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THE MOLLUSCICIDAL PROPERTIES OF *SYNADENIUM GRANTII*

(With 6 Tables & 3 Figs.)

By

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(Received at 3/10/1989)

دراسة خواص نبات سينادينيم جرانتى كمبيـــد للقواقـــع

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أجريت هذه الدراسة لإستبيان تأثير نبات السينادينيم جرانتى على قوقعى الليمنيـــا والبيومفلاريا · وقد شملت الدراسة تأثير المسحوق الجاف للنبات على القواقع وأيضاً مـــن خلال إستخدام أكثر من مليب كيمائى فضلا عن إجراء نفس التجربة في وجود عوامل بيئيـــة مختلفة مثل درجة الحرارة والطين مع تغيير قلوية وحامضية الوسط موضع التجربة · وقدا أوضحت النتائج أن نشاط الخلاصة النباتية يقاوم العوامل البيئية السالفة الذكر مع ملاحظة أن هـــذا النشاط إزداد تحت الوسط الحامضى وقل في الوسط القاعدى ·

SUMMARY

The dry powder from Synadenium grantii was screened for molluscicidal activity against B.elaxandria and L.natalensis. The comparative susceptibilities of B.alexandrina and L.natalensis to the toxic action of the different solvents were determined. Investigation under the effect of some simulated field conditions indicated that the activity of the plant is resistant to the effect of sun light, mud and different temperatures (16-30°C). Whereas the activity was increased under acidic pH, it was slightly depressed in alkline media.

INTRODUCTION

For economic and ecological consideration, the use of plant molluscicide is increasingly favoured. The appealing aspects with these are that they may by highly effective, rapidly biodegradable, in-expensive, readily available and probably easily applicable with simple techniques appropriate to endemic areas in developing countries. Moreover,

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plant molluscicides will probably be most useful in areas where transmission is predominately focal, and thus can play an important role in integrated programmes and self-help schemes at village level (McCullough, et al. 1980). During the past 52 years, more than 1000 plant species belonging to about 35 plant families have been screened, most of them superficially for molluscicidal activity (WHO, 1981). However, only few examples have reached the stage of field trials; Phytolacca dodecandra (PHYTOLACCACEAE, LEMMA, 1970), Entada phasecoloides (LEGUMINOCEAE, YASURAOKA, et al. 1977) Jatropha curcas (EUPHORBIACEAE, YASURAOKA, et al. 1980). None of these plants represent the ideal molluscicide and thus the world health organization (1983) recommended further investigation on plant molluscicides.

The present investigation reports on the molluscicidal properties of dry powder extract from Synadenium grantii which owes its importance to high molluscicidal activity if compared to that of Phytolacca dodecandra (LEMMA, 1970) and the plant may be of more economic value as it is more easily available.

MATERIAL and METHODS

Biomphilaria alexandrina (Ehrenberg 8-12 mm) and L.natalensis (Krause average shell length 6-9 mm) were used in this study. They were collected from irrigation canals that were not treated with molluscicides. The snails were left to aclimatize in the laboratory conditions for three weeks before being used. Lettuce leaves were added daily.

Preparation of extracts:

The plant was collected and shade dried. The finely powdered plant material was exhaustively extracted with pet. ether, benzene, chloroform, acetone and ethanol. The solvents were distilled off under vacum till complete dryness and the residues bioassayed for molluscicidal activity as aqueous solutions.

Screening tests:

Stocksolutions (100 ppm) were prepared on weight/volume in dechlorinated water. As well as different concentrations from the dry whole plant were carried out. Standard procedures were followed throughout the work (WHO, 1965). Exposure and recovery periods were 24 hours each. Mollotox was used as a reference molluscicide. Data were analysed according to LITCHFIELD and WELCOXON (1949). LC_{50} = Lethal concentration that kills 50% of the snails treated. LC_{90} = lethal concentration that kills 90% of the snails treated. Slope = To find the limits of LC_{50} and LC_{90} (Maximal and Minimal).

RESULTS

Comparative susceptibility of B.alexandrina and L.natalensis to the molluscicidal activity of the dry poweder of S.grantii was studied.

From the results in Tables 1 & 2 of the attached figure it is evident that the activity of the extracts tested increases by increasing the polarity of the solvents used and highest activity was recorded with ethanol.

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Time concentration relationship of the molluscicidal activity of the dry powder of S.grantii.

