EVALUATION OF CERTAIN FORMULATIONS OF NATURAL PRODUCTS AGAINST THE COWPEA WEEVIL, *CALLOSOBRUCHUS MACULATUS* F.

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Abstract

Dust powder formulations were prepared for the following plant parts directly as plant powders and for their extracts with ethanol, using talc and mosaic as diluents for preparing dusts. The plant parts were : leaves of shih (*Artemisia cina*), gum of sorrel (*Rumex vesicarius*) and seeds of kalakh (*Ferula communis*). The locally prepared dusts were evaluated against adults, eggs and the offspring of *C.maculatus* that infested cowpea seeds. Results obtained proved that dusts of plant extracts were faster and much more efficient than dusts of normal plant powders either in their initial or residual effect after 3 months of treatment. Dust of sorrel ext./mosaic was the most efficient dust against adults, eggs and the offspring of *C.maculatus* followed by sorrel ext./talc, kalakh ext./talc and shih ext./talc.

INTRODUCTION

Excessive reliance on pesticides has been accompanied by the development of several problems such as development of resistance and problems of environmental pollution. Thus, there is a continuing need for new pesticides harmless to the environment to replace conventional hazardous insecticides.

Accordingly, during the last two decades large numbers of plants have been screened for their biologically active chemicals exhibiting diverse effects on insects such as antifeedant effect (Goyal *et al.*, 1971), toxic effect (Legunes, 1990), inhibition of respiration (Lewis et al., 1993) and reproduction retardation (Tanzubi and McCaffery, 1990). The admixture of wood ashes, products derived from plants, various inert dusts (Asran, 1982) and formulations with grains and seeds is carried out in many countries. These methods appear to rely for its effectiveness upon the fact that materials are either sorptive or abrasive agents which have the ability to

absorb oriented wax molecules resting on the tanned protein of the insect epicuticle, and they promote the rapid loss of body moisture of insects infesting the grain and cause their death by desiccation.

The aim of this present study is to determine the efficiency of some plant extracts against the cowpea weevil, Callosobruchus maculatus F., which is considered a serious pest of cowpea seeds.

Natural agents, such as these suitable plants, have the advantages of efficiency, low cost, reduced chance of developing insect resistance to insecticides and low health hazards for both appliers and consumers.

MATERIALS AND METHODS

Plants used

Arabic name	English name	Latin name	Part used
Shih	Wormwood	*Artemisia* sp.	Leaves
Heltate	Sorrel	*Rumex vesicarius*	Gum
Kalakh	Giant fennel	*Ferula communis*	Seeds

Solvent : Ethyl alcohol

Diluents :

1. Talc powder (magnesium meta silicate) : It was supplied by El-Nasr Co. for phosphate, Cairo. Talc have the following properties : pKa (surface activity value) > 1.5 <3.3, pH = 8.20 and particale size less than 40 microns (EL-Sisi, 1986).

2. Mosaic powder (calcium carbonate) : It was supplied by the Company of Sandy Bricks, Cairo. Mosaic powder have the following properties : pKa > 3.3, pH = 7.80 and particale size less than 40 microns (EL-Sisi, 1986).

Extraction and formulation of the extracts as dust powders

Plant parts were dried, ground using laboratory grinder, extracted with the polar solvent ethyl alcohol by adding 100 ml. solvent (ethyl alcohol) to 10 g of ground plant parts then filtration after 3 days of adding the solvent and concentration of the extract to 50 ml. using rotary vacuum evaporator.

Dust powder formulations were prepared for both ground plant powder "by mixing 10 g of plant powder with 90 g diluent (talc and mosaic)" and for extracted plant powder using spray impregnation technique described by Furmidge (1972) by

spraying 50 ml. of plant extract on 100 g diluent, then mixing well and sieving the completely dried mixture through 74 micron sieve.

The following dust powder formulations were prepared :

1. Shih powder + talc as diluent (Shih p./talc) .
2 . Shih extract + talc as diluent (Shih ext./talc) .
3 . Shih extract + mosaic as diluent (Shih ext./mosaic) .
4 . Sorrel powder + talc (sorrel p./talc) .
5 . Sorrel powder + mosaic (sorrel p./mosaic) .
6 . Sorrel extract + talc (sorrel ext./talc) .
7 . Sorrel extract + mosaic (sorrel ext./mosaic) .
8 . Kalakh powder + talc (Kalakh p./talc).
9 . Kalakh powder + mosaic (Kalakh p./mosaic).
10 . Kalakh extract + talc (Kalakh ext./talc).
11. Kalakh extract + mosaic (Kalakh ext./mosaic).

Test insect : The cowpea beetle, Callosobruchus maculatus 1-2 days old were obtained from laboratory culture on cowpea seeds.

Treatments : The calculated amount of each dust to give the required rate of application (4%) was added to a quantity of 400 g. of seeds in glass jar and mixed thoroughly for 10 min. to ensure even distribution. Each treated quantity was divided into two portions, of 200 g. each, to enable making 2 sets of tests, one was immediately tested after treatment for the initial efficiency and the other was evaluated after 3 months for residual efficiency using the same experimental set up.

