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Population Density, Food Consumption and Damage Caused by the Land Snail *Monacha cantiana* to Some Vegetable Crops at Kafr El-Sheikh Governorate

Wafaa A. Shahawy ; Nadia M. Mostafa and Hend S. El-Tahawe
Plant Protection Research Institute, Agricultural Research Centre, Giza, Egypt.

ABSTRACT

The land snail *Monacha cantiana* is one of the most serious pests especially at north and east of Delta. It causes considerable damage to the majority of crops at Kafr El-Sheikh Governorate. In this study, a trial was carried out at Kafr El-Sheikh Governorate on the predominant land snail *M. canntiana* to throw light on its population density, food consumption and damage caused by it under field and laboratory conditions. Trial was conducted on some vegetable crops i.e. parsley, lettuce, onion, garlic, pepper and Jews mallow showed that the highest number of snails was recorded in March for onion and pepper with 65.6 and 19.0 snails/½ m^2, respectively and in April for parsley, lettuce, garlic and Jews mallow with 68.6, 81.6, 74.6 and 7.0 snails/½ m^2, respectively during 2015 season. In general, *M. cantiana* recorded highest infestation levels during March and April as compared to May, but numbers of snails in 2016 season were clearly less than 2015 season. The mean consumption values of *M. cantiana* snails for fresh leaves of some vegetable plants under laboratory conditions were 0.546, 0.185, 0.320, 0.070 and 0.117 g/10 snails/5 days for lettuce, parsley, onion, garlic and pepper, respectively. It is clear that lettuce leaves were most favorite for snails, while garlic leaves were the least. Concerning determination the damage caused by *M. cantiana* to fresh lettuce leaves under field conditions, the obtained data showed that the reduction percentage in lettuce leaf area reached its maximum value (4.81%) in the middle of April, while the minimum value (1.17%) was in the end of the same month.

INTRODUCTION

Land Mollusca is a serious problem in nurseries, green houses, orchards and yield crops in many parts of the world. In Egypt, the land snails became one of the serious mollusc pests because of the damage they do to numerous agronomic, horticultural and ornamental plants in Delta region (Gaber *et al*., 2007). Snails attack plants at different growth stages and consequently reduces their yield (El-Okda, 1981). Damage involving considerable financial losses is inflicted on different agricultural crops. Snails feed on leaves, flowers, roots and tuber of nearly all vegetables, field crops, ornamental plants as well as fruits. Land snails cause heavy damage specially to seeds and seedlings of cereals and seed oil plants (Eshra, 1997). Economic damage caused by these molluscs is due to not only feeding but also to contamination with their bodies, feaces or slime leading to deterioration of the product quality (Heiba- *et al*., 2018). Among these snails, the terrestrial snail *M. cantiana* which became an important agricultural pest causing a great damage to crops in different localities in Egypt. Few data were dealing with survey and distribution of land snails species in Kafr El-Sheikh Governorate. *M. canntiana* were recorded with a relatively high population density on major economic crops at Kafr El-Sheikh Governorate (Sharshir *et al*., 1996 and Shalaby *et al*., 2007). *M. cantiana* snails were recorded with high density during spring months (March, April and May) as compared with winter or fall months (Shahawy, 1998). Control of snails on different crops is heavily dependent on the use of pesticides, which cause environmental contamination (Diaa *et al*., 2017). Any method for snail control depends greatly on knowledge of ecological and biological aspects of snail infestation, so the ecological and biological information are very necessary for protection of crops from damage due to land snails (Heiba- *et al*., 2018). It helps in choosing the suitable integrated land snails management methods which depends on specific composition of the pests, the state and density of their population (Zedan *et al*., 2006 and Mortada *et al*., 2012).

The present aimed to through light on the seasonal population density of the land snail *M. cantiana* on some vegetable crops, the food consumption and damage caused by these snails to some of these crops.