In this series of experiments batches of snails were exposed for 3, 6, 9, 24 and 48 hrs to different concentrations of the dry powder. The results in Table (3) shows that:

a) The significant mortality percentages recorded after 3 hrs indicate that B.alexandrina and L.natalensis snails are quickly susceptable to the action of the high concentrations of the exact.

b) Increasing the exposure period from 24 hrs. to 48 hrs resulted in an increase in the mortality percentage. Such observation may be explained by the slow action of the lower concentration that favours the activity of the dry powder of the plant and consequently its validity for field application.

Temperature-concentration relationship of the molluscicidal activity of the dry powder of S.grantii:

From the results in table (4), it is evident that:

1- A detectable decrease in the mortality percentage at 10°C compared with the activity at 16°C compared with the activity at 16°C was observed.

2- At 30°C detectable increase in the mortality percentage was observed.

From the above two observations, it is obvious that the summer months are very suitable for the field application.

Effect of sun radiation and mud on the molluscicidal activity of the dry powder of S. grantii:

The different dilutions of the dry powder were exposed to direct sun light for 6 hrs, then tests for 24 hrs exposure and 24 hrs recovery were carried out. The results in table (5) indicate that no detectable changes could be detected in the mortality percentages resulting from the radiated and the irradiated dilutions. This may be explained by the photochemical inactivity of the active constituents in the plant under the experimental conditions used.

Since water in the irrigation canals is usually mixed with mud under the influence of flowing water, this factor has to be looked for as an important environmental factor. Such a condition was initiated in the laboratory by preparing different dilutions of the dry powder of the plant using tap water containing 10,000 ppM mud. The snails were placed in beakers containing the dry powder dilutions together with 10,000 ppm mud and the beakers were continuously but gently shaken on an electric shaker for 24 hrs. The snails were removed to tap water for 24 hrs. Recovery periods and the mortality percentages were determined. From the results in table (5), the presence of mud affected a considerable decrease in the mortality percentages. At low concentrations the effect of mud is determined.

Effect of storage:

Different concentrations were stored at room temperature for 7 days. From the results in table (5) the activity of all concentrations were depressed by storage but was not diminished.

Effect of PH:

Different concentrations of dry powder were prepared using standard reference water previously adjusted at pH 4, 7, 9. The results in table (6) indicate that the lowest concentrations necessary for 100% mortality of snails are resistant to acidic pH but this activity was depressed at alkline pH.

DISCUSSION

The rising costs of chemotherapy and of synthetic molluscicides have led to an increasing intreset in plants and plant-derived compounds which are lethal to the intermediate host of schistosomiasis and fascioliasis (DAFFALA and AMIN, 1976). The use of plants with molluscicidal properties appears to be a simple and inexpensive technology for the control of the snail vector. None of the representations (Phytolacca dondecandra Croton macrostachys and Jatropha curcas) reached the field experimentation was up to the standard of the ideal plant molluscicide (WHO, 1983). Hence further investigations on molluscicidesof plant origin was among the principal recommendation of the WHO (1983).

The present work showed that S.grantii was more toxic to B.alexandrina and L.natalensis with LC_{90} at 22 ppm and LC_{90} at 26 ppm after 24 hrs of exposure respectively (Table 2 and Fig. 2). The activity of the dry powder of S.grantii against B.alexandrina LC_{90} at 22 was more toxic than the activity of the water extract of Phytolacca dodecandra LC_{90} = 18-26 pm (LEMMA, 1970). Besides this promising activity of the plant it is of economic importance since the whole plant parts are used as molluscicidal. Moreover, the slope of the dry powder of the plant was lower and hence its L-dp lines is less steeper than that of the reference molluscicide Mollotex which indicate less possibility for the development of resistance.

The molluscicidal activity of the dry powder of the plant showed stability to the effect of mud, sun radiation, temperature above 30°C and hydrogen ion concentration -4. This result indicated that there is a positive relationship between high temperature to 30°C and the toxic action of the plant and there is lowest depression in the activity of alkline pH.

In conclusion, the dry powder of S.grantii has acceptable molluscicidal activity which is stable under the effect of sun radiation, mud and storage. The plant appeared to be worthy for field application.

REFERENCES

Daffala, A.A. and Amim, M.A. (1976): Laboratory and field evaluation of the molluscicidal properties of hebatelmollok. E. Afr. J. Med. Res., 3: 185-195.

Lemma, A. (1970): Laboratory and field evaluation of the molluscicidal property of Phytolacca dodecandra Bull. Wld. Hlth. Org., 42: 597-617.

Litchfield and Welcoxon (1949): A simplified method of evaluating dose, effect experiment. J. Pharm. Exp. Therap., 96: 99-113.

McCullough, F.S.; Gayral, P.H.; Duncan, J. and Christie, J.D. (1980): Molluscicides in schistosomiasis control. Bull. Wld. Hlth. Org. Monograph Ser., 50: 124-138.