In each test, the 200 g. portion of the treated seeds was divided into four parts of 50 g each to make replicates for each test. The experimental unit was thus 50 g. of treated seeds to which 25 adults of the test insect were added in a plastic tube (2 x 3 inch). and kept at constant conditions of 27°C and 65-70% R.H.

Mortality counts were recorded daily until all the insects died. Controls were prepared in the same manner. It consisted of three types:

1. Untreated check
2 . Talc check
3 . Mosaic check

Mortality percentages were corrected by Abbott's formula (1925).

Hatchability : To study the hatchability, 100 seeds each holding one egg were grouped to four replicates, and were examined daily to determine the hatched eggs.

Progeny : The number of offspring emerged from each tested group was estimated after eight weeks from the start of the treatment.

RESULTS AND DISCUSSION

1. Initial and residual effects of prepared dusts against adults of *C.maculatus*

Results obtained in Table 1 could be summarized as follows:

a. All prepared dusts proved high initial and residual effects against adults of C.maculatus although their residual effects slightly decreased than the initial mortality percentages.

b. Dust formulations of plant extract showed faster effect than those of plant powder in their initial and residual effects.

C. Dust powder formulations with mosaic as diluent gave faster effect after one day of treatment than in the case of using talc as diluent but the insecticidal effect for dusts of the two diluents was either inverted or already the same after the exposure period especially for the residual effect (3 months).

d. Complete mortality was obtained after three days with the extracts of the three plants investigated, while powdered plants required 4-5 days exposure to obtain complete kill.

e. Storage of powders for three months caused a loss in efficiency and none of the examined preparations could produce 100% kill even after six days of exposure, which leads to the conclusion that such preparations must be used fresh if it is meant for initial kill.

The above results agree with Mahgoub (1987) who proved the insecticidal efficiency of some plant powders and ashes against adults of *C.maculatus*.

2. Effect of prepared dusts on some biological aspects of C.maculatus

a. Hatchability percentage of eggs

Results shown in Table 2 indicated that dusts of plant extracts reduced egg

Table1. Corrected percentages kill of *Callosobruchus maculatus* (F.) caused by different formulations of some plants.

Dust Powder formulations of	Correct % kill after mentioned days of insect exposure										
	Initial					Initial					
	1	2	3	4	5	1	2	3	4	5	5
1- Shih P./Talc	61.33	85.67	93.50	100	--	25.00	56.33	81.30	93.67	96.00	97.30
2- Shih ext./Talc	72.17	89.33	100	--	--	58.33	70.67	88.00	89.33	95.30	97.67
3- Shih ext./Mosaic	89.63	90.00	100	--	--	69.00	72.50	80.90	86.00	90.70	92.67
4- Sorrel P./Talc	54.50	77.00	84.12	95.33	100	22.67	69.33	79.30	85.70	89.70	91.67
5- Sorrel P./Mosaic	55.03	71.03	88.67	94.67	100	32.00	53.67	69.00	76.30	87.90	89.30
6- Sorrel ext./Talc	74.00	93.12	100	--	--	55.50	81.33	92.70	96.00	96.67	97.00
7- Sorrel ext./Mosaic	86.67	90.00	100	--	--	58.63	78.00	81.00	91.70	93.00	93.90
8- Kalakh P./Talc	58.00	89.33	89.66	90.00	100	12.00	42.00	67.30	80.60	85.06	91.90
9- Kalakh p./Mosaic	66.18	74.67	88.00	93.00	100	19.33	51.33	80.60	85.91	89.70	93.00
10- Kalakh ext./Talc	71.33	91.33	100	--	--	32.03	71.33	78.60	86.33	92.67	95.00
11- Kalakh ext./Mosaic	79.67	98.00	100	--	--	61.15	70.67	78.70	88.67	93.00	94.67
Untreated check	2	4	4	12	20	--	--	--	--	--	--

hatchability more than those of plant powders both in their initial and residual effects. Plant extracts mixed with mosaic powder as diluent gave the highest effect (Shih ext./mosaic, sorrel ext./mosaic and kalakh ext./mosaic), followed by those mixed with talc/powder (sorrel ext./talc, kalakh ext./talc and shih ext./talc). Residual effect of the tested dusts slightly decreased than initial mortality. This results well agreed with Iskander *et al.* (1995) for the same plant parts extracts prepared as emulsifiable concentrates against eggs of *Tetranychus arabicus*.

Table 2. Effect of locally prepared dust powder formulations of some plants on the hatchability of eggs and percentages of emerging of Callosobruchus maculatus (F.) (27°C and 65-70% R.H.).

