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PRELIMENARY STUDIES ON THE MOLLUSCICIDAL PROPERTIES OF SOME LOCAL PLANTS

(With 7 Tables & 2 Figs.)

By

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دراسة مبدئية لبعض النباتات كمبيد للقواقـــــــــع

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أجريت هذه الدراسة لبيان تأثير بعض النباتات المحلية على قوقعى البيومفلاريا والليمنيا العوائل الوسيطة لدودة البلهارسيا والدودة الكبدية على التوالي · وقد إتضح من الدراســـــة أن مسحوق نباتى أجاف كيرشوفيا ـ أجاف هيتراكانثا له تأثير قاتل على القوقعين موضـــع تجربة عند التركيز ١١٠ ، ١٩٠ جزء في المليون على الترتيب · كما أثبتت الدراســـــة أن فاعلية النباتين لم تتأثر تحت الظروف البيئية المختلفة مثل أشعة الشمس ـ درجة الحـرارة حتى ٣٠ درجة مئوية ووجود الطمى والوسط القاعدى بينما تأثرت هذه الفاعلية قليلاً عند كلا مـن درجة الحرارة المنخفضة (١٠ درجة مئوية) والوسط الحامضى · ونظراً لدرجة إرتفاع فاعليـــة مسحوق كلا من النباتين في إستخدامهما كمبيد للقواقع وسهولة تطبيقهما وأيضاً قلة التكلفـــة الإقتصادية (حيث يستخدم أجزاء النبات كلها) يقترح تطبيقهما على مستوى حقلى كبير ·

SUMMARY

The comparative susceptibility of Biomphilaria alexandrina and Lymnaea cailliaudi to the action of the dry powder of some plants was determined. The aqueous suspensions of the dry powder of Agave kerchovei and Agave heteracantha showed LC_{90} at 110 ppm and 190 ppm respectively. The potency of the dry powder of both plants against B.alexandrina and L.cailliaudi has been found to be stable under the effect of sun-light, temperature 30°C, mud and alkline pH, but slightly diminished under the effect of acidic pH and low temperature possible availability of both plants render them as possible molluscicides of economic importance.

INTRODUCTION

Schistosomiasis is one of the most wide-spread parasitic disease, is of special social and economic importance as a world health problem (JORDAN, 1972). Also

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fascioliasis is among the most important problems facing animal production in many parts of the world. Since the recently applicable synthetic molluscicides are expensive, need hard currency and have certain pollution hazards such as toxicity to non-target livings in the snail habitat, (LEMMA, 1970) there remains a pressing need for the cheaper, more safe and easily available botanical molluscicides. It has been reported on a variety of plants with molluscicidal activity in laboratory and/or field trials (LEMMA, 1970; MEDINA and WOODBURY, 1979; MEDINA and RITCHIE, 1980). In continuation to our investigationin this field (SHOEB and EL-SAYED, 1984 & 1986 and SHOEB and EL-EMAN, 1987), the present investigation reports on the molluscicidal properties of the dry powder of some local plants especially Agave kerchovei and Agave hetercantha against B.alexandrina and L.cailliaudi.

MATERIAL and METHODS

The snail intermediate host of schistosomiasis in Egypt B.alexandrina (Shell diameter 6-8 mm) and the snail intermediate of fascioliasis, L.cailliaudi (Shell diameter 9-11 mm) were used in this study. They were collected from irrigation canals which were not treated before with molluscicides. The snails were left to aclimatize in the laboratory conditions three weeks before being used in the toxicity tests.

Preparation of the plant material:

The plants under investigation (Table 1) were collected, identified, shade dried and finely powdered. The dry powder was used as an aqueous suspension at concentration (100-500 ppm). The number of the snails used in each experiment and control was 10. The number of replicates was 2. Exposure and recovery periods were 24 hours each unless otherwise stated. Standard procedures were followed according to (WHO, 1953 & 1965). Statistical analysis of the data was carried out according to LITCHFIELD and WILCOXON (1949).

RESULTS

Comparative susceptibility of B.alexandrina and L.cailliaudi to the action of the dry powder of A.kerchovei and A.heteracantha.

From Table (1) it is evident that only the two Agavaceae i.e. Agave kerchovei and Agave heteracantha are molluscicidal active and hence they were selected for detailed investigation. The other plants didn't show any activity towards B.alexandrina and L.cailliaudi at concentration up to 500 ppm.

From the results in Table (2), it is obvious that the LC_{90} of the dry powder of A. kerchovei was 110 ppm indicating higher activity than the dry powder of A.heteracantha LC_{90} = 190 ppm.

