EFFICACY OF *RICINUS COMMUNIS* EXTRACTS IN DIFFERENT SOLVENTS AS PROTECTANTS AGAINST THE COWPEA WEEVIL, *CALLOSOBRUCHUS MACULATUS* F. (COLEOPTERA : BRUCHIDAE)

SANAA M. MAHGOUB

Plant Protection Research Institute, Agricultural Research Centre, Giza, Egypt.

(Manuscript received 23 December, 1996)

Abstract

Ricinus communis seed extracts in 4 different solvents (petroleum ether, chloroform, acetone and methanol) at LC_{50} and LC_{95} as surface treatment were tested to protect cowpea seeds against the cowpea weevil, *Callosobruchus maculatus* F. Effect of extracts on the fertility of *C.maculatus*, hatchability of its eggs, progeny of emerging adults and immature stages were tested. Results indicated that *R.communis* extracts reduced egg production of *C.maculatus* females, hatchability of eggs and adult emergence. Chloroform extract was the most effective at LC_{50} and LC_{95} levels. Other extracts could be arranged according to their effect on egg laying as follows: methanol > acetone> petroleum ether. As for egg hatchability, chloroform extract was more effective than the other tested extracts. For all tested 4 extracts, rates of adult emergence were considerably reduced at LC_{50} level and dropped to zero at LC_{95} level. All tested extracts affected percentages of adults emerged from treated seeds, 5, 10 and 15 day after infestation at both LC_{50} and LC_{95} levels.

INTRODUCTION

Environmental pollution due to insecticidal treatments is a serious problem confronting the world. As an alternative for pesticides, use of plant extracts may serve as good control agents. There is a continuing need for exploring plant extracts that are more effective, safe and more economical than existing insecticides. More than 1400 compounds have been evaluated as repellents (Anon, 1959). Some other naturally occurring active materials have been extracted from plants (Jacobson. 1975).

In Pakistan, some indigenous plants have been used for keeping insects from human and food materials (Golob and Webley, 1980). Su et al. (1972), Schoonhoven (1978) and El-Borolosy et al. (1989) reported that some plant extracts suppress

repoduction of some grain insects.

The aim of the present work is to test several solvents to extract biologically active materials from castor oil (R.communis). The cowpea weevil, *Callosobruchus maculatus* F. was choseń as the test insect and cowpea seed were chosen as the test seeds. The broad objective is to contribute to the knowledge on protecting stored pulses from bruchid insect attacks.

MATERIALS AND METHODS

1. Preparation of crude extracts

Dry seeds of castor oil plant, *Ricinus communis*, were ground at a high speed micromill, 250 g. of the resulting powder were successively extracted with different organic sovents of increasing polarities. Petroleum ether (40-60°C), chloroform, acetone and methanol with 0.0, 4.4, 5.4, 5.4 and 6.6 polarities, respectively. Petroleum ether was used first where the powder was applied at a ratio of one gram/3 ml of solvent. Extracts were kept under laboratory conditions for 48 hr., then filtered on anhydrous sodium sulphate. Petroleum ether was evaporated under vacuum at temperature ranging 40-45°C until dryness, and the residue was weighed. Defatted powder was thoroughly dried before successive extraction using other organic solvents. The same procedure was followed using each experimental solvent. Resulted crude dried extracts were kept in a refrigerator at -6°C until bioassay evaluation (Afifi et al., 1988).

2. Maintenance of experimental insects

A standard colony of the test insect, *Callosobruchus maculatus*, on cowpea seeds (variety Kareem 6) with 15.6% moisture content was maintained at constant conditions of 65 ± 5% R.H. and 27°C. Adult beetles (1-2 days old) were accordingly chosen as test insects for the present investigation.

3. Surface treatment of commodities

Different weight from each dried plant extract were dissolved in 10 ml of the same solvent of extraction to obtain serial concentrations. Each solution was mixed with 10 grams of tested seeds. The solvent was then completely evaporated using an electric fan until a thin film of castor oil extract coated the seeds.

4. Effect of tested plant extracts on some biological aspects of C.maculatus :

4.1. Number of deposited eggs laid/female

Ten cowpea seeds treated with LC_{50} and LC_{95} of plant extracts were intro-

duced into a glass tube (1 x 3 inches). One couple of newly emerged adults was placed in every tube and covered with muslin. After 24 hr, the treated seeds were removed and replaced with another treated seeds. Such procedure continued to be practiced daily until the death of females. The number of eggs deposited by mated female adults on the treated seeds was counted. Three replicates were made for each concentration. In addition, three replicates of untreated seeds were used as control.