MATERIALS AND METHODS

1. Population density of the land snail *M. cantiana* on some vegetable plants:

An experiment was carried at Sakha region, Kafr El-Sheikh Governorate under field conditions during the two successive seasons 2015 and 2016 to study the population density of *M. cantiana* infested vegetable crops, such as: lettuce (*Lactuca sativa*), Parsley (*Petroselinum crispum*), onion (*Allium cepa*), garlic (*Allium sativum*), pepper (*Capsicum annuum*) and jews mallow (*Corchorus olitorius*). An area of half feddan cultivated with each of previous crops was chosen to conduct this experiment. Three replicates each of quadrate sample (50 x 50 cm^2) were randomly examined weekly during the growing season of each crop from March 15th to May 30th. Examination was done during the early morning (Asran *et al*., 2011). All snails found on either leaves and branches or soil surface in the quadrate were counted and left in their initial places (Baker, 1988).

2. Consumption average of certain fresh vegetable leaves for the land snail *M. cantiana* under laboratory conditions:

This experiment was planned to investigate the consumption average of leaves of five plant species i.e. (lettuce, parsley, onion, garlic and pepper) for the snail *M. cantiana* under laboratory conditions of Kafr El-Sheikh Governorate during spring of 2018. Adult snails of *M. cantiana* were collected from untreated infested fields at Sakha region and transferred into muslin bags to laboratory (Al-Akraa *et al*., 2010). Forty healthy individuals were selected for each treatment then divided into four replicates each of 10 snails. A known weight from leaves of each vegetable crop were offered to snails in plastic jars (one-liter capacity) for five successive days from March 19th to 23rd. The consumed amount of each food material by snails were recorded daily, and jars were replenished (Eshra, 1997 and Al -Akraa *et al*., 2010). Data was subjected to statistical analysis and the means were compared using Duncan's multiple range test (DMRT) (1955).

3. Damage caused by *M. cantiana* to lettuce plantations under field conditions:

A field trial was carried out to estimate damage caused by *M. cantiana* snails to lettuce leaves at Kafr El-Sheikh Governorate. Half feddan infested with *M. cantiana*

at Sakha region were chosen to conduct this experiment which took six weeks starting from 15 March to 30 April, 2018. Three replicates were chosen randomly each of ½ m^2 and three leaves of lettuce were picked up every two weeks at random from each one. Leaf samples were immediately transferred to the laboratory. Both of the whole leaf area in addition to the damaged areas were determined by leaf area meter apparatus. The percentage of leaf damage was calculated according to the equation adopted by El-Deeb *et al*. (1985).

$$\% \text{ damage} = \frac{\text{Area of damaged leaf surface}}{\text{Whole area of leaf}} \times 100$$

RESULTS AND DISCUSSION

1. Population density of *M. cantiana* snails on some vegetable plants:

The seasonal population density of the predominant land snail *M. cantiana* was studied on certain vegetable crops i.e. (lettuce, parsley, onion, garlic, pepper and Jews mallow) at Sakha region, Kafr El-Sheikh Governorate during two successive growing seasons 2015 and 2016. The experiment was carried out from 15 March to 30 May. *M. cantiana* was recorded on all plant parts and soil surface. Data obtained in Table (1) showed that the level of infestation varied from one crop to another.

Table 1. Population density of the land snail, *Monacha cantiana* on six vegetable plants during spring seasons of 2015 and 2016.

Sampling date		Number of snails/½ m^2											
		Parsley		Lettuce		Onion		Garlic		Pepper		Jews mallow	
		2015	2016	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016
Mar.	15	42.3	2.4	75.5	13.9	65.6	0.3	56.5	11.0	0.8	-	-	-
	22	23.6	1.6	62.0	13.6	43.3	0.3	40.6	14.3	3.0	-	-	-
	29	25.6	3.3	78.0	16.3	54.3	0.0	44.6	9.6	19.0	-	-	-
Apr.	5	68.6	2.6	81.6	13.0	38.3	0.0	74.6	30.6	3.3	-	-	-
	12	27.5	5.6	45.0	8.3	13.3	0.0	-	-	10.8	-	7.0	-
	19	13.6	6.0	41.3	1.0	11.3	0.0	-	-	11.3	0.0	4.6	0.0
	26	24.3	2.3	21.3	1.3	7.6	0.0	-	-	0.6	0.0	2.6	0.0
May	2	3.6	4.0	8.0	0.0	-	0.0	-	-	4.6	0.3	5.0	0.0
	9	21.6	3.0	8.3	0.3	-	0.3	-	-	2.3	0.0	3.6	0.0
	16	12.0	25.6	1.3	1.0	-	0.6	-	-	6.3	0.0	0.3	0.0
	23	4.6	2.3	1.3	-	-	-	-	-	3.3	0.0	2.6	0.0
	30	2.6	-	-	-	-	-	-	-	-	0.0	2.3	0.0