Effect of time on the molluscicidal activity of the dry powder of A.kerchovei and A.heteracantha:

The results in Table (3) indicate that:

a) Increasing the exposure period from 24 hrs. to 48 hrs. results in an increase in the mortality percentage.

b) The lowest concentrations necessary for 100% mortality with 24 hrs are 150 and 200 ppm of A.kerchovei and A.heteracantha against B.alexandrina where 100 and 175 ppm against L.cailliaudi.

Effect of different degrees of temperature:

Table (4) displayed the results of snails exposed to different concentrations of the dry powder of two plants at 10°C, 16°C and 30°C for 24 hours,followed by 24 hours recovery periods. It can be concluded that there was decrease in activity at 10°C opposed by an increase in activity at 30°C.

Effect of river - bed mud:

Under natural conditions flowing water has sufficient turbulence to cause rapid mixing of particles in cause rapid mixing of particles in water. In an attempt to simulate this condition in the laboratory, different dilutions of the dry powder of two plants were prepared in water containing 10,000 ppm. Batches of B.alexandrina and L.cailliaudi anails were placed in beakers which were continuously shaken on an electric shaker for 24 hrs. The snails were left for 24 hrs. recovery period in distilled water. From the results in Table (5), it is evident that: No significant changes in the mortality percentages of snails as compared with the control experiment without mud.

Effect of sun light:

The different dilutions (25-350 ppm) of the dry powder of two plants used were exposed to direct sun-light for 6 hrs. From the results in Table (6) it is evident that the activity of the different dilutions exposed to sun-light is not affected.

Effect of pH:

Different dilutions of the dry powder of both plants were prepared using standard reference water previously adjusted at pH 4, 7 and 10 indicate that: A slight decrease in the mortality percentage at pH 4 whereas a detectable increase at pH 9 was observed.

DISCUSSION

The present study reports on the molluscicidal activity of about 22 plants collected from different localities. The results in Table (1) indicate that the molluscicidal activity in general is limited to the type of chemical constituents of the plants and this is favoured by the reported activity of Phytolacca dodecandra (LEMMA, 1970), Cornus

florida (HOSTATTMANN, 1978). These different plants representing different families with different chemical constituents. The results on the present two Agavaceae dry powder are commented in the following points.

1- Synthetic molluscicides are not only expensive and imported with hard curency (DAFFALA and AMIN, 1976) but also exert environmental problems in the snails habitat (WHO, 1965 a) Therefore the pressing need for cheaper, more safe, local and easily available molluscicides atention is at present increasingly given to plant molluscicides.

2- Agavaceae plants which are commonly planted for ornamental purposes can easily grow in mud and sandy soils and can aclimatize in hot and cold regions, proving that the possibility of easier availability than the plant molluscicides of choice Phytolacca dodecandra.

3- The application of total dry powder in testing experiments proves an important economic value and possibly easy application with simple technique.

4- The stability of the molluscicidal activity of the dry powder of these plants, at their concentrations necessary for 100% mortality of B.alexandrina and L.cailliaudi to the effect of sun radiations, slightly higher concentration to the presence of high mud concentrations adds to the validity of the dry powder of the plants for possible field application.

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Table (1)

Screening of some local plants against B.alexandrina and L.cailliaudi

Plant	Family	Molluscicidal activity					
		Biomphilaria			Lymnaea		
		100	300	500	100	300	500
Onasis natrix	Leguminosae	-	-	-	-	-	-
Onasis vaginlis	"	-	-	-	-	-	-
Senecio deffotainei	Compositae	-	-	-	-	-	-
Achillea santolina	"	-	-	-	-	-	-
Centaurea glomirata	"	-	-	-	-	-	-
Anacyclus alexandrinus	"	-	-	-	-	-	-
Suaeda pruinosa	Chenopodiaceae	-	-	-	-	-	-
Hammada elegans	"	-	-	-	-	-	-
Halocnemum strobilceum	"	-	-	-	-	-	-
Hordeum murinum	Gramineae	-	-	-	-	-	-
Cynodon dactylon	"	-	-	-	-	-	-
Phragmites mauritianus	"	-	-	-	-	-	-
Agave kerchovei	Agavaceae	+	+	+	+	+	+
Agave heteracantha	"	+	+	+	+	+	+
Urtica urvens	Urticaceae	-	-	-	-	-	-
Ifloga spicata	Compositae	-	-	-	-	-	-
Limoniastrum monopetalum	Plumbaginaceae	-	-	-	-	-	-
Frankenia revoluta	Frankeniaceae	-	-	-	-	-	-
Asphodelus mictocarpus	Liliaceae	-	-	-	-	-	-
Marrubium alysson	Labiatae	-	-	-	-	-	-
Echium sericeum	Boraginaceae	-	-	-	-	-	-
Juncus acutus	Juncaceae	-	-	-	-	-	-

Table (2)
Susceptibility of adult B.alexandrina to the molluscicidal action of dry powder of Agave kerchovei and Agave heteracantha

