powder was extracted first with petroleum ether (40-60) in a flask and left for 48 hr., the extract was then filtered and the solvent was then evaporated under reduced pressure by using a rotary evaporator. The defatted powder was thoroughly dried before being extracted next with chloroform then acetone solvent as adopted from Afifi et al. (1989).

Evaluation of extracts toxicity

Toxicity of *A. visnaga* as extracted by the three organic solvents determined by adding different concentration ranging from 2000 up to 10000 ppm to wheat grains.

Twenty five, 1-2 weeks old *R. dominica* adults, were obtained from the maintained stock culture and placed on the treated wheat grains which were then placed in glass tubes.

The tubes were covered with muslin fixed with rubber bond and a control was prepared containing untreated grains. After 3, 5, 7 and 14 days, the tubes were investigated and the number of live and dead insects counted. Accumulated mortality percentages, (Lc50 and Lc95) and regression, lines slope were determined and corrected by Abbott's formula (1925) and computed mortality percentages conducted after 72 hours exposure according to Finney, (1952).

Effect of tooth pick seed extracts on fecundity and F1 progeny of *R. dominica*

Several weight of 10 gm. of wheat grains were prepared and each 10 gm. of grains were treated with the determined LC₅₀ or LC₉₅ of each tooth pick seed as extracted by the three organic solvents. The treated wheat grains were placed in glass tubes (1x3 inches), subsequently, five couples of *R. dominica* 1-2 week old adult insects were included in each tube. After two weeks, the tubes were opened and the insects removed, and the number of deposited eggs on the grains were counted according to the method described by Froankenfeld, (1948) and How, (1952).

The same previous experiment was repeated, but laid eggs were left undisturbed until hatching. After two weeks the adult insects were removed and the tubes left for seven weeks, up to progeny emergence and the number of emerged F1 adult offspring were counted.

All of the forementioned experiments were replicated three times and a control containing untreated wheat included.

Assessment of residual efficiency of tooth pick organic extract

Tubes containing 10 gm. of wheat grains were treated with LC₉₅ concentration of each extract, were divided into several groups and stored.

Three tubes were selected every week and twenty five adults of *R. dominica* were introduced into three tubes, this process was repeated every week and up to 14 weeks. Mortality counts were carried out following the third day of introduction insects.

Insect mortality percentages were calculated and corrected according to Abbott,⁵ formula (1925). Similarly three replicates of untreated wheat were used as a control for each week.

The effect of tooth pick extract on grain germination

Germination of the wheat grains treated with LC₉₅ of tooth pick extracts, was determined according to the International rules for seed testing (Anonymous 1966) at the initial time and the end of the considered storage period (14 weeks).

Wheat grain weight loss treated with tooth pick extract:

Percentage moisture content of wheat grains treated with tooth pick seed organic extracts were determined according to the equation reported by Khare and Johari (1984) equation:

$$\text{Weight loss (\%)} = \frac{\text{initial weight} - \text{final dry weight}}{\text{Initial dry weight}}$$

Tooth pick persistence assess

To assess the persistence of the tested extracts, sets of 20 adults each of *R. dominica* were exposed in tubes to wheat grains treated with LC₉₅ of extract at the intervals of 1,2,3,4,5 and 6 weeks. Untreated wheat grains were used for comparison.

RESULTS AND DISCUSSION

Effect of tooth pick extracts on *Rizopertha dominica*

On the basis of the determined mortality of *R. dominica* offered wheat grains treated with tooth pick seed extract the use of chloroform as a solvent was found to be the most toxic against adult insects, in Table (1) proved that mortality values increased with increase of the concentration and time of exposure. After three days from treatment, mortality ranged from 22-96, 26-95 and 27-90% for petroleum ether, chloroform and acetone extracts respectively. Increased to 44-100, 62-100 and 62-100% after 7 days post-treatment at the various concentrations for all extracts respectively. After 14 days the mortality percentages reached 94-100, 76-100 and 74-100 for the same extracts, respectively.

As shown in Table (2) the LC₅₀ values tooth pick seed extracts, after 3 days post-treatment was 675, 534 and 665 (ppm), while the LC₉₅ values was 893, 874 and 1227 (ppm) for petroleum ether, chloroform and acetone extracts, respectively. This result showed that *R. dominica* adults are more sensitive to extracts, respectively.

Effect of tooth pick seed extracts on progeny F1 *R. dominica*

Data in Table 3 indicate that exposing of *R. dominica* to wheat grains treated with the LC₅₀ and LC₉₅ of the tested extracts caused a great reduction in the mean number of F1 progeny. At LC₅₀ this reduction within all extracts was over 94% and reached 99% at LC₉₅ level. No adults were emerged at LC₉₅ levels with acetone extract compared with mean no. of 19 insect produced at control.

