

**ECOBIOLOGICAL STUDIES ON THE BROWN
GARDEN SNAIL, *EOBANIA VERMICULATA*
MULLER UNDER LABORATORY AND
FIELD CONDITIONS IN SHARKIA
GOVERNORATE**

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Received 13 / 9 / 2003

Accepted 17 / 11 / 2003

ABSTRACT: Population dynamics, breeding season and effect of food type on growth of *Eobania vermiculata* were studied under laboratory and field conditions. The snails were counted in navel orange orchards on soil surface and tree trunks during the period from January 2001 to December, 2002. Results revealed that the snails were found throughout allover the whole year with low numbers in January and gradually increased to reach its peak in May. The snail numbers were fluctuated on both soil surface and tree trunks during the year, since a relatively few numbers were noticed on tree trunks in autumn and winter months while the opposite was recorded on soil surface during the period of study. On the other hand, the highest numbers were recorded on tree trunks during spring season compared with soil surface. The breeding season of *E. vermiculata* snails started from mid- October until mid-January of the next year in the newly reclaimed sandy area, El-Salhia locality in Sharkia Governorate. The maximum mean numbers of clutches and eggs were 4.75 and 204.25 per 50 × 50 cm² of soil, respectively, recorded in mid-December, then decreased slowly toward the end of egg laying period. The effect of certain host plant leaves or potato slices on shell growth of *E. vermiculata* was studied during 12 months under laboratory conditions. The tested food materials can be arranged in order of suitability as follows, potato, lettuce, cabbage, navel orange, banana and mango.

Key words: Land snails, *Eobania vermiculata*, population dynamics, breeding season, clutch size.

INTRODUCTION

In Egypt, land molluscs are introduced as new pests in agricultural crops, it caused great damage to vegetable and field crops, orchards and other plants (Kassab and Daoud 1964, Asran 1994, Mohamed 1994, and El-Deeb *et al.*, 1996). In Sharkia Governorate, *Monacha cartusiana* Muller and *Eobania vermiculata* Muller snails were considered to be the most common species. They also were known as destructive pests, causing damage to economic crops (Ghamry *et al.* 1993, Arafa 1997, Ismail 1997, El-Masry 1997, Hegab *et al.* 1999 and Mahrous *et al.* 2002). The aim of this study is to through light on seasonal population behavior and breeding season of *Eobania vermiculata*. Moreover, the influence of certain host plant materials i.e. leaves of lettuce, cabbage, navel orange, banana and mango as well as potato slices on shell growth of *E. vermiculata* was illustrated also.

MATERIALS AND METHODS

1. Population dynamics of *Eobania vermiculata*:

This experiment was conducted in a heavy infested orchards of navel orange (*Citrus sinensis*) in Inshas locality, Belbies county, Sharkia Governorate. All alive snails on both soil surface, (50 cm around the tree trunk) and tree trunks (one meter above soil surface) were counted monthly beginning from January to December during two successive years, 2001 and 2002. Five trees were randomly chosen, marked and examined monthly. The alive snails were counted and left in their initial places (Baker, 1988). Temperature and relative humidity during the period of study were obtained from Abou-Kapeer Agriculture Climate Station, Sharkia Governorate. Correlations among temperature, relative humidity and population density of *E. vermiculata* during two years on soil surface and tree trunks were calculated.

2. Numbers of clutches and eggs laid by *E. vermiculata* under field conditions:

This study was carried out in a navel orange (*Citrus sinensis*) orchards (17 years old) infested with *E. vermiculata* snails in El-Salhia locality, Sharkia

Governorate. Four replicates ($50 \times 50 \text{ cm}^2$) were randomly chosen in the field, marked and examined biweekly from September 2001 to March 2002. Number of clutches and eggs were counted. Mean \pm S.E. was calculated for number of clutches and eggs as well as clutch size during the egg laying period.