Plant	Exposure time (hrs)	LC_{50} (ppm)	LC_{90} (ppm)	Slope
A. kerchovei	24	65 (52.00-81.25)	110	1.53
	48	62 (54.38-70.68)	90	1.29
A. heteracantha	24	125 (99.2-157.5)	190	1.37
	48	116 (101.7-132.2)	160	1.28

Table (3)
Time-concentration relationships of the molluscicidal activity of the dry powder of A.kerchovei and A.heteracantha

Concentration (ppm)	%mortality of adult B.alexandrina and L.cailliaudi after the following exposure p.(hrs).																			
	A. kerchovei										A.heteracatha									
	B.alexandrina					L. cailliaudi					B.alexandrina					L.cailliaudi				
	3	6	9	24	48	3	6	9	24	48	3	6	9	24	48	3	6	9	24	48
350	30	60	100	100	100	60	90	100	100	100	30	50	70	100	100	50	70	100	100	100
300	20	60	100	100	100	40	70	100	100	100	0	50	70	100	100	20	50	80	100	100
250	10	40	80	100	100	40	70	100	100	100	0	30	60	100	100	10	40	80	100	100
200	0	20	60	100	100	10	50	100	100	100	00	20	50	100	100	0	30	70	100	100
175	0	20	40	100	100	0	50	100	100	100	0	20	20	70	100	0	30	60	100	100
150	0	10	40	100	100	0	10	90	100	100	0	0	20	50	60	0	10	30	60	90
125	0	0	20	90	100	0	10	90	100	100	0	0	0	20	30	0	0	10	60	70
100	0	0	0	80	100	0	0	60	100	100	0	0	0	0	30	0	0	0	30	40
80	0	0	0	80	100	0	0	30	90	100	0	0	0	0	0	0	0	0	0	20
60	0	0	0	50	70	0	0	0	60	80	0	0	0	0	0	0	0	0	0	0
50	0	0	0	10	30	0	0	0	30	50	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	10	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0
Control	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

MOLLUSCICIDAL PROPERTIES OF SOME LOCAL PLANTS

Table (4)

Effect of different temperatures on the molluscicidal activity of the dry powder of A.kerchovei and A.heteracantha against B.alexandrina and L.cailliaudi

Concentration ppm	% mortality of adult B.alexandrina and L. cailliaudi exposed to the D.powder&Foll.Temp.											
	A. kerchovei						A. heteracantha					
	B.alexandrina			L.cailliaudi			B.alexandrina			L.cailliaudi		
	10°C	16°C	30°C	10°C	16°C	30°C	10°C	16°C	30°C	10°C	16°C	30°C
350	100	100	100	100	100	100	100	100	100	100	100	100
300	100	100	100	100	100	100	80	100	100	100	100	100
250	80	100	100	100	100	100	60	90	100	100	100	100
2200	80	70	100	100	100	100	40	50	100	100	100	100
175	60	70	100	100	100	100	40	50	100	70	90	100
150	40	50	100	80	100	100	0	20	80	50	70	100
125	20	20	100	50	70	100	0	0	60	10	30	80
100	0	20	100	20	40	100	0	0	30	0	10	60
80	0	0	70	0	40	100	0	0	10	0	0	30
60	0	0	30	0	10	80	0	0	10	0	0	20
50	0	0	10	0	0	50	0	0	0	0	0	0
25	0	0	0	0	0	20	0	0	0	0	0	0
Control	0	0	0	0	0	0	0	0	0	0	0	0

Table (5)

Effect of 10,000 ppm river-bed mud on the molluscicidal activity of the dry powder of A.kerchovei and A.heteracantha against B.alexandrina and L.cailliaudi

Concentration ppm	% mortality of snails			
	A. kerchovei		A. heteracantha	
	B. alexandrina	L.cailliaudi	B.alexandrina	L.cailliaudi
350	100	100	100	100
300	100	100	100	100
250	100	100	100	100
200	100	100	70	100
175	100	100	50	80
150	100	100	10	50
125	80	100	0	20
100	60	70	0	0
80	30	70	0	0
60	10	40	0	0
50	0	10	0	0
25	0	0	0	0
Control	0	0	0	0

Table (6)

Effect of sun radiation on the molluscicidal activity of the dry powder of A.kerchovei and A.heteracantha against B.alexandrina & L.cailliaudi

Concentration ppm	% mortality of snails			
	A. kerchovei		A. heteracantha	
	B.alexandrina	L. cailliaudi	B.alexandrina	L.cailliaudi
350	100	100	100	100
300	100	100	100	100
250	100	100	100	100
200	100	100	80	100
175	100	100	80	90
150	100	100	60	80
125	100	100	20	60
100	80	100	0	220
80	80	90	0	0
60	60	70	0	0
50	30	40	0	0
25	0	0	0	0
Control	0	0	0	0

Table (7)

