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 LC50 and LC95 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 LC50 and LC95 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 LC50 level and dropped to zero at LC95 level. All tested extracts affected percentages of adults emerged from treated seeds, 5, 10 and 15 day after infestation at both LC50 and LC95 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 (Sohel and Webley, 1980). Su et al. (1972), Schoonhoven (1978) and El-Borolossy et al. (1988) reported that some plant extracts suppress
reproduction 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 chosen 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 micronmill, 250 g. of the resulting powder were successively extracted with different organic solvents 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 (Affifi et al., 1988).

2. Maintenance of experimental insects

A standard colony of the test insect, Callosobruchus maculatus, on cowpea seeds (variety Karoem 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 LC50 and LC95 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 (LC50 and LC95) 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 LC50 or LC95 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*.

<table>
<thead>
<tr>
<th>Extract</th>
<th>Mean no. of eggs/female</th>
<th>% Hatchability</th>
<th>% Adult emergence</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LC50</td>
<td>LC95</td>
<td>LC50</td>
</tr>
<tr>
<td>Petroleum ether</td>
<td>39.4</td>
<td>5.6</td>
<td>72.6</td>
</tr>
<tr>
<td>Chloroform</td>
<td>7.8</td>
<td>3.7</td>
<td>69.9</td>
</tr>
<tr>
<td>Methanol</td>
<td>10.5</td>
<td>5.2</td>
<td>84.1</td>
</tr>
<tr>
<td>Acetone</td>
<td>21.5</td>
<td>5.3</td>
<td>83.0</td>
</tr>
<tr>
<td>Control</td>
<td>86.8</td>
<td>94.1</td>
<td>79.8</td>
</tr>
</tbody>
</table>

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. communis* seem to be effective for the control of *Callosobrachrus 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.

<table>
<thead>
<tr>
<th>Extract</th>
<th>Percentage of emergence after (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>LC50</td>
</tr>
<tr>
<td>Petroleum ether</td>
<td>2.0</td>
</tr>
<tr>
<td>Chloroform</td>
<td>0.0</td>
</tr>
<tr>
<td>Acetone</td>
<td>13.0</td>
</tr>
<tr>
<td>Methanol</td>
<td>4.0</td>
</tr>
</tbody>
</table>
REFERENCES


دراسة تأثير مستخلصات بذور الخروع في كل من الثور البري والكلاورفووم والسيتوين والبلاينوال على بعض الجوانب البيولوجية لثمرة خنفساء اللوبية.

أدى خطف بذور اللوبية بناء المستخلصات بتركيزي 1/8%، 1/4%، 1/2%، 2/3% على حرق للثمرة العامة وماعادة البذور التي سبق معالجتها بالثمرة لمدة 100 يوما إلى تخفيف مستخلصات الكلاورفووم 2/3% نسبته في الثمرة بعد تكاثرها 36.8% على البايسية / الناشئة على النوايا مقابل 49.8% الناشئة / الناشئة في الثمرة بعد تكاثرها 36.8% على البايسية / الناشئة على النوايا. أما مستخلصات الأفرينية للثمرة فعثرت بذورها إلى نسبها في خفض النجاح البذري كافح 36.8% على البايسية / الناشئة في الثمرة بعد تكاثرها 36.8% على البايسية / الناشئة على النوايا. وقد أثرت مستخلصات البذور في عدد الأوراق النتيجة حيث لم تختلف البذور من الناحية الوراثية في خفض العوامل الناتجة عن التكاثر 36.8% أو 49.8%.

معهد بحوث وحماية النباتات - مركز الحيوان الزراعي - الدقى - الجيزة.