WHO (1965): Snail control onthe prevention of Bilharziasis Wld. Hlth. Org. Monograph Ser., 50: 124-138.

WHO (1981): Plant Molluscicides. A review WHO/VBC/81. 834.

WHO (1983): Report of Scientific working group on plant molluscicides. TDR/SCH-SWG (4), 83. 3.

Yasuraoka, K.; Irie, Y.; Takamura, H.; Hashiguch, J.; Santos, M.J. and Santos, A.T. (1977): Laboratory and field assessment of the molluscicidal activity of gogo (Entada phaseoloides) against the amphibious snail intermediate hosts of Schistosoma japonicum Jap. J. Exper. Med., 47: 483-487.

Yasuraoka, K.; Hashiguchi, J. and Blas, B.L. (1980): Laboratory assessment of the molluscicidal activity of the plant Jatropha curcus against Oncomelania snails. Proc., Philippine-Japan Jait Conf. Schist. Res. and Cont. Manila Japan. Inter. Cooperant. Agency, 110-112.

Table (1): Comparative susceptibility of adult B.alexandrina to the molluscicidal action of different extracts of Synadenium grantii

Extracts	LC_{50} ppm	LC_{90} ppm	Slope
Pet. ether	1.2 (0.98-1.46)	2.3	1.50
Benzene	1.5 (1.22-1.83)	3.1	1.65
Acetone	0.9 (0.70-1.15)	2.0	1.69
Chloroform	1.5 (1.62-2.70)	2.1	2.10
Alcohol	0.8 (0.65-1.02)	1.7	1.67
Mallotox	0.105 (0.088-0.126)	0.172	1.49

Table (2)

Comparative susceptibility of adult B.alexandrina to the molluscicidal action of dry powder of Synadenium grantii

Snail	LC_{50} ppm	LC_{90} ppm	Slope
B. alexandrina	15 (12.0-18.7)	22	1.26
L. natalensis	16 (13.3-19.2)	26	1.47

Table (3)

Time concentration relationship of the molluscicidal activity of the dry powder of Synadenium grantii against B.alexandrina and L.natalensis

Concentration ppm	B. alexandrina					L. natalensis				
	3	6	9	24	48	3	6	9	24	48
400	60	100	100	100	100	80	100	100	100	100
300	50	100	100	100	100	60	100	100	100	100
250	40	100	100	100	100	40	100	100	100	100
200	20	100	100	100	100	40	100	100	100	100
150	10	90	100	100	100	20	100	100	100	100
100	0	80	90	100	100	10	90	100	100	100
50	0	50	60	100	100	0	70	80	100	100
40	0	20	50	100	100	0	50	60	100	100
30	0	0	10	100	100	0	20	30	100	100
20	0	0	0	80	100	0	0	10	60	100
15	0	0	0	40	100	0	0	0	30	100
10	0	0	0	20	70	0	0	0	10	100
7	0	0	0	0	60	0	0	0	0	80
5	0	0	0	0	40	0	0	0	0	60
2	0	0	0	0	20	0	0	0	0	30
Control	0	0	0	0	0	0	0	0	0	0

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Table (4): Effect of different temperatures of the molluscicidal activity of the dry powder of Synadenium grantii against B.alexandrina and L.natalensis

Concentration ppm	B. alexandrina			L.natalensis		
	10C°	16°C	30°C	10°C	16°C	30°C
100	70	100	---	100	100	100
70	30	100	---	100	100	100
50	10	70	---	100	100	100
40	0	50	100	100	100	100
30	0	20	100	100	100	100
25	0	20	100	80	70	80
20	0	10	60	25	40	80
15	0	0	30	20	10	40
10	0	0	0	0	0	40
5	0	0	0	0	0	0
Control	0	0	0	0	0	0

Table (5): Effect of sun, mud and storage of the molluscicidal activity of the dry powder of Synadenium grantii against B.alexandrina and L.natalensis

Concentration ppm	B. alexandrina			L. natalensis		
	Sun	Mud (10,000 ppm)	Storage	Sun	Mud (10,000ppm)	Storage
50	100	100	100	100	100	100
40	100	100	70	100	100	90
30	100	70	40	100	90	60
25	100	40	0	100	60	20
20	100	20	0	100	40	0
15	60	0	0	50	0	0
10	40	0	0	50	0	0
7	0	0	0	0	0	0
Control	0	0	0	0	0	0

Table (6)

Effect of PH values of the molluscicidal activity of the dry powder of Syndaenium grantii against B.alexandrina

