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Some Promising Plant Species for the Use as Biological Control Agents against Land Snails Populations

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ABSTRACT

Studies were conducted at the private farm to evaluate the efficacy of botanical extracts in reducing snails' populations on different host plants. Because snail's populations have become important economic pest attacking various vegetation's in last decade in Egypt. According to this study, the molluscicidal activity of plant extracts against some snail species was investigated. The obtained data indicated that Euphorbia helioscopia and Mentha spicata were the most effective materials against snails. The effect of plant extracts on the population's dynamics of the pest species, the level of infestations and plant damage were assessed. Significantly more of the pests infested the control plants than the treated plots (P<0.01). The mean percentage of damage of cabbage heads (size or weight) on the treated plots was significantly heavier than that of the control unsprayed plots. The use of these plant extracts can be incorporated into an overall control programme of these pests. The same trend for data recorded among lettuce and clover was equal. Lettuce plants more susceptible to snails than cabbage or clover due to its soft leaves.

Keywords: Snails, Cabbage, Lettuce, Clover, Botanical extracts

INTRODUCTION

The *Phylum Mollusca* is probably the third most important animal group after the arthropods and vertebrates [1]. Snails belong to the class Gastropoda. Snails are *Mollousca*, a group of invertebrate animal with soft un-segmented bodies. Snails are destructive agricultural crops causing economic damage to a wild variety of plants including horticulture, field crops. Damage caused by snails depends not only on their activity and population density, but also on their feeding habits. Snails are effectively that have a strong, spherical shell attached to their back, which they use as a farm of protection and compact accommodation. Cabbage *Brassica oleracea* L. is an important leafy vegetable and seeking all the peoples of the world. Egyptian clover *Trifolium alexandrinum* of the most important animal feed crop in Egypt. In recent snails spread dramatically and became threatening crops, vegetables and fodder.

The main method, which can effect on the population density, the alternative methods include placing a tray of beer on the ground. Many researchers are used some different methods which used for different sites, such as baits and chemical treatments. Insecticides of plant origin may be the suitable materials for controlling snails in fodder crops, but their potential was initially limited, and ignored. Nicotine, rotenone and pyrethrum were used [2]. Another plants, as weeds belonging possess one or more useful properties such as repellence or antifeedant [3,4]. For instance, *Euphorbia helioscopia* (family-Euphorbiaaceae), *Dodonia viscosa* (family-Sapindaceae), *Mentha spicata* (family-Lamiaceae), *Colocasia esculenta* (family-Araceae) and *Urtica urens* L. (family-Uritaceae) are natives in Egypt is found to be weak insecticidal for controlling snails. The fruits and vegetables get poor marketing rating with reduced value [5,6].

The Egyptian clover, *T. alexandrium* and different vegetable crops such as lettuce, *Lactuca saiva*, cabbage, *B. oleracea* were the most preferred crop for snail, *M. containa.* Different methods are used for pest management to control the target pest. This is required not only to prevent crop loss but also to maintain quality products mainly for export vegetables. It is clearly known that successful control methods of terrestrial depends greatly on the local base of knowledge of biological and ecological aspects of mollusc particularly IPM [7,8]. In Egypt, there is currently no information on the biochemical structures of some weeds repel snails. Based on the foregoing, present study is undertaken to evaluate the pesticidal activity (repellent or antifeedant) of different crude extracts of leaves and stems of some weeds, *E. helioscopia, C. esculenta, M. spicata, D. viscosa* and *U. urens* L. against snail's numbers.

MATERIALS AND METHODS

Field trials were conducted in 2016 cropping season, on special farm at Menofyia Governorate. The soil types are sandy clay with organic matter content. Temperatures during the experimental period from mid-December 2015 to May 2016 varied from 15-33°C. The field used for this study had an area of 600 m^2. The layout consisted of five ridges per plot (three main ridges and two discard ridges one on either side of the main ridges) spaced at 1 m. apart. Each plot size was 150 m^2 and was separated by a 1.5 m. wide border margin on all sides.

The chosen area divided into four plots each about 150 m^2 for each host (cabbage, lettuce and clover). The host plants chosen are: lettuce, cabbage and Egyptian clover. The fourth area was left as control, which contain different weed species as source for snail individuals and adjacent the experimental area.