3. Effect of food type on growth pattern of *E. vermiculata* under laboratory conditions:

The effect of certain host plant leaves i.e. cabbage, lettuce, banana, mango and navel orange as well as potato slices on growth pattern of *E. vermiculata* snails as indicated by shell diameter was investigated during the period from December 2000 to November 2001 under laboratory conditions. In the beginning of December 2000, five young juveniles (7 days – old) of a similar shell size were measured and placed in a pot ($\frac{3}{4}$ kg capacity) filled with clay soil to a depth of about 8 cm. Equal volume of water was added to each pot to keep soil moisture near field capacity. Juveniles were obtained from culture previously prepared and propagated under laboratory condition. Each treatment was

replicated 3 times. The pots were closed with muslin cloth and kept at room temperature. The soil was remoistened as needed and the food was replaced daily. Monthly, shell diameter of hatchlings was measured using vernier caliper until November 2001. Data were subjected to statistical analysis using F test and the least significant differences were calculated at 5 % level.

RESULTS AND DISCUSSION

1. Seasonal population behavior of *E. vermiculata* on navel orange trees:

Data in Table (1) and Figs. (1 & 2) revealed that individuals of *E. vermiculata* were found in navel orange orchards throughout the year months. The lowest numbers on tree trunks were determined during November to February of the next year with values of 1.6 and 4 snails during November 2001 and 2002, respectively. In the beginning of March, numbers increased until it reached its peak in May where it recorded 95 and 96.4 snails per $50 \times 50 \text{ cm}^2$ for 2001 and 2002, respectively. As

Table (1): Population dynamics of the brown garden snail, *Eobania vermiculata* infesting navel orange trees at Inshas locality, Belbies district, Sharkia Governorate during two years 2001 and 2002 in relation to temperature and relative humidity.

Date of examination	Mean number of snails / sample									
	2001			2002			Temperature		Relative humidity %	
	Soil	Trunk	Mean	Soil	Trunk	Mean	2001	2002	2001	2002
Jan.	26.8	2	14.4	37.8	9	23.4	19.3	14.0	36.6	63.5
Feb.	41.4	1.6	21.5	51.8	8	29.9	20.1	16.2	60.8	61.1
Mar.	57.8	13.8	35.8	68.6	19	43.8	24.1	17.9	60.1	59.1
Apr.	41.6	57.4	49.5	49.2	65.2	59.2	26.6	24.4	55	54.3
May	27.4	95	61.2	36.4	96.4	66.4	30.7	25.4	52.5	52.8
Jun.	17.8	52	34.9	22.2	65	43.6	28.9	28.8	55.6	55.7
Jul.	17.8	36.2	27.0	24.8	43.2	34.0	27.8	29.2	63.7	59.9
Aug.	7.8	33	20.4	12.2	37.8	25	35.9	28.1	65	60.3
Sept.	10	27.2	18.6	15.8	20.8	18.3	29.9	26.9	62.2	57.4
Oct.	20	6.6	13.3	28.6	11	19.8	25.4	24.5	59.6	60.2
Nov.	23	1.6	12.3	28.4	4	16.2	20.4	20.3	59.3	64
Dec.	25.2	2.6	13.9	31	4.2	17.6	14.8	16.6	58.5	64

Table (2): Correlation (r) among temperature (Temp.) and relative humidity (R.H.) and population density of *E. vermiculata* snails in navel orange orchards as influenced by season and site of samples (soil surface and tree trunks).

Variable	Seasons	Soil surface	Tree trunks
Temp.	2001	-0.419 ^{n.s}	0.664 [*]
	2002	-0.609 [*]	0.618 [*]
R.H.	2001	-0.165 ^{n.s}	-0.028 ^{n.s}
	2002	-0.069 ^{n.s}	-0.889 ^{**}