*** Each value represents the mean number of snails per sample**

Parsley:

In 2015, data in Table (1) revealed that the initial infestation of *M. cantiana* on parsley was (42.3 snails/½ m^2) in March 15th. The number of snails was noticeably decreased in March 22nd, but it increased again and recorded its peak (68.6 snails/½ m^2) in 5th of April. However, the lowest mean was (2.6 snails/½ m^2) in May 30th.

In 2016, the occurrence of this snail on parsley was observed in few numbers through 2016. It was observed that the population of the snail was clearly less than 2015 season. The peak of snail numbers was observed in May 16th with (25.6 snail/½ m^2).

Lettuce:

In 2015, population density of the snail *M. cantiana* on lettuce appeared to have a peak in April 5th with (81.6 snails/½ m^2). The lowest mean number (1.3 snail/½ m^2) was recorded through May 16th and 23th, since the population achieved the same value (1.3 snails/½ m^2).

In 2016, as parsley, lettuce attracted lower numbers of snails than 2015 season. The highest number was (16.3 snails/½ m^2) in march 29th, then the population of snails decreased and the infestation completely disappeared in May 2nd, but it appeared later with very few numbers.

Onion:

In 2015, population fluctuation of snail numbers displayed into two peaks during March, one in the middle of the month and the other in 29th day with (65.6 and 54.3 snails/½ m^2), respectively. The lowest value was (7.6 snails/½ m^2) by the end of onion season in April 26th.

In 2016, the results presented in Table (1) showed that onion plants attacked by very few numbers of snails through March 15th, 22th (0.30 snails/½ m^2) and also through May 9 and 16th (0.30 and 0.60 snails/½ m^2) respectively. *M. cantiana* individuals couldn't be observed throughout the period from March 29th to May 2nd.

Garlic:

In 2015, data in Table (1) presented the population density of *M. cantiana* on garlic. The occurrence of this snail was observed in (56.5 snails/½ m^2) through March 15th and the highest mean value was in April 5th with (74.6 snails/½ m^2). Garlic plantations were harvested by the middle of April.

In 2016, population density of *M. cantiana* took a trend closely similar to that monitored at 2015, since the peak also was observed in April 5th with (30.6 snails/½ m^2). By April, 12th, garlic plantation was harvested.

Pepper:

In 2015, data in Table (1) showed that infestation in pepper was observed in few number (0.80 snails/½ m^2) in the beginning of the trial. The highest snail population recorded during March 29th (19.0 snails/½ m^2).

In 2016, the new pepper plantation grew in April, but it didn't attract any snails till May, since the snails were rarely found with very few numbers of (0.3 snails/½ m^2) only in May 2nd.

Jews mallow:

In 2015, Jews mallow plantations had been appeared by April 2nd and the snail population achieved its maximum value at the same time with low level of (7.0 snails/½ m^2). Few numbers of snails were observed on Jews mallow during its growing season, but the lowest were in May 16th.

In 2016, Jews mallow plantation didn't attract any snails all over its growing season.

Generally, it could be concluded that *M. cantiana* recorded higher infestation levels during March and April as compared with May. These results are in agreement with the findings of El-Deeb *et al*. (1996) who reported

that *M.cartusiana* was most active during wet days of spring on Egyptian clover. Sharshir *et al*. (1996) assured that *M. cantiana* attacked navel orange and Egyptian clover at Kafr El-Sheikh Governorate in Spring where the prevailing temperature were around 25°C.

Also, Shahawy (2013) recorded the highest numbers of *M.cantiana* snails on Cucurbit vegetables in April, however, the lowest numbers were in June.

2. Consumption average of certain fresh vegetable leaves for the land snail *M. cantiana* under laboratory conditions:

Consumption average were detected with *M. cantiana* by using fresh leaves of some vegetables i.e. (lettuce, parsley, onion, garlic and pepper) under laboratory conditions of Kafr El-Sheikh Governorate.

