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Evaluation of some microbial compounds against land snail species under field conditions at Kafr El-Sheikh Governorate

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Abstract

This study was conducted at Abu-Abdalla village, Sedy Salem district, Kafr El-Sheikh Governorate during two successive seasons 2021/2022. To evaluate the bactericidal activity of protecto and the fungicidal activity of biofly on population density reduction of various land snail species infesting Egyptian clover (*Trifolium alexandrinum*) as a field crop and orange (*Citrus sinensis*) trees as orchard crop, using rates (500 ,250 and 125 gm /200 L.W./Fadden and (100, 75 and 50 cm/100L.W /Fadden), respectively using spray methods. Same tested compound (Protecto and Biofly) at the same rates and method of application were used against *Monacha cantiana* (Montagu) (Gastropoda: Hygromiidae) and *Theba pisana* (Müller) (Gastropoda: Helicidae) snails infesting orange (*Citrus sinensis)* trees at the same location. In addition, Protecto and Biofly were tested as poison bait in concentrations of 5, 10 and 15 % against *M. cantiana* and *T. pisana* infesting orange trees. The tested compound reduced *M. cantina* population at the different concentrations with variable degrees. The reduction of the population started with low values after the second day of treatment, but the reduction increased gradually to reach its maximum at the end of tested period (15 days).

Introduction

In Egypt, the destructiveness of land snails is far greater today than informer time (Kassab and Daoud, 1964; El-Okda, 1983 and Abdallah *et al.*, 1992). Land snails have been concentrated in the northern Governorate of Delta region and in Upper Egypt to several host plants. These animals become active all year and their activities increase in spring and autumn seasons (Godan,1983). These snails become an important agricultural pest, causing great damage to different crops and orchards production in different localities.

These snails were recorded with relatively high population density on major economic crops at Kafr El-Sheikh Governorate (Sharsher *et al*., 1996). Until now, these pests are controlled chemically by synthetic molluscicides or insecticides

(Crowell, 1967 and El-Okda,1981). These chemical compounds cause environmental contamination which gives rise to residues in food, fruits, and water.

Therefore, it was necessary to apply some methods as a biological control to the management of the snails population under field conditions by using microbial compounds (Abdel *Megeed et al., 1998*; Zedan *et al*.1999; Sleem, 2002; Idrees, 2003; Gaber *et al*., 2005; Khider *et al* ., 2006 and Mortada *et al*., 2009) .

Materials and methods

Effect of two microbial compounds on various land snail species infesting different crops:

1. Tested microbial compounds:

-Protecto

Bacillus thuringiensis var Kurstaki active ingredient 9.4% and inert ingredient 90.6%.

- Biofly

Beauveria bassiana 30 x 10^3 conidia / cm.

2. To evaluate the bactericidal activity of protecto and the fungicidal activity of biofly on population density reduction of various land snail species infesting Egyptian clover (*Trifolium alexandrinum*)as a field crop and orang (*Citrus sinensis*) trees as orchard crop , field experimental was carried out at Abu-Abdalla village ,Sedy Salem district, Kafr El-Sheikh Governorate during successive season 2021 /2022. For these studies two experiments areas (One feddan each) were chosen, the first area was cultivated with Egyptian clover (*Trifolium alexandrinum*) which high infested with *Monacha cantiana* (Montagu) (Gastropoda: Hygromiidae) and *Succinea putris* (L.) (Pulmonata: Succineidae) snails . These snails were found in clover plantations in high density compared with other snail species. The second area was cultivated with citrus trees, orange (*C. sinensis)* which were infested with *M. cantiana* and *Theba pisana* (Müller) (Gastropoda: Helicidae) snails. The tested biocides were applied at rats (125, 250 and 500 gm /200 L.W/Feddan) for Protecto and (50, 70 and 100 ml/100 L.W/Feddan) for Biofly , spraying method was used. . The experiments were conducted in a completely randomized block design consisting of two treatments including control and replicated five times (5x5m each). The remaining experimental area acted as a buffer between plots. The tested compounds were sprayed after three days of irrigation on the damp soil in the evening. In the case of orange trees, five trees infested with *M.cantiana* and *T. pisana* snails for each treatment and snails population on trees trunks (One meter) and on soil surrounded trees (One meter diameter) were counted . Protecto and Biofly were used as poison baits, the rate of 2 ,3, 5 and 10 gm % for Protecto and 2 ,3, 5, and 10 cm% for Biofly. Toxic bran baits used against snails infested orange trees, placed plastic sheets around trees (El- Okda , 1983). The snails population (Snails / 0.5 m^2) was recorded before and after 1, 2, 3, 5, 7, 9, 12 and 15 days post treatment. Reduction percentages were calculated according to **Henderson and Tilton equation (1955):**