Each value represented correlation coefficient

n.s = Non significant

* = Significant at 0.05 level

** = Highly significant at 0.01 level

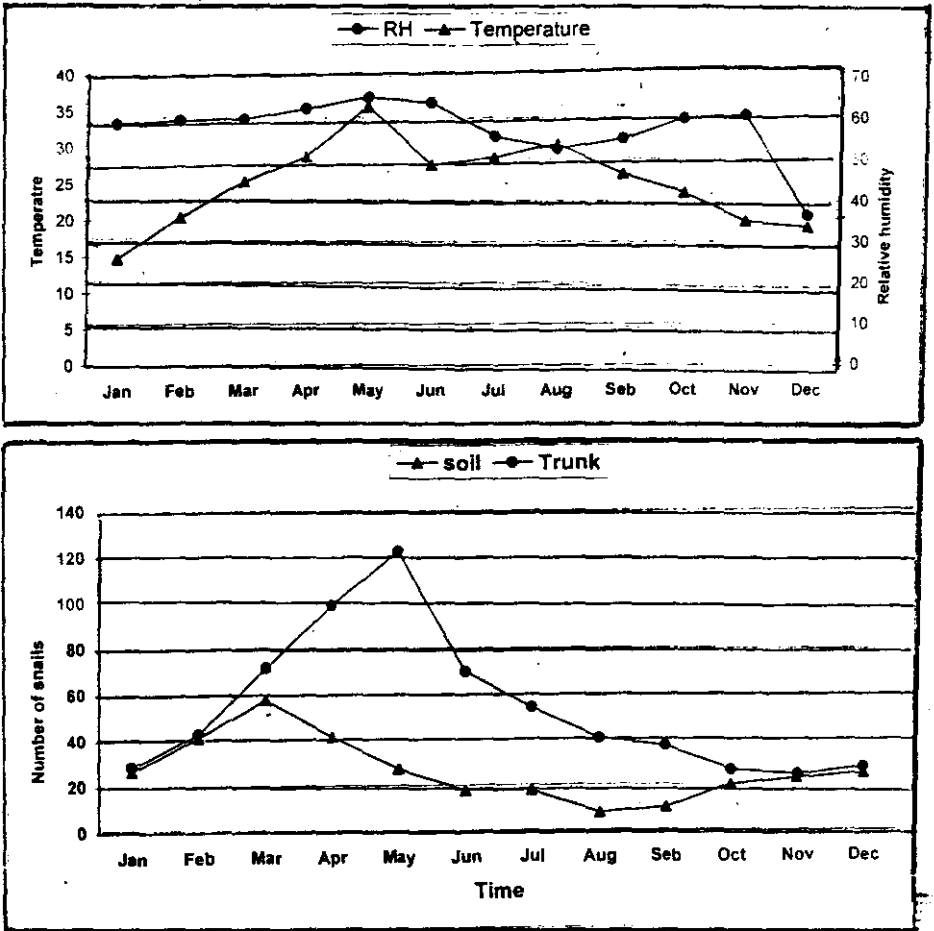


Fig. (1): Population dynamics of the brown garden snail, *E. vermiculata* infesting navel orange trees at Inshas county, Belbies district, Sharkia Governorate during 2001 in relation to temperature and relative humidity.