Table 1. Toxic effect of *Ammi visnaga* seeds extracts on percent mortality of *Rhizopertha dominica* F. adults exposed in treated grains

Solvents	Conc.	1	3	7	14
Petroleum ether	600	8	22	44	94
	700	54	67	80	98
	800	62	78	98	100
	900	64	96	100	100
	Cont.	0.0	0.0	0.0	0.0
Chloroform	400	0.0	26	62	76
	500	0.0	33	68	80
	600	40	54	90	100
	800	52	95	100	100
	Cont.	0.0	0.0	0.0	0.0
Acetone	500	0.0	27	62	74
	600	0.0	40	70	90
	700	40	48	70	92
	800	40	66	80	98
	1000	42	90	100	100
	Cont.	0.0	0.0	0.0	0.0

Table 2. LC₅₀ and LC₉₅ values and slopes of regression line for tested extracts of *Ammi visnaga* against *R. dominica*.

Solvents	LC ₅₀ (ppm)	LC ₉₅ (ppm)	Slopes
Petroleum ether	675	893	13.49
Chloroform	534	874	7.67
Acetone	665	1227	6.16

Table 3. Mean number of progeny emergency and reduction of *R. dominica* as affected by the tested extracts.

Solvents	Concentration	Mean No. of progeny emergency	Reduction %
Petroleum ether	LC ₅₀ (675)	1	97
	LC ₉₅ (893)	1	98
	Control	45	0.0
Chloroform	LC ₅₀ (534)	2	96
	LC ₉₅ (874)	0.75	99
	Control	61	0.0
Acetone	LC ₅₀ (665)	1	99
	LC ₉₅ (1227)	0.0	100
	Control	19	0.0

The obtained results are complete harmony with that obtained by (Sawsan, 2001) and Ahmed and AL-Moajel (2005).

Effect of LC₉₅ on wheat grains germination

Soon after wheat treatment (initial time) with tooth pick seed petroleum ether extract, germination was not high affected (Table 4).

Table 4. Germination of wheat grains stored 14 weeks after treatment with tooth pick seeds extracts.

Tested solvents	Concentration ppm	Initial (0)		At the end of storage time (14 weeks)	
		Germination %	Reduction	Germination %	Reduction
P. ether	893	89 ±2	7.3	58±3.6	36.9
Chloroform	874	84±32	12.2	50±1.4	45.6
Acetone	1227	81±22	15.6	49±4.3	46.7
Control	0.0	96±0.8	0.0	92±0.0	0.0

Meanwhile, chloroform and acetone extract caused high reduction in treated wheat germination. At the final investigation (14 weeks), all treatments revealed effects on wheat germination. Ahmed and Al Moajel (2005), found that wheat grains treated with tooth pick seed extracts also lost their viability at the end of 14 weeks of storage. Also, this results harmony with that obtained by (Abd El-latif (2004).

Effect of tooth pick seed extract on weight loss of wheat grains

Treated wheat grains with tooth pick extracts caused a weight loss in grain weight ranging between 72-84% then the control when treated at LC₅₀ level. Meanwhile, when treated with LC₉₅, this loss was between 88-90% than the control (Table 5). These results agree with those obtained by Ahmed and Al-Moajel (2005).

Table 5. Weight loss of the wheat grains treated with tooth pick extracts infestation by *R. dominica*.

Solvents	Concentration (ppm)	Dry weight loss %	Dry weight reduction %
Petroleum ether	LC ₅₀ (675)	3.79	80
	LC ₉₅ (893)	2.21	88
	Control	19.00	
Chloroform	LC ₅₀ (534)	3.02	84
	LC ₉₅ (874)	2.00	89
	Control	19.00	
Acetone	LC ₅₀ (665)	2.00	72
	LC ₉₅ (1227)	1.00	90
	Control	19.00	

Persistence of tooth pick extracts on *R. dominica*

Table 6 further indicates that, for any tested concentration adult mortality of *R. dominica* after storage was greater than to the initial mortality and decrease in the material extract activity was noted after five weeks.

But, the chloroform extract was the most persistence than other extracts at one week, then the effective decreased up to five week. In this respect Halawa, (2004) the tested concentration adult mortality of *S. oryzae* after storage was greater than or equal to the initial mortality, i.e. no decrease in the material powder activity was noted.

Table 6. Persistence of tooth pick extracts toxic on *R. dominica* re-reared on wheat grains stored after 5 weeks at 26±2c° and 65±5R.H.