$R\% = (1 - t_2 \times r_1 / t_1 \times r_2) \times 100$

Whereas:

t = Population size at treated area

r = Population size at untreated area

$t_1 \times r_1$ = Pre-treatment

$t_2 \times r_2$ =post-treatment

Results and discussion

Effect of certain microbial coumpounds against some land snails infesting different crops under field conditions:

The efficacy of Protecto and Biofly was evaluated against *M. contiana* and *S.putris* infesting Egyptian clover (*T. alexandrinum*) at Abu- Abdalla village, using rates (500 ,250 and 125 gm /200 L.W./Fadden and (100, 75 and 50 cm/100L.W /Fadden), respectively using spray methods. The same tested compound at the same rates and method of application was used against *M. cantiana* and *T. pisana* snails infesting orange (*C. sinensis*) trees at the same location. In addation to, Protecto and Biofly were tested as poison baits in concentrations of 5, 10 and 15 % against *M.cantiana* and *T.pisana* infesting orange trees . The tested compound reduced *M. cantiana* population at the different concentrations with variable degrees. The reduction of the population started with low values after the second day of treatment, but the reduction increased gradually to reach its maximum at the end of the tested period (15 days).

Data in Table (1) showed t respectively ,t rates 500 , 250 and 125 gm /200L.W/Feddan reduced *M. cantiana* population on clover at the 2nd and 15th day post treatment with (32.1 and 93%) , (19.6 and 80.1 %) and (16.1 and 71,6 %), respectively The average rate of reduction for the three tested rates after 15 days post treatment were 61.0 , 45.0 and 40.5 % , while Biofly at rates of 100 , 75 and 50 cm /100 L.W/Feddan exhibited (19.1 and 83.1%), (17.2 and 69.5 %) and (13.2 and 61.3 %) reduction at 2nd and 15th days post treatment respectively, with average % reduction of 48.5, 38.8 and 26.0 %.

Table (1): Effect of various microbial compounds against *Monacha cantiana* snails clover using spray method under field conditions during spring season 2022.

Tested compounds	Tested rates	% Reduction after days								Mean
		1	2	3	5	7	9	12	15	
Protecto	Soo mg	0	32.1	49.6	60.1	79.3	84.5	89.6	93.5	61.0
	250	0	19.6	28.5	47.5	61.2	70.5	76.2	80.1	48.0
	125	0	0	16.1	38.2	63.0	66.1	69.3	71.5	40.5
Biofly	500 cm	0	19.1	33.6	57.5	60.0	64.1	70.2	83.1	48.5
	250	0	17.2	19.0	36.2	47.2	53.0	68.1	69.5	38.8
	125	0	0	13.0	21.5	29.0	33.6	49.5	61.3	26.0

Data in Table (2) showed that, Protecto at rates 500, 250 and 125 gm / 200L.W/ Feddan reduced *S. putris* population snails at 2nd and 15th days post treatment with (41.6 and 83.1%), (20.4 and 73.0 %) and (16.1 and 51.2 %) , respectively. The average reduction % for the tested rates after 15 days post treatment was 52, 3, 44.6 and 31.5 %, respectively. On the other hand, Biofly at rates 100, 75 and 50 cm /100L.W/Feddan exhibited (23.1 and 80.0%), (17.6 and 72.0 %) and (15.2 and 61.5%) reductions at 2nd and 15th post treatment, respectively with average % reduction of 53.9, 50.0 and 42.4% at the same tested period and concentration.

Table (2) : Effect of some microbial compounds against *Succenia putris* snails on clover using a spray method under field conditions during spring season 2022.