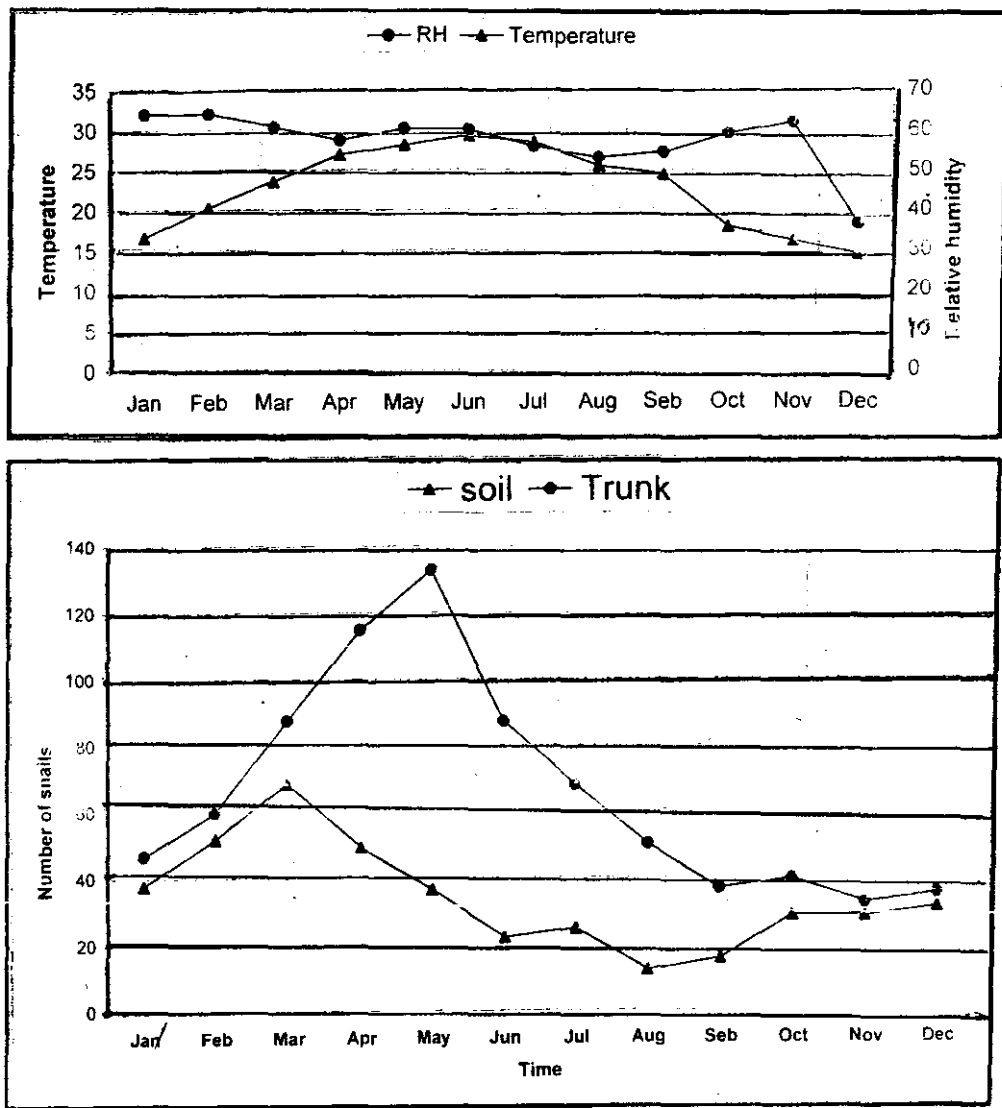


Fig. (2): Population dynamics of the brown garden snail, *E. vermiculata* infesting navel orange trees at Inshas county, Belbies district, Sharkia Governorate during 2002 in relation to temperature and relative humidity.

for soil surface, the lowest numbers were noticed in summer season where it reach 7.8 and 12.2 snails in August 2001 and 2002, respectively. On the other hand, the highest numbers of snails on soil surface were recorded during winter and spring months where it reach its maximum values during March month recording 57.8 and 68.6 in 2001 and 2002, respectively. Regarding mean of snail numbers during the two years of 2001 and 2002, it was noticed that the lowest numbers were found in November month with values of 12.3 and 16.2 during 2001 and 2002, respectively. On the other hand the highest numbers were noticed during May month with values of 61.2 and 66.4 during 2001 and 2002, respectively. Statistical analysis in Table (2) revealed that temperature and relative humidity significantly affected the population density of *E. vermiculata*. These results are in harmony with those reported by many authors (El-Okda, 1979; Nakhla *et al.*, 1993; Nakhla and Tadros, 1995; El-Masry, 1997; Abd-El-Ail, 2001 and Mahrous *et al.*, 2002).

2. Breeding season of *E. vermiculata* under field conditions:

Data presented in Table (3) revealed that *E. vermiculata* snails laid clutches during more than three months started from October, 2000 to Mid-January, 2001. Individuals laid eggs in a hole (3.5 cm depth \times 5 cm wide) by digging subsoil surface in humid soil. Number of clutches and clutch size (number of eggs per clutch) were changed during the breeding season. In the beginning of egg laying period number of clutches per 50 \times 50 cm² was 2 clutches, while mean clutch size was 28.1 eggs. As the time elapsed number of clutches and clutch size were gradually increased to reach its maximum value of 4.75 clutches and 43 eggs per clutch in the mid of December, 2000. After then, number of clutches and clutch size were gradually decreased recording 2 clutches and 24.8 eggs in the mid of January 2001. General mean of clutches laid by *E. vermiculata* during the breeding season was 3.0 ± 1.08 with range of 8 to 19 clutches per 0.25 m². The general mean of clutch size was 33.61 ± 6.64 eggs with range of 15 to 77 eggs per clutch. Statistical analysis revealed that there were significant differences between numbers of clutches, eggs and clutch size of *E.*

Table (3): Mean numbers of clutches and eggs laid by land snail *Eobania vermiculata* in 50×50 cm² during the period from October 2000 to January 2001 under field condition.