Grown lettuce and cabbage in the lines width 50 cm and the distance between each plant and others 50 cm for cabbage and 30 cm for lettuce, while in case of clover cultivars, the cultivation take place in basins (5 × 5 m) and large density. The center of experimental area was the control area. The pieces that have been planted various host plants (cabbage, lettuce and clover) have been cleaned from any species of weeds. Inspect of five plants to demonstrated its efficiency as a repellent or antifeedant effects, these plants are two grass plants, vegetable, aromatic (medicinal plants) mint plant and fence plant (*D. viscosa*). The crude extract samples used for the fifth tested plants by placing 300 g. fresh plants and then add 5 cm^3 of distilled water and then put blender for 5 min, then nominate to take the liquid and get rid of the molecule steel. The knapsack with capacity of 20 liters is used.

The snails numbers began to appearance in early December or second mid of the same month and began clamping plants at low temperatures during night time (5 pm to 5 am). The crude extracts concentrations used for each one are: 2.0, 4.0 and 8.0 cm^3/L of water. All tested materials were applied for three applications (once every two weeks). The host plant samples (5 plants) were randomly inspected visually per plot for counting the snails individuals one day before and after spray time early morning (5 am). The average number of snails for each plant (5 replicates) were counted and recorded. Concerning the alfalfa experimental area for inspection plants and counted snails, 30 × 30 cm^2 were determined for counting the number of snails. All data were analyzed using Analysis of Variance (ANOVA) and treatment means were separated by Student Newman Keuls test at 5% [9].

RESULTS

Plant products known to possess molluscicidal activity against the snails that importance in vegetables are presented in Tables 1-4 along with details of their for generic names plant parts tested to possess biological activity and their information's. The food preference and consumption of certain vegetable plants and field crops leaves for some snail's species. *M. cartusina* and the *bapisana* were studied by El-Deeb et al. [10]. Results showed that cabbage and lettuce was the most prefer crop, followed by clover.

A number of land snails pests were found to be attack the plants; the species included some species such as *Monacha cartusina*, *Eobania vermiculata* Muller and *bapisana* Muller (*Helicidae*, Ord. *Sylomatophora*). In 2016 season, the mean numbers of snails recorded in Tables 1, 2, 3 and 4 showed that the there are differentiation between the preference of snail individuals and the tested host plants.

First treatment

Effect on canopy plants

In winter season 2016 (mid-December 2015) the mean numbers of snails in plots treated with *E. helioscopia*, *U. urens* L. and *M. spicata* were lower than the values in plot treated by *D. viscosa* and *C. esculenta* at a high rate of application (8.0 cm^3/lit.). Table 1 showed that the number of snails correlated significantly negative with the increasing of crude extract at concentration 8.0 cm^2/lit. *E. helioscopia*, *M. spicata* and *U. urens* L. at concentration of 8.0 cm^3/L gave a good effects on snails individual numbers (6.2, 5.1 and 5.2 individuals, respectively). On the other hand the high number of snails recorded in plots treated with *Dodonia* and *Colocasia* extracts at 8.0 cm^3 concentrations. In all observations, the lower concentration (2.0 cm^3) has a high number of snails, which ranged between 7.3-12.1 individuals. The statistical analysis showed no significant correlation recorded between all cruds at low concentrations. The check plot recorded high number of snails individuals 25.6 individuals and highly significant differentiation compared with different concentrations for all tested crude extracts. However, cabbage is susceptible crop to snails pest infestation in the zone area at warm conditions, which causes great loss to the growers. Table 1 indicated that the mean percentage of snails reduction ranged between 19.95% (*D. viscosa*) and 44.1% (*M. spicata*). These pests infest the plants at different stages of their growth and causes serious damage to the head and leaves of the crops, as well as the wrapper leaves which reduce its marketability [11-13].

Table 1: Repellent or antifeedant effects of some different crude extracts against snails on cabbage

Crude extracts/conc. (cm^3/l)	Mean No. of snails individuals before & after treatment after 24 h from spraying (± SE)									
	Plant extracts									
	Euphorbia helioscopia		*Urtica urens*		*Dodonia viscosa*		*Mentha spicata*		*Colocasia esculenta*	
	*B	**A	B	A	B	A	B	A	B	A
2.0	25.1 ± 1.3	18.4 ± 1.5	22.2 ± 3.1	17.3 ± 1.8	19.7 ± 2.2	15.1 ± 2.3	20.1 ± 2.7	16.1 ± 1.8	22.3 ± 2.2	15.3 ± 1.8
4.0	15.3 ± 0.7	9.6 ± 1.6	19.1 ± 2.0	10.2 ± 2.4	15.3 ± 1.9	11.7 ± 2.0	17.2 ± 1.7	10.0 ± 1.4	21.2 ± 2.3	16.7 ± 2.2
8.0	12.4 ± 1.2	2.2 ± 0.4	17.3 ± 1.9	4.1 ± 0.4	11.2 ± 3.0	9.0 ± 2.1	15.9 ± 2.9	8.2 ± 2.2	19.7 ± 1.7	10.2 ± 1.6
Control	25.6 ± 1.6		25.6 ± 1.6		25.6 ± 1.6		25.6 ± 1.6		25.6 ± 1.6	
Mean% reduction	45.4		48.3		22.17		36.77		33.6	
F	4.3		3.8		4.1		2.7		3.0	