Tested compound	Tested rates	%Reduction after days								Mean
		1	2	3	5	7	9	12	15	
Protecto	500 mg	0	41,6	39.0	46.3	60.9	68.2	76.3	83.1	52.3
	250	0	20.4	31.0	43.5	55.1	64.2	69.2	73.0	44.6
	125	0	16.1	19.7	31.7	42.2	44.1	47.1	51.2	32.5
Biofly	100 cm	0	23.1	43.7	64.7	67.2	74.0	78.1	80.0	53.9
	75	0	17.6	41.0	58.5	67.7	72.0	71.0	72.0	50
	50	0	15.2	27.4	49.0	54.9	60.7	70.3	61.5	42.4

Data in Table (3) showed that , applied Protecto at rates 500 , 250 and 125 gm/200 L.W/Feddan to reduced population snails *M.chantiana* on orange trees at 2nd and 15th days post treatment with (21.6 and 74.1%) , (26.0 and 64.7%)and (0 and 60.6%), respectively .The average % reduction for the three tested concentrations after 15 days post treatment were 42.9 , 38.3 and 30.5 % , respectively while Biofly at rates 100 ,75 and 50 cm / 100 L.W/ Feddan of orange trees were (18.6 and 59.6%) , (23.4 and 46.3%) and (0 and 30.4%) reduction at 2nd and 15th post treatment ,respectively with average reduction% of 32.7 , 31.4 and 17.6% .

Table (3): Effect of two microbial compounds against *Monacha cantiana* snails on orange as spray method under field conditions during spring season 2022.

Tested compound	Tested rates	% reduction after days								Mean
		1	2	3	5	7	9	12	15	
Protcto	500 mg	0	21.6	34.3	39.3	46.1	59.3	68.2	74.1	42.9
	250	0	26.0	31.0	33,6	49.1	50.6	51.1	64.7	38.3
	125	0	0	20.3	35.1	38.2	40.4	49.2	60.5	30.5
Biofly	100 cm	0	18.6	24.3	22.7	36.0	49.2	51.3	59.6	32.7
	75	0	23.4	29.4	26.3	30.0	48.4	45.2	46.3	31.4
	50	0	0	18.7	20.0	20.1	23.2	28.1	30.4	17.6

Data in Table (4) showed that application of Protecto at the same rates reduced *T.pisana* snails population at 2nd and 15th days post treatment with (39.2 and 81.3%) , (27.1 and 69.4%) and 18.3 and 59.7 %)respectively with average %reduction 50.3 , 41.4 and 33.2% , while Biofly at the same rates on orange trees exhibited (24.1 and 70.3%) , (16.3 and 64.1%) and (0 and 51.5%) .The following results showed that effect of various bio-compounds as poison baits against *M.chantiana* and *T.pisana* snails infesting orange trees at the same location during Spring season of 2022.

Table (4): Effect of two microbial compounds against *Theba pisana* snails on orange trees as a spray method under field conditions during spring season 2022.

Tested compounds	Tested rates	%Reduction after days								Mean
		1	2	3	5	7	9	12	15	
Protecto	500 mg	0	39.2	43.5	50.1	50.0	62.1	76.1	81.3	50.3
	250	0	27.1	30.2	394	46.8	57.2	61.3	69.4	41.4
	125	0	18.3	29.1	31.1	30.2	46.1	51.3	59.7	33.2
Biofly	100 cm	0	24.1	39.3	48.0	59.0	68.0	70.1	70.3	47.4
	75	0	16.3	39.34.6	33,5	39.0	47.1	64.1	64.1	41.4
	50	0	0	11.0	29.1	40.3	42.0	51.5	51.5	28.0

Data in Table (5) showed that, the biocid Protecto at rates 15, 10 and 5 gm % reduced *M. chantiana* snails population at 2nd and 15th days post treatment with (21.6 and 81.3%), (14.0 and 69.7%) and (0 and 48.1%), respectively . The average % reduction for the three rates after 15 days post treatment was 41.4, 30.7 and 25.2%, respectively. Biofly exhibited (11.2 and 64.1%), (0 and 60%) and (0 and 28.1%) with average 29 .9 ,27.8 and 15.3%, respectively at the same tested period and concentration.

Table (5): Effect of two microbial compounds against *Monacha cantiana* snails on orange trees as a poison bait under field conditions during spring season 2022.