4.2. Hatchability percentage of deposited eggs

Cowpea seeds bearing deposited eggs were transferred to clean glass tubes and incubated at 27°C and 65±5% R.H. Eggs were inspected daily and the number and percentage of hatched eggs were recorded.

4.3. Number of adults emerged from treated seeds

Samples of 10 grams of treated seeds kept in 1x3 inches glass tubes covered with muslin were infested with 5 pairs of newly emerged adults of *C.maculatus*. After 48 hr, the insects were removed and incubated for 5, 10 and 15 days at 27°C and 65 ± 5% R.H. Infested seeds showing symptoms of having immature stages were treated with the different solvents of tested extracts (LC_{50} and LC_{95}) and incubated at the same conditions until the emergence of the new generation's adults. Each test and the control were replicated 3 times.

4.4. Progeny of test insects

Ten couples of *C.maculatus* were placed in glass tubes with 20 gm. of cowpea seeds treated with LC_{50} or LC_{95} levels of each of the solvents of plant extract for one week. The tubes were kept in the incubator at the same conditions. The total number of emerged F1 offspring was counted after 5 weeks. A control containing the same number of insects and untreated seeds was set for each experiment.

RESULTS AND DISCUSSION

Table 1 shows that all tested extracts had a clear effect on the number of eggs laid/female compared to control. At LC50 level, chloroform extract was the most effective (7.77 eggs) and petroleum ether extract was the least effective (39.77 eggs). Methanol and acetone extracts showed moderate to relative effect (10.47 and 21.53 eggs, respectively). At LC95 level, the same trend was observed. The mean no. of eggs laid/female was 3.77, 5.2, 5.3 and 5.6 for chloroform, metha-

nol, acetone and petroleum ether extracts, respectively. Such results agree with the findings of Mahgoub (1987) who reported that treatment with *R.communis* oil gave a significant reduction of eggs laid by *C.maculatus*.

Table 1. Effect of different *R.communis* seed extracts on certain biological aspects of *C.maculatus*.

Extract	Mean no. of eggs/female		% hatchability		% adult emergence	
	LC50	LC95	LC50	LC95	LC50	LC95
Petroleum ether	39.4	5.6	72.6	55.0	1.0	0.0
Chloroform	7.8	3.7	69.9	39.3	0.4	0.0
Methanol	10.5	5.2	84.1	75.0	0.6	0.0
Acetone	21.5	5.3	83.0	78.1	0.3	0.0
Control	86.8		94.1		79.6	

As for the percentage of hatchability, data refer to that it reached 70% for chloroform extract and 84% for methanol at LC50 level compared with 39% and 78% for chloroform and acetone extracts, respectively at LC95 level. Percentage emergence of the adults at LC50 level was 0.31, 0.39, 0.64 and 1.02% for acetone, chloroform, methanol and petroleum ether extracts, respectively, while at LC95 level, all treatments prevented adult emergence.

Table 2 gives the percentage of adults emergence after different periods for seeds treated with the different tested extracts. At LC50 level, the rate of emergence was noticeably reduced after 5, 10 and 15 days of infestation. At LC95 level, all treatments entirely prevented adult emergence for 5 and 10 day-treatments, while for 15-day treatment, few adults succeeded to emerge (1, 6, 0 and 2 adults for petroleum ether, chloroform, acetone and methanol, respectively).

Previous results lead to the general conclusion that petroleum ether, chloroform, acetone and methanol extracts of castor oil seeds *R.commumis* seem to be effective for the control of *Callosobruchus maculatus* on cowpea seeds as they decreased the pest's egg laying capacity, egg hatchability and percentage of adult emergence from infested cowpea seed up till 15 days after treatment with castor oil extracts.

These results coincide with the results of Mostafa et al. (1995) who studied the effect of petroleum ether extracts of *Nigella sativa* seeds at two levels (LC50 and LC95) on the reproductive capacity of *C.maculatus* up to 90 days after treatment, and Ahmed and Mahgoub (1996) who mentioned that petroleum ether, chloroform, acetone and methanol extracts of *R.communis* seeds affect the mortality of *C.maculatus* adults and that the residual effect of these extracts remained up to 50 days.