*B: Before spraying and **A: After spraying

Concerning for Table 2 which show the effect of different crud extracts used with different concentrations on the number of snails, indicated that the lettuce plants are the most important and more attractant host for snails individuals compared with other hosts (cabbage and clover). The counts before treatment in cabbage area ranged between: 12.4-25.1 (*E. helioscopia)*, 17.3-22.2 (*U. urens)*, 11.2-19.7 (*D. viscosa*), 15.9-20.1 (*M. spicata*) and 19.7-22.3 (*C. esculenta*) compared with lettuce area which as follow: 21.6- 22.3, 19.8-25.9, 21.2-23.4, 22.7-25.7 and 20.4-23.3 individuals for *E. helioscopia*, *U. urens*, *D. viscosa*, *M. spicata* and *C. esculenta* respectively. The recorded results indicated that there are negative correlations between concentrations and snails numbers. The low number of snails/plant recorded in plot treated with a rate of 8.0 cm^3. (7.3 and 8.1) individuals in plots treated with *E. helioscopia* and *U. urens*, while the biggest count recorded in plot treated with *C. esculenta* and *D. viscosa* 15.6 and 19.0, respectively. Table 2 revealed that the% of reduction in snails population ranged between 50.17% (*M. spicata*) and 11.61% (*D. viscosa*). On the other hand, the% of snails population near from the data in Table 1 and there is no significant correlation recorded between the two hosts (cabbage and lettuce).

Table 2: Repellent or antifeedant effects of some different crude extracts against snails on lettuce

Crude extracts/conc. (cm^3/l)	Mean No. of snails individuals before and after treatment after 24 h from spraying (± SE)									
	Plant extracts									
	Euphorbia helioscopia		*Urtica urens*		*Dodonia viscosa*		*Mentha spicata*		*Colocasia esculenta*	
	B*	A**	B	A	B	A	B	A	B	A
2.0	22.3 ± 1.1	17.2 ± 2.4	19.8 ± 1.1	15.0 ± 1.9	21.2 ± 2.3	19.3 ± 2.4	25.7 ± 1.9	19.2 ± 0.9	23.3 ± 2.3	19.1 ± 2.2
4.0	22.0 ± 2.3	13.8 ± 3.0	24.7 ± 2.0	15.1 ± 0.9	23.4 ± 3.0	20.7 ± 2.1	22.7 ± 1.7	15.0 ± 1.4	22.4 ± 2.0	18.0 ± 1.7
8.0	21.6 ± 2.0	7.3 ± 1.8	25.9 ± 1.7	8.1 ± 1.2	22.2 ± 2.6	19.0 ± 1.1	23.0 ± 2.0	8.8 ± 0.6	20.4 ± 2.1	15.6 ± 1.9
Control	25.6 ± 1.6		25.6 ± 1.6		25.6 ± 1.6		25.6 ± 1.6		25.6 ± 1.6	
Mean% reduction	42.11		43.9		11.6		50.17		25.96	
F	1.4		2.2		1.1		2.0		1.6	

*B: Before spraying and **A: After spraying

The snails were found on all the plots cultivated with lettuce. However, after spraying with the various crudes their numbers of snails were significantly reduced. Infestation was rather high reaching its high numbers on the control plants.

Table 3 clearly indicated that the snails population prefers to feed on clover leaves. Even though their numbers increased with the growth of the plants, they remained relatively higher on the control plants until harvest. Significantly more of them were recorded on the control plants than the treated plot. From the data recorded in Table 3 revealed that the zone area treated with mint crude has a lowest number of snails which ranged between 5.1-8.0 individuals and negative correlated with different concentrations. The crude extracts can arrange descending as follow: *D. viscosa* (9.8), *C. esculenta* (7.9), *E. helioscopia* (6.2), *U. urens* L. (5.2) and *M. spicata* (5.1) individuals, respectively at 8.0 cm^3/L concentration. The snails were found on all the clover plots. However, after spraying with the various extracts, their numbers were significantly reduced on the treated plots (P>0.01). Infestation was rather high, reaching its peak numbers within 3 months from the beginning of treatment in control plots. Even though their numbers decreased with the growth of the plants. Table 3 also revealed that the mean% reduction is higher 44.1 (*M. spicata*) and the lower% is 19.95 (*D. viscosa*).