Concentration	B. alexandrina		
ppm	4	7	9
50	100	100	100
40	100	100	100
30	100	100	80
25	100	90	60
20	100	80	20
15	80	40	0
10	40	20	0
7	10	0	0
5	0	0	0
Control	0	0	0

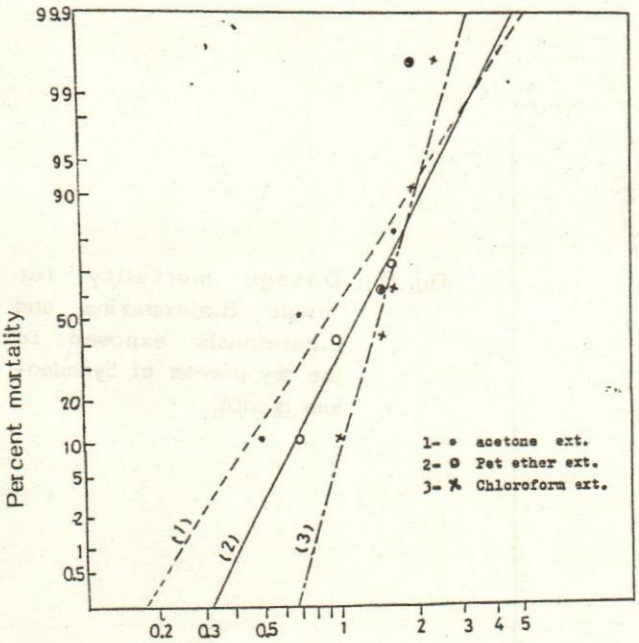

Fig. (1): Dosage mortality of adult B.alexandrina exposed to acetone, pet; ether and chloroform extracts of the Synadenium grantii.

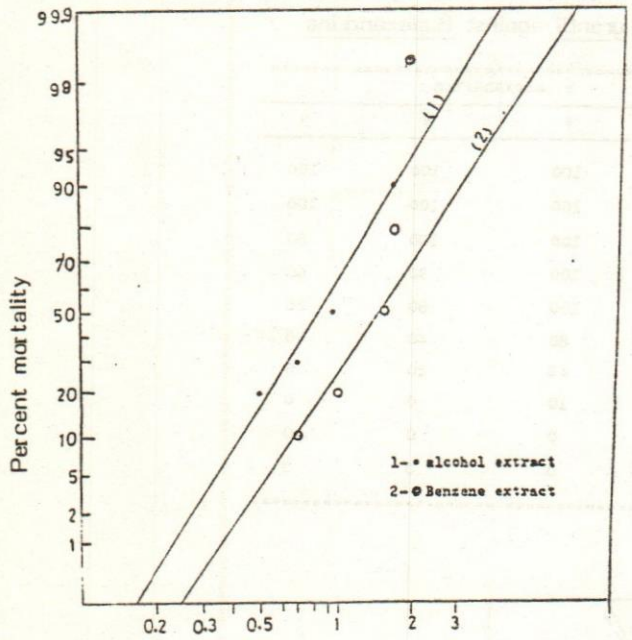

Fig. (2): Dosage mortality of B.alexandrina exposed to the Alcohol and benzene extracts of Synadenium grantii.

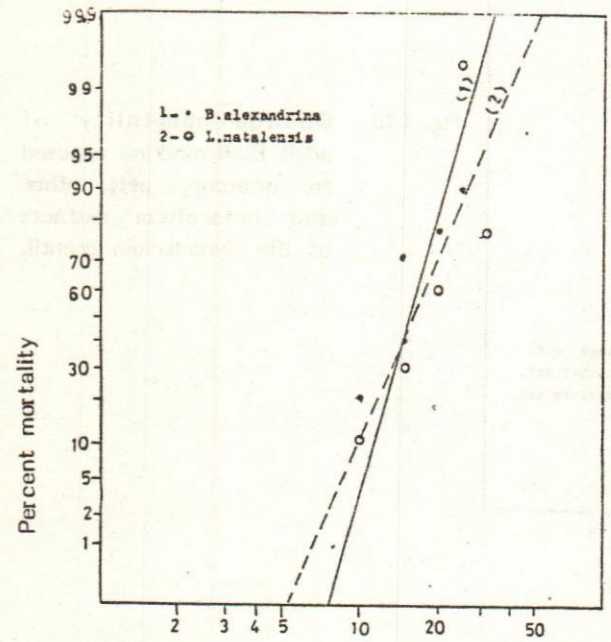

Fig. (3): Dosage mortality for adult B.alexandrina and L.natalensis exposed to the dry powder of Synadenium grantii.