Table 2. Effect of different *R.communis* seed extracts on the percentage of emergence of *C.maculatus beetles emerged from infested cowpea seeds treated after different intervals from infestation.*

Extract	Percentage of emergence after (days)								
	5			10			15		
	LC50	LC95	Cont.	LC50	LC95	Cont.	LC50	LC95	Cont.
Petroleum ether	2.0	0.0	40.0	18.0	0.0	71.0	3.0	1.0	147.0
Chloroform	0.0	0.0	34.0	0.0	0.0	54.0	19.0	6.0	98.0
Acetone	13.0	0.0	39.0	14.0	0.0	75.0	0.0	0.0	129.0
Methanol	4.0	0.0	34.0	0.0	0.0	67.0	15.0	2.0	170.0

REFERENCES

1 . Afifi, F.A., A.M. Hekal and M. Salem. 1988. Fenugreek seed extracts as protectants of wheat grains against certain stored product insects. Annals of Agric. Sci., Fac. Agric., Ain Shams Univ., Cairo, Egypt, 33 (2) : 1331-1334.

2 . Ahmed, S.M. and S.M. Mahgoub. 1996. Insecticidal properties of the extracts of Ricinus communis seeds against the cowpea beetle *Callosbruchus maculatus* F.J. Agric. Res. Rev. (In press).

3 . Anon. 1959. Laboratory evaluation of compounds as repellents to four beetles, *Tribolium* spp. USDA Agric. Matg. Res. Rep. No. 32 L, 46 pp.

4 . El-Borolosy, F.M., I.A. Hemeida, E.Z. Fam and S.M. Ahmed. 1989. Evaluation of the effectiveness of some plant and paraffin oils against the rice weevil, *Sitophilus oryzae*. Proc. 1st Int. Conf., Econ. Ent., Cairo, Egypt, 1: 393-402.

5 . Golob, P. and D.J. Webley. 1980. The use of plants and minerals as traditional protectants of stored products. Rep. Trop. Prod. Ins. G., 138, Vit., 32 pp, London.

6 . Jacobson, M. 1975. Insecticides from plants. A review of the literature, 1954-1971. USDA Agric. Handbook No. 641, 138 pp.

7 . Mahgoub, S.M. 1987. Studies on the rice weevil, *Sitophilus oryzae* L. and the cowpea beetle, *Callosobruchus maculatus* F. Ph.D. Thesis, Fac. Agric., Cairo Univ.

8 . Mostafa, Taheya S., M. Salwa Ahmed and M. Sanaa Mahgoub. 1995. Evaluation of Nigella sativa extract for the control of Callosobruchus maculatus and Sitophilus oryzae. Egypt. J. Appl. Sci., Zagazig Univ., 10 (8) : 7-21.

9 . Schoonhoven, A.V. 1978. Use of vegetative oils to protect stored bean from Bruchid attack. J. Econ. Entomol., 71 (2) : 254-256.

10. Su, H.C.F., R.D. Spiers and C.M. Patric. 1972. Toxicity of citrus oils to several product insects. Laboratory evaluation. J. Econ. Entomol., 65 : 1438-1441.

كفاءة مستخلصات بذور الخروع في مذيبات مختلفة كمواد واقية ضد حشرة خنفساء اللوبيا.

سناء محمود محجوب

معهد بحوث وقاية النباتات – مركز البحوث الزراعية – الدقى – الجيزة .

درس تأثير مستخلصات بذور الخروع في كل من الأثير البترولي والكلوروفورم والأسيتون والميثانول علي بعض الجوانب البيولوجية لحشرة خنفساء اللوبيا.

أدي خلط بذور اللوبيا بتلك المستخلصات بتركيزي ٥٠٪، ٩٥٪ ثم تعريض الحشرات الكاملة للخنفساء للبذور المعاملة ومعاملة البذور التي سبق عدواها بالحشرة لمدد ٥ ، ١٠ ، ١٥ يوما الي خفض متوسط عدد البيض لكل انثي بدرجة ملحوظة. وكان مستخلص الكلوروفورم الاكثر تأثيرا علي الحشرة عند تركيزي ٥٠، ٩٥٪ (٧,٨ ، ٣,٨ بيضه / الانثي علي التوالي) مقابل ٨٩,٨ بيضه/انثي في المقارنة. أما المستخلصات الأخري المختبرة فترتبت تنازليا تبعا لفاعليتها في خفض تعداد البيض كالآتي : الميثانول ثم الاسيتون ثم الاثير البترولي. هذا وقد نجحت جميع المستخلصات المختبرة بتركيزي ٥٠٪ ، ٩٥٪ في خفض نسبة البيض، وكان مستخلص الكلوروفورم اكثرها كفاءة (٦٩,٩٪ و ٣٩,٣٪ علي التوالي). وأدي استخدام المستخلصات المختبرة الي نقص كبير في عدد الذرية الناتجة حيث لم تعط البذور التي عوملت بها بتركيز ٩٥٪ أية ذرية. وقد أثرت المستخلصات المختبرة تأثيراً ملموسا علي أطوار الحشرة الموجوه داخل البذور عند تركيزى ٥٠٪ أو ٩٥٪.