Variables	Sampling time							General mean ± S.E.	LSD ₀₅
	15 Oct.	30	15 Nov.	30	15 Dec.	30	15 Jan.		
Clutches	2.0	2.25	2.5	4.5	4.75	3.0	2.0	3.0 ± 1.08	0.60
Eggs	56.25	71.75	94.25	187.25	204.25	118.5	49.75	106.86 ± 58.14	30.667
Clutch size	28.1	31.8	37.7	41.6	43.0	39.5	24.87	33.61 ± 6.64	1.03

vermiculata at different intervals during the study period. Staikou and Lazaridou- Dimitriadou (1990) in Greece reported that the reproductive period of *Monacha cartusiana* started between August and November. Ali and Suleman (1992) in Pakistan indicated that based on the frequency of egg clutches of *M. cartusiana* in the field, spring season appeared to be the peak of breeding period followed by autumn. Kassab and Daoud (1964) showed that *Helicella vestalis* snails laid its eggs in clutches, each contained 25 to 30 eggs. Eggs deposited at any time during spring season. Ismail (1997) reported that the breeding season of *M. cartusiana* snails under the field conditions lasted from mid-November to mid February. The mean number of clutches per $50 \times 50 \text{ cm}^2$ in the field during the breeding season was 5.69 ± 0.93 with range of 4 to 8 clutches and the mean of clutch size was 22.55 ± 8.36 eggs with range of 5 to 57 eggs. Abd-El All (2001) reported that the snails of *Monacha cartusiana* and *Helicella vestalis* laid their eggs during the period from the beginning of December, 1998 to mid - February, 1999. General means of clutches laid by *M. cartusiana* and *H.*

vestalis were 5.66 and 3.76 clutches per $50 \times 50 \text{ cm}^2$, respectively with range of 3 to 9 clutches (*M. cartusiana*) and 2 to 6 clutches. (*H. vestalis*). On the other hand, general means of clutch size for *M. cartusiana* and *H. vestalis* were 26.12 and 24.36 eggs / clutch, respectively with range of 6 to 51 eggs per clutch (*M. cartusiana*) and 8 to 49 eggs per clutch (*H. vestalis*).

3. Effect of food type on growth of *E. vermiculata*:

Data in Table (4) showed that when the newly hatched juveniles of *E. vermiculata* were fed on different host plants during 12 months, shell diameter was significantly differed from one plant to another. The highest values were obtained with lettuce, cabbage and potato slices, since shell diameter in November, 2001 was 32.60, 32.33 and 32.00 cm, respectively, while lowest ones were obtained with the navel orange, banana and mango leaves, since shell diameter in November, 2001 was 20.33, 17.60 and 16.20 cm, respectively. Generally, the five plant leaves and potato tubers could be arranged

Table (4): Effect of food type on growth of *E. vermiculata* as indicated by shell diameter (mm) under laboratory conditions.

Date	Cabbage	Lettuce	Banana	Mango	Navel orange	Potato
Dec.	3.73	3.80	3.60	3.23	3.23	3.53
Jan.	5.20	5.40	3.80	3.56	3.63	4.36
Feb.	9.23	9.13	4.63	4.13	4.33	6.60
Mar.	12.90	12.66	4.96	4.53	5.10	9.10
Apr.	16.13	16.73	5.70	4.86	6.33	13.13
May.	19.16	20.20	6.40	5.46	6.86	15.53
Jun.	21.86	22.66	8.06	7.40	9.20	18.46
Jul.	25.46	25.93	9.60	9.06	10.60	21.86
Aug.	28.66	28.60	11.60	11.20	12.86	24.93
Sep.	32.33	32.60	12.60	12.33	14.46	28.46
Oct.	-	-	15.40	13.53	17.26	32.00
Nov.	-	-	17.60	16.20	20.33	-
Mean	14.61 ^b	14.81 ^{ab}	8.72 ^d	7.96 ^c	9.49 ^c	19.84 ^a