Extracts	Con. (ppm) LC ₉₅	Average No. of adults within certain after storage of infected wheat grains after exposure period				
		1	2	3	4	5
Petroleum ether	893	9 ±2.3	13 ±1.2	9.5±1.5	5.0±2	10±0
	Cont.	2 ±1.2	1.3 ±0.9	1.3±0.9	0.0±0	0.5±0.5
Chloroform	874	15 ±10	15 ±0.9	23.5±0.5	21±1	20.5±0.5
	Cont.	2 ±1.2	1.3 ±0.9	1.3±0.9	0.0±0	0.5±0.5
Acetone	1227	17 ±1	18 ±4	17.5±0.5	13±3.5	19.5±1.5
	Cont.	2 ±1.2	1.3 ±0.9	1.3±0.9	0.0±0	0.5±0.5

Effect of tooth pick on F1 progeny of *R. dominica*

Data in Table 7 indicate that exposing of *R. dominica* adult to wheat grains treated with the LC₅₀ and LC₉₅ of the tested extracts caused a great reduction in the mean number of F1 progeny/5 pairs. At LC₅₀ this reduction within all extracts was over 94% and reached 100% at LC₉₅ level. No adult were emerged at LC₉₅ levels with all the tested extracts compared with mean no. of 64.3 insect/5 pairs produced at control.

The obtained results are in complete harmony with that obtained by Abdel- Latif (2004), the numbers of emerged adults were observed and the reduction in F1-progeny reached 100% for all treatments compared with untreated grains.

Table 7. Effect of tooth pick seed extracts on F1 progeny of *R. dominica*, adults exposed to treated wheat grains.

Tested concentrations extracts	LC ₅₀		LC ₉₅	
	Mean No. of F1 progeny /5pairs	Reduction %	Mean No. of F1 progeny /5pairs	Reduction %
Petroleum ether	3.0	95.60	0.0	100
Chloroform	4.3	94.10	0.0	100
Acetone	0.7	98.97	0.0	100
Control	68.0	0.0	64.3	0.0

Residual effect

Table 8 indicated that pet. Ether, chloroform and acetone extracts at the concentration of LC₉₅ gave 90% kill against *R. dominica* adults up to 4 weeks and decreased highly till 8 weeks (35,37 and 29% kill) for pet. Ether, chloroform and acetone extract, respectively. The residual activity of these extracts deteriorated gradually until it reach 44.67, 57.00 and 31.00% after 14 weeks for pet. Ether, chloroform and acetone respectively, (Ahmed an Al-Moajel, 2005).

Table 8. Corrected mortality of *R. dominica*, adults exposed for 3 days to wheat grains treated with LC₉₅ of the tested extracts after different post-treatment periods.

Period after treatment (in weeks)	Petroleum ether extract corrected mortality %	Chloroform extract corrected mortality %	Acetone extract corrected mortality %
Initial	99	98	100
1	96	96	96
2	98	96	96
3	95	95	94
4	92	95	90
5	90	94*	70
6	84	90	60
7	57	72	58
8	35	37	29

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سمية مستخلصات بذور الخلة ضد حشرة ثاقبة الحبوب الصغرى

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اجريت تجارب معملية لاستخلاص بذور الخلة بواسطة عدة مذيبات (الايثير البترولى- الكلوروفورم-الاسيتون) وذلك لاختبار سميتهم ضد ثاقبة الحبوب الصغرى التى تصيب القمح، استخدمت هذه المستخلصات على مستوى التركيز القاتل لـ ٩٥،٥٠% لكل منها كمعاملة سطحية على الحبوب.

وقد لوحظ ان مستخلص الكلوروفورم كان الاكثر كفاءة عند استخدامة فى التركيز القاتل لـ ٩٥، ٥٠% . ومن النتائج المتحصل عليها انه قد تائرت الكفاءة التناسلية لثاقبة الحبوب الصغرى تائرا شديدا عند استخدام هذين التركيزين القاتلين لـ ٩٥،٥٠% حيث حدثت حماية كاملة للحبوب حيث لم يخرج خلفه من الحبوب بكتا التركيزين.

وان معاملة الحبوب بالتركيز القاتل لـ ٩٥% اعطت حماية فوق خمسة اسابيع مثل من مستخلص الكلوروفورم والايثير البترولى، اربع اسابيع فى حالة مستخلص الاسيتون.

كماتائرت نسبة الانبات لحبوب القمح المعاملة حيث انخفضت عند نهاية فترة التخزين، وان الحبوب المعاملة بالتركيزين القاتلين لـ ٩٥،٥٠% بالمستخلصات ادى الى انخفاض الفقد فى الوزن مقارنة بالغير معاملة.