Table 3: Repellent or antifeedant effects of some different crude extracts against snails on clover

Crude extracts/conc. (cm^3/l)	Mean No. of snails individuals before and after treatment after 24 h from spraying (± SE)									
	Plant extracts									
	Euphorbia helioscopia		*Urtica urens*		*Dodonia viscosa*		*Mentha spicata*		*Colocasia esculenta*	
	B*	A**	B	A	B	A	B	A	B	A
2.0	15.8 ± 1.7	12.1 ± 2.9	10.7 ± 1.6	8.1 ± 2.2	13.2 ± 0.9	10.0 ± 1.7	10.6 ± 0.8	7.3 ± 0.5	12.2 ± 1.1	10.0 ± 2.2
4.0	13.1 ± 2.2	10.3 ± 2.3	12.3 ± 1.0	9.3 ± 2.3	10.7 ± 1.0	8.7 ± 1.5	12.3 ± 1.2	8.0 ± 2.0	13.4 ± 0.9	9.0 ± 1.8
8.0	13.9 ± 1.6	6.2 ± 3.1	10.6 ± 1.1	5.2 ± 1.9	11.8 ± 1.0	9.8 ± 1.1	15.1 ± 1.9	5.1 ± 0.5	11.7 ± 1.3	7.9 ± 1.1
Control	19.7 ± 1.4		19.7 ± 1.4		19.7 ± 1.4		19.7 ± 1.4		19.7 ± 1.4	
Mean% reduction	33.39		33.20		19.95		44.1		27.8	
F	0.8		0.6		1.0		1.7		1.9	

*B: Before spraying and **A: After spraying

Second treatment

Effect on crop quality

In the second experiment an attempt was made to study the effect of snails pest on quantity and quality of the tested hosts under investigation. Table 4 spot light on the effect of snails pests on cabbage, lettuce and clover quality. For data recorded in Table 4 revealed that, the number of snails/5 plants ranged between 6.0-9.8, 6.4-11.4 and 4.3-7.2 for cabbage, lettuce and clover, respectively compared with control in the 4 Tables. Snails individuals easy to clumping the host plants for feed and then reduce the quality of its host due to its fesses. The highest reductions of host damage among plant extracts were observed on plots treated with *U. urens* L., *M. spicata* and *E. helioscopia* L. which were significantly (P<0.05), lower than in other plots. The number of damaged plants for all tested extracts indicated that the mean of damage plant were as follow: cabbage (3.0-6.0), lettuce (4.0-8.0) and clover (2.0-6.0) individuals.

Table 4: Efficacy of botanical extracts on snails damage to cabbage, lettuce and clover cultivations

Crude extracts 8.0 cm^3/l	Mean No. of snails/plant (± SE)						Mean No. of damage/10 plants (± SE)			% of damage plant		
	Cabbage		Lettuce		Clover		Cabbage	Lettuce	Clover	Cabbage	Lettuce	Clover
	B*	A**	B	A	B	A						
Euphorbia helioscopia	20.3 ± 3.1	6.0 ± 1.1	23.3 ± 2.2	7.0 ± 1.7	19.1 ± 3.0	5.4 ± 2.2	3.0 ± 0.2	5.0 ± 0.4	3.0 ± 0.3	30.0	50.0	30.0
Urtica urens	22.0 ± 2.9	6.4 ± 0.8	22.7 ± 2.0	7.6 ± 0.9	20.4 ± 1.8	5.0 ± 1.7	4.0 ± 0.4	5.0 ± 0.5	2.0 ± 0.4	40.0	50.0	20.0
Dodonia viscosa	20.91 ± 0.7	9.8 ± 0.7	25.3 ± 2.4	11.4 ± 2.2	19.8 ± 1.9	7.2 ± 1.6	5.0 ± 0.3	7.0 ± 0.2	5.0 ± 0.4	50.0	70.0	50.0
Mentha spicata	21.7 ± 2.2	6.4 ± 1.1	21.2 ± 2.5	6.4 ± 1.9	18.3 ± 2.2	4.3 ± 1.8	4.0 ± 0.1	4.0 ± 0.6	3.0 ± 0.1	40.0	40.0	30.0
Colocasia esculenta	22.8±1.6	7.8 ± 1.8	23.8 ± 1.7	10.4 ± 2.3	19.0 ± 2.4	6.1 ± 3.1	6.0 ± 0.2	8.0 ± 0.1	6.0 ± 0.2	60.0	80.0	60.0
F	1.0	0.7	0.5	0.9	0.4	0.5	0.3	0.9	0.6	0.8	0.2	0.4

*B: Before spraying and **A: After spraying

This pest appeared at different stages of growth of the plants and this was one week after transplanting there was found on all the plants. However, after spraying with the various botanical extracts their numbers were significantly reduced in the treated plants ($P<0.01$). The% of damaged host plants ranged between 20.0-80.0% plants. For other crudes, the high percentage of infestation (80.0%) in lettuce zone recorded in plots treated with *Colocasia* extracts. Table 4 also indicated that the heavily infestation by snails differs between host plants and crude extract concentrations used.