Tested compounds	Tested rates	%Reduction after days								Mean
		1	2	3	5	7	9	12	15	
Protecto	15 gm	0	21.6	29.3	33.2	41.6	58.1	66.1	81.3	41.4
	10	0	14.0	21.2	24.0	29.6	36.1	51.2	69.7	30.7
	5	0	0	16.1	30.0	30.6	33.1	40.6	48.1	25.2
Biofly	15	0	11.2	19.3	22.0	27.6	42.7	51.9	64.1	29.9
	10	O	0	16.3	24.3	33.4	39.6	48.7	60.0	27.8
	5	0	0	12.0	18.0	20.0	20.3	24.0	28.1	15.3

Data in Table (6) showed that, Protecto at rates 15, 10 and 5 gm % reduced *T. pisana* snails population at 2nd and 15th days post treatment with (31.6 and 70.2%) ,(19.6 and 61.3%) and (0 and 49.0%), respectively with average 41.6 , 37.2 and 27.0% , respectively at the same tested period and concentrations. Also, Biofly exhibited (10.1 and 60.0%) , (0 and 49,0%) and (0 and 40%) with average % reduction 25.3 , 22,5 and 20.5% respectively.

Table (6): Effect of two microbial compounds against *Theba pisana* snails on orange trees as a poison bait under field conditions during spring season 2022.

Tested compounds	Tested rates	% Reduction after days								Mean
		1	2	3	5	7	9	12	15	
Protecto	15 gm	0	31.6	39.2	36.8	48.1	49.0	58.0	70.2	41.6
	10	0	19.6	30.1	38.5	38.0	53.1	57.1	61.3	37.2
	5	0	0	16.3	28.4	41.6	37.5	42.6	49.0	27.0
Biofly	15	0	10.1	19.3	18.3	24.0	29/0	41.9	60.0	25.3
	10	0	0	14.6	21.6	26.0	28.0	40.5	49.0	22.5
	5	0	0	9.0	15.1	24.6	39.1	36.3	40.0	20.5

These results agree with those, Lokma and Al-Harby (1999) tested Protecto 9.4% containing *B. thuringiensis* as a biocid under laboratory and field conditions against the snails *Monacha cartusiana* (Muller) (Gastropoda:Helicoidea) and *Rumina decollate* (L.) (Gastropoda:. Subulinidae). The results revealed that Protecto as a soking spray was more effective than baits against the two snails under laboratory conditions. Soking spray method gave high mortality percentage, reaching 100% for *M. cartusiana* when used at concentration of 10 gm of protecto 9.4% / 100 ml water, while mortality percentage did not exceed 56% for *R. decollate*. At the same time, toxic baits application used at 10 gm of Protecto 9.4% /100gm bran gave 90% mortality against *M. cartusiana* and 52% against *R. decollate*. The field experimental trial indicated that mortality was caused by using Protecto 9.4%at 10 gm /100 ml water concentration as soking spray against *Monacha* sp. Was 80%. The obtained results encourage more studies for estimating the potential of biocides against land snails. Sleem (2002) studied that ,the effect of vertemic on the digestive gland of the land snails *E. vermiculata* , he found that a low sublethal dose of vertemic (0.o5 mg of Abamactine /snail / day) induced tubule cells vaculation of digestive gland and on increase in the yellowish spherules , while higher sublethal dose of vertemic (0.15 mgob Abamactin /snail/day) caused sever general damage in the digestive tubules , tubular epithelial degeneration and marked loss of the entire digestive gland structure , widening of tubular and complete necrosis.

Idrees (2003) tested both *B. thoringiensis var Barlliner and B. thoringiensis var Karstaki* in addition to *B. bassiana* 3x10^6 conidia /cm for biological control of the three land snails, *M. cantiana*, *T. pisana* and *S. putris*. results revealed that *B. bassiana* 3x10^6 (Biofly) was the highest toxic action against *M. cantiana* followed by *B. thoringiensis var Berliner* and B. thorengensis var kurstaki when using as a leaf dipping technique. Results of poison baits treatments of *B. thorengeinsis var Berline*r against various land snail species revealed that, *T. pisana* was the most sensitive to tested compounds (LC_{50} 2.69 ppm) followed by *M. cantiana* (LC_{50} 3.9 ppm), while *S. putris* snails were LC_{50} 5.8.