Effect of pH on the molluscicidal potency of the dry powder of A.kerchovei and A.heteracantha against B.alexandrina

Concentration ppm	% mortality of snails					
	A. kerchovei			A. heteracantha		
	4	7	9	4	7	9
350	100	100	100	100	100	100
300	100	100	100	100	100	100
250	100	100	100	100	100	100
200	100	100	100	100	90	70
175	100	100	100	90	60	30
150	100	100	80	60	40	10
125	100	100	70	30	20	0
100	100	80	50	10	0	0
80	60	50	10	0	0	0
60	30	20	0	0	0	0
50	10	0	0	0	0	0
25	0	0	0	0	0	0
Control	0	0	0	0	0	0

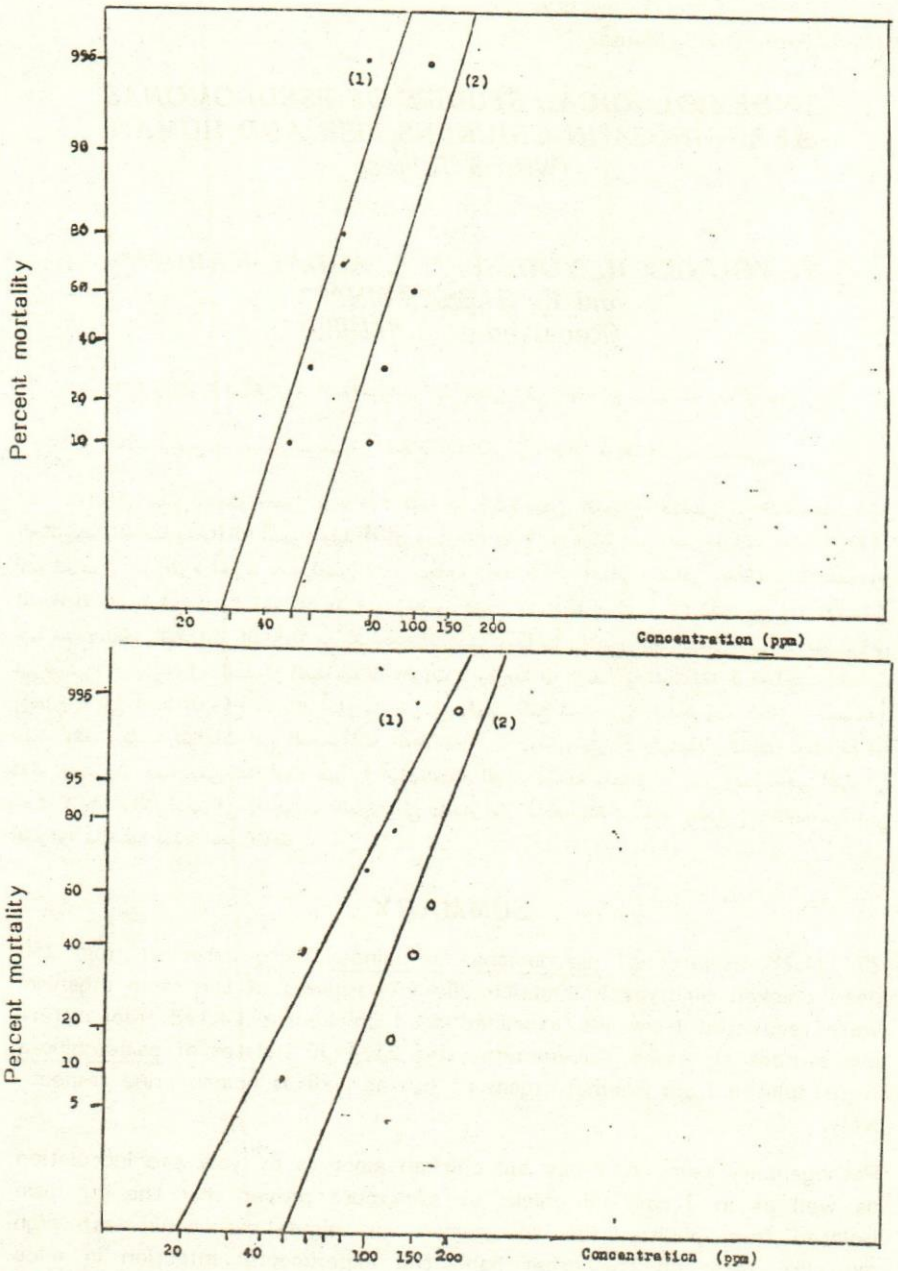

Fig. (1): Dosage mortality for adult B. alexandrina exposed to A.kerchovei (1) and A. heteracantha (2) after 24 hours.

Fig. (2): Dosage mortality for adult B.alexandrina exposed to A.kerchovei (1) and A.heteracantha (2) after 24 hrs.