Dust powder formulation of	Initial		Initial	
	% Egg hatchability	% Adult emergency	% Egg hatchability	% Adult emergency
1- Shih P./Talc	81.09	36.20	85.89	67.30
2- Shih ext./Talc	57.00	9.36	64.80	39.60
3- Shih ext./Mosaic	28.00	0.00	33.30	15.20
4- Sorrel P./Talc	75.01	31.90	76.52	58.90
5- Sorrel P./Mosaic	75.00	23.20	76.26	54.60
6- Sorrel ext./Talc	46.08	3.50	48.75	10.90
7- Sorrel ext./Mosaic	33.67	0.00	36.09	0.00
8- Kalakh P./Talc	76.88	33.00	78.00	61.30
9- Kalakh P./Mosaic	66.67	18.90	69.00	49.10
10- Kalakh ext./Talc	54.06	4.22	54.88	28.10
11- Kalakh ext./Mosaic	42.00	0.00	42.44	0.00
Untreated check	93.55	96.70	91.05	96.90
F Value	33.26		26.85	
L.S.D.	4.78		3.56	

b. Number of offspring

Tested dusts gave an observed reduction in the number of offspring which emerged from treated seeds. It was evident that the efficiency of sorrel ext./ mosaic and kalakh ext./mosaic prevent emergence of offspring up to 3 months of treatment followed by shih ext./mosaic which prevents emergence in initial, but reduced emergence of adults after 3 months of treatments. The other plant extract dusts mixed with talc were less effective than plant powders. It was noticed that there was a highly significant reduction effect between the emergence in the treatments compared with untreated check. These results agree with Emara *et al.* (1994)

who proved that shih, sorrel and red pepper have acaricidal effects against varroa mites that infested bee colonies, also agree with El-Sisi and Badr (1995) who proved that shih and other plant extracts reduced the populations of cotton leaf worm, *Spodoptera littoralis.*

Finally, it could be concluded that dusts of plant extracts gave the fastest and highest effect against adults, egg and reproduction of C.maculatus. Sorrel ext./ mosaic, shih ext./mosaic, kalakh ext./mosaic were efficient dusts followed by plant extracts mixed with talc and plant powders mixed with mosaic or talc and it could be recommended using of those dusts as one element of integrated pest management for controlling this pest for their safety and economic considerations.

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تجهيز وتقييم بعض المواد الطبيعية ضد حشرة خنفساء اللوبيا -*Callosobruchus maculatus F.*

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تم تجهيز ثلاثة مستخلصات لكل من نبات الحلتيت Rumex vesicarius وأوراق نبات الشيح Artemisia sp.وكذلك بذور نبات الكلخ Ferula communis وذلك باستخدام مذيب كحول الايثايل . كذلك تم تجهيز ثلاثة مساحيق لهذه النباتات وذلك بطحنها ونخلها، ثم بخلط التلك والموزيك كمواد مخففة بكل من المستخلصات والمساحيق المجهزة فتكون مساحيق تعفير لهذه المواد ، وذلك لدراسة تأثير هذه التجهيزات ضد حشرة خنفساء اللوبيا حتى ثلاثة أشهر من المعاملة. وفيما يلى ذكر النتائج المتحصل عليها.

(١) كانت هناك علاقة عكسية بين مدة التخزين ونسبة موت الحشرة فقد وجد انحدارا بسيطا فى نسبة الموت بعد تخزين اللوبيا المعاملة بهذه المواد لمدة ثلاثة شهور.

(٢) مساحيق التعفير المجهزة للمستخلصات النباتية كانت أسرع وأكفأ فى تأثيرها عن مساحيق التعفير المجهزة من الأجزاء النباتية المطحونة.

(٣) مساحيق التعفير لمستخلص الحلتيت والشيح والكلخ المحملة على الموزايك كمادة مخففة كانت أكفا التجهيزات ، يليها مساحيق التعفير للمستخلصات المحملة على التلك ، وأخيرا كانت مساحيق التعفير للأجزاء النباتية المطحونة والمحملة على الموزيك والتلك.

(٤) أظهرت المستخلصات المستعملة اختزال واضح فى نسبة فقس البيض الذى تراوح ما بين (28.0%) لمستخلص الشيح المحمل على الموزايك ، (81.09%) لمستخلص الشيح المحمل على التلك.

(٥) أدت المستخلصات المحملة الى اختزال كبير فى عدد الخلفة الناتجة من بذور اللوبيا. فقد كانت أكثرها كفاءة على وجة الخصوص مستخلص الحلتيت المحمل على الموزايك وكذلك مستخلص الكلخ المحمل على الموزايك أيضا اللذان منعا خروج الحشرات نهائيا وذلك بعد تخزين لمدة ٣ شهور. هذا وقد اظهرت النتائج ان هناك اختلافا معنويا كبيرا بين المعاملة والمقارنه.

واخيرا يمكننا القول بأنه يمكن التوصية باستخدام هذه المستخلصات النباتية الأمنة (بعد تجهيزها فى صورة مساحيق تعفير) فى مقاومة حشرة اللوبيا وذلك لسهولة وأمان استخدامها ورخص تكاليفها. وكذلك شدة تأثيرها على هذه الحشرة التي تعتبر من أهم حشرات الحبوب المخزونة التى تصيب العائلة البقولية بصفة عامة.