In conclusion, control responsibility and / or the farmer must be taken into account, two important factors, where and when mollusciciding operations were carried out during the course of the present study. It is interesting to notice that terrestrial snails were active only after irrigation, in moist weather, in damp evenings and early morning hours. It is thus under these circumstances that snails can come into contact with molluscicides. Also, the density of snails population are increases at field edges, especially beside field water canals, in tall herbs and under weeds which cover pontes, therefore, focal/ seasonal mollusciciding operations are likely to be the role rather than blanket (=area wide). Also, the present study indicated biological control plays an important role in reducing the population numbers of snail infestation minimize environmental pollution.

References

Abdallah, E.A.M.; Kassem, F.A. and Kadous, E.A. (1992): Laboratory and field evaluation of local bait formulation of certain pesticides against Mollusca species.J. Pest Control Environ. Sci., 46:179-192.

Abdel Megeed**, M.L.; Tharwat, M.E. and Mostafa, B.B. (1998):** Bioactivity of *Bacillus thuringiensis* against *Biomphalaria alexandrina* snails. 7th Con.Agri. Dew. Res., R. Agric. Ain Shams, Cairo. 15-17 Annals Agric. Sci. 3:973-989.

Crowell, H. H. (1967): Slugs and snails control with experimental poison baits. J. of Econ. Entomol., 60(4): 1048-1050.

El-Okda, M.M.K. (1981): Lcomotion activity and infestation abundance of certain terrestrial Mollusca in fruit orchards. Alexandria province, Egypt. Proce. 4th Arab Pesticide Conference, vol. 2. Tanta University, 11: 279- 288.

El-Okda, M.M.K. (1983): Terrestrial snails and slugs (Pulmonata) destructive Mollusca in ornamental plantages in Alexandria, Egypt. In: Proceedings of the 5th Arab Pesticide Conference, Vol. 2. Tanta University, pp. 369–378.

Gaber, W.M.; Fatma, K. and Youssef, A.S. (2005): Effect of Spinosad biocides as bait and contact applications against tree land snail species. J. Agri .Res., 84 (5) : 1403-1404.

Godan, D. (1983): Pest slugs and snails, biology and control. Federal Biological Res. Center of Agric. And Forest Konigin Luises Trabe 19b -400 berlin (113), p. (110)

Henderson, G.F. and Tilton, E.W. (1955): Test with acaricides against the brown wheat mite. J. Econ. Entom., 48:157-161.

Idrees, N.M.M. (2003): Application of some environmentally safe methods for population management land snails in the newly reclaimed land in Egypt M.Sc. Thesis, Fac. Agri., Ain Shams Univ**., pp.** 150**.**

Kassab, A. and Daoud, H. (1964): Notes on the biological and control of economic importance land snails U. A. R. Agric. Res. Rev., (42):17-98.

Khider, F.K.; Gaber, W.M.; Youssef, A.S. and Husssien, S.S. (2006): Biochemical effect of two natural pestiside on the brown garden snail *Euobania vermiculata* (Muller). Egypt. J. Agric. Res., 84 (3): 713-723.

Lokma, H.E. and Al-Harby, F. (1999): Effect of *Bacillus thoringiensis* on two land snails *Monacha cantiana* and *Rumnia decollate*. Zagazeg Res., 26 (2) :429- 436.

Mortada, M.M.; Soliman, A.M. and Shalaby , G.A. (2009): Land snails attacking sugar beet fields : Efficicy of certain biocid land moluscicides against *Monacha cantiana* snails at Dakahlia and KafrEl- Sheikh Governorates .J.Agri. Sci. Mansoura Uni., 34(3) :2325-1330.

Sharsher,F.A.; Okka, M.A. and Helal, R. M. (1996): non-targeted soil organisms and predacious mites associated with the land snail *Monach cantiana* (Muller) in Kafr El-Sheikh. J. Agri. Res. Tanta Uni.,22 (3) :407-416.

Sleem, H.S. (2002): Histological effect of vertemic on the agricultural pest snail, *Eubania vermiculata*. J. Egypt Acad. Soc. Environ. Develop., 3(2):111-125.

Zedan, H.A.; Saleh, A.A. and Abd El-Ali, S.M. (1999): Bactericidal activity of *Bacillus thuringiensis* against snails: toxicological and histological studies. The 2nd Int. Conf. of pest control, Mansoura, Egypt, 489-497.