L.S.D._{0.05}

Host 0.2131
 Time 0.3014
 Host × Time 0.634

descendingly according to their effect on growth of *E. vermiculata* that measured by shell diameter as follows: potato slices, lettuce and cabbage leaves were more favorable, followed by navel orange leaves while the lowest effect was obtained with banana and mango leaves. Discussing the foregoing results it could be concluded that variations in growth pattern of snail shell diameter of *E. vermiculata* after feeding on different food types for 12 months, may be attributed to differences in nutrient composition of the tested

foods. Cobbinah and Osei-Nkrumah (1988) studied the growth rate of *Achatina achatina* as measured by snail weight and shell diameter. The four tested food stuffs were arranged in order of suitability as follows: green pawpaw, cocoyum leaves, flam flower leaves and ripe palm fruits. Staikou and Lazaridou-Dimitriadou (1989) showed that snails of *Helix lucorum* fed on lettuce showed higher assimilation efficiency than those fed on *Urtica dioica* and *Pestisites albus*. The highest daily consumption and

assimilation rate were observed in newly hatched snails and the lower in adult snails. Arafa (1997) studied the effect of food type on weight of *Monacha* sp. at monthly intervals. He found that the highest values of weight increment were recorded during spring months. On the other hand leaves of sweet pea gave the highest weight average/month followed by lettuce while cabbage leaves gave the lowest values. Ismail (1997) reported that leaves of lettuce and cabbage were more favorable for *Monacha cartusiana* snails followed by broad bean and Egyptian clover, while navel orange was the lowest one in this respect.

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the snail, *Monacha cartusiana* 362.
(Muller, 1884) (Gastropoda:

دراسات إيكولوجية وبيولوجية على فروع الحدائق البنى أوبواتيا فيرميكولاتا تحت الظروف المعملية والحقلية بمحافظة الشرقية

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تم دراسة ديناميكية التعداد وموسم التزاوج وتأثير نوع الغذاء على نمو الصدفة في فروع الحدائق البنى ذو الشفة المنعكسة *أوبواتيا فيرميكولاتا*. وبالنسبة لديناميكية التعداد فقد أجريت الدراسة في بستان يرتقال بسرة بمنطقة إتشاص وتم قياس التعداد شهرياً على سطح التربة وجذوع الأشجار لمدة عامين متتاليين. وأوضحت النتائج أن القواقع متواجدة طوال العام وتظهر بأعداد قليلة خلال شهر يناير ثم تبدأ في الزيادة تدريجياً حتى تصل إلى ذروتها خلال شهر مايو. كما يتذبذب التعداد على سطح التربة وجذوع الأشجار خلال العام الواحد حيث وجدت بأعداد قليلة على جذوع الأشجار خلال فصلى الخريف والشتاء بينما كان العكس صحيحاً على سطح التربة. وفي فصل الربيع كانت الأعداد مرتفعة على الجنوع بينما كانت منخفضة على سطح التربة. وبالنسبة لموسم التزاوج وقد وجد أن هذا القوقع يبدأ فترة وضع البيض من منتصف أكتوبر وحتى منتصف يناير من العام التالي. وكان أعلى تعداد من كتل البيض وعدد البيض خلال منتصف ديسمبر متوسط ٤,٧٥ كتلة و ٢٠٤,٢٥ بيضة في مساحة ٥٠ × ٥٠ سم^٢ ثم تبدأ بعد ذلك في الانخفاض حتى نهاية موسم وضع البيض. أما بالنسبة لتأثير نوع الغذاء على نمو القوقع فقد اختبرت ستة أنواع من الغذاء هي أوراق الخس والكرنب والبرتقال بسرة والموز والمانجو وكذلك شرائح درنات البطاطس. وتمت التغذية عليها ابتداء من خروجها من البيضة ولمدة عام كامل وقد وجد أن أعلى نمو لصدفة القوقع عند تغذيته على شرائح البطاطس يليها أوراق الخس ثم الكرنب، بينما كان أقلها عند التغذية على أوراق المانجو.