DISCUSSION AND CONCLUSION

The use of natural plant extracts and their analogues have been considered for the management of agricultural snails pest. This is due to the fact they are less determined to the environment than the synthetic pesticides. Different formulations of plant extracts caused various degrees of reduction of the target pest and also offered various levels of protection to the hosts against damage by snails. These findings confirmed earlier work done by some researches for different pests [14-16]. The appearance of the snails affected the growth of the plants. Data recorded in all the treated plots revealed that there are some different levels between the snails infestations. The consistent and significant decrease in the numbers of snails on the treated plots indicates the effectiveness of the botanical extracts. The reduction in snail populations was due to the chemical properties of the crude extracts, which caused mortality or when the snails prefer to escape towered the land. On the other hand the next points is very for protect vegetable plants from snails attacks: (1) The extracts on the surface of land may be effect on snails when try to escape forward land surface; (2) Lettuce is the first host plant for feeding snails because its leaves allow to snails individuals to prevent itself from sun and also can easy feed on soft tissue leaves. Further study is required to isolate antifeedant or repellent compounds from the tested host which may be similar to antifeedant compound in established plants such as neem trees.

Different crude extracts of different plants seem to be not attracted but repel or antifeedant effect on the land snails. The use of crude extracts caused various degrees of reductions of the target pest and also offered various levels of protection to the host. The use botanical extracts can be of importance to the resource-poor growers in many countries mainly developing countries. The significant reduction in pests numbers on the treated plants was an indication that they can be used as alternatives to chemical pesticides.

REFERENCES

[1] A. South, *Terrestrial Slugs Biology and Control*, **1992**.
[2] H. Schmutterer, Proceedings, First International Neem Conerence, Rottach-Egern, Germany, **1981**, 21-32.
[3] J.I. Olaifa, W.O. Erhun, A.E. Akingbohungbe, *Insect. Sci. Appl.*, **1987**, 8(2), 221-224.
[4] G. Stoll, *Agrecology*, **1988**, 188.
[5] D.M. Glen, M.J. Wilson, *Food. Ind. Hi-Techi.*, **1997**, 8, 23-27.
[6] D.M. Glen, M.J. Wilson, P.B. Brain, G. Strood, *Biol. Control*., **2000**, 17, 73-81.
[7] W.M. Gabr, A.S. Youssef, F.K. Khidr, *Egypt J. Agr. Res.*, **2006**, 4, 43-50.
[8] R.R. Ramzy, M.Sc. Thesis, Faculty of Science, Assiut University, Egypt, **2009**, 164.
[9] SAS Institute, Inc. SAS/STAT Users Guide, Version 6, 4th Edn., **1989**, 943.
[10] H.I. El-Deeb, M.E. Foda, H. Zedan, N.M. Edress, *J. Env. Sci.*, **2001**, 3, 90-104.
[11] D.E. Eigenbrode, A.M. Shelton, M.H. Dickson, *Env. Entomol.*, **1990**, 19(4), 1080-1090.
[12] I.A. Ismail, R.S. Abdel-Rahaman, M.A. Abdel-Raheem. *Int. J. Chem. Tech. Res.*, **2015**, 8 (9), 187-195.
[13] I.A. Ismail, R.S. Abdel-Rahman, M.A. Abdel-Raheem. *Int. J. Chem. Tech. Res.*, **2016**, 9 (4), 122-125.
[14] S.A. Salem, Ahmed S Reda A.M.E. Abd El -Salam, *Can. J. Prot.*, **2014**, l2(2), 60-63.
[15] S.A. Salem, Abd El-Salam, M.A. Abdel-Raheem, N.A. Farage, F.M. El-Hawary, *Der. Pharma. Chem.*, **2016**, 8(20), 74-77.
[16] A.M.E. Abd El-Salam, H.A. Salem, S.A. Salem, *Arch. Phytopathol. Plant. Prot.*, **2013**, 46(9-12), 1054-1060.