Results obtained in Table (2) showed that the mean consumption value of fresh leaves of tested plants recorded (0.546, 0.185, 0.320, 0.070 and 0.117 g/10 snails/5 days) for lettuce, parsley, onion, garlic and pepper, respectively. In general, based on the mean consumption value/host as indicator for host preference it is clear that fresh leaves of lettuce were most preferred by *M. cantiana* followed by onion, whereas parsley and pepper were less preferable than the two previous vegetables, while garlic leaves were the lowest preferred by snails. Statistical analysis for these means showed significant differences between lettuce and all the tested plants. No significant differences were recorded between parsley, pepper and onion, while onion and garlic differed significantly in their attractiveness to the snails. On the other hand, the mean daily consumption value/g for *M. cantiana* snail after 1, 2, 3, 4 and 5 days were (0.312, 0.196, 0.245, 0.245 and 0.240), respectively.

Table 2. Consumption average of certain fresh vegetable leaves for the land snail *Monacha cantiana* under laboratory conditions (Kafr El-Sheikh, 2018).

Vegetable crop	Average daily consumption per 10 snails (g)					Mean ± S.E
	1st day	2nd day	3rd day	4th day	5th day	
Lettuce	0.630	0.350	0.600	0.550	0.600	0.546 ± 0.05 a
Parsley	0.050	0.150	0.250	0.225	0.250	0.185 ± 0.03 bc
Onion	0.800	0.300	0.200	0.225	0.075	0.320 ± 0.12 b
Garlic	0.000	0.000	0.025	0.075	0.250	0.070 ± 0.04 c
Pepper	0.080	0.180	0.150	0.150	0.025	0.117 ±0.20 bc
Daily consumption	0.312	0.196	0.245	0.245	0.240	

These results agree with Chang (1991) who reported that fresh leaf discs form lettuce were more preferred to land snail *Cepeae nemoralis*, either under laboratory or field conditions. Asran (1994) reported that the daily average of food consumption ranged from 0.005 to 0.026 g/day for the land snail *Helix aspersa*. Also, Abd El-Hak (1997) showed that fresh leaves of lettuce were more preferred for *Monacha sp*. and *Eabania sp.* followed by peas and cabbage while garden rocket leaves were the lowest. Mahrous *et al*. (2002) reported that cabbage and lettuce harbored the highest numbers of *M. cartusiana* snails, while, pepper, pea and tomato attracted lower numbers.

3. Damage caused by the land snail *M. cantiana* to lettuce plantations under field conditions:

This trial was carried out at half feddan infested with *M. cantiana* at Kafr El-Sheikh Governorate during spring of 2018 to determine the percentage of damaged area in lettuce leaves by snails. Data in Table (3) showed that *M. cantiana* snails caused initial damage to lettuce leaves in 15 March with 2.38% reduction, since the whole area of the leaf was 200.52 ± 22.0 cm^2 and the damaged area was 4.78 ± 0.91 cm^2. The damage percentage achieved a slight increase after two weeks and reached to 2.95%. The damaged area was 6.62 ± 3.03 cm^2 in the middle of April and the reduction percentage reached its maximum value with 4.81%. In the end of April % reduction in lettuce leaf area clearly decreased to 1.17% due to decrease the population of snail in the field, since the whole leaf area was 127.50 ± 11.88 cm^2 and the damaged area was 1.49 ± 0.57 cm^2. Kassab and Daoud (1964) reported that the injuries affected by land snail species varied greatly from place to place depending on the abundance of the animals, the nature and extent of their food supply and weather conditions.

Table 3. Damage caused by *Monacha cantiana* land snails for lettuce plantations under field conditions (Kafr El-Sheikh, 2018).

Sampling date	Total leaf area (cm^2)	Damaged area (cm^2)	Reduction (%)
March 15	200.52 ± 22.0	4.78 ± 0.91	2.38
April 1	74.55 ± 14.9	2.20 ± 0.62	2.95
April 15	137.50 ± 11.21	6.62 ± 3.03	4.81
April 30	127.50 ± 11.88	1.49 ± 0.57	1.17

These results agree also with Hermann (1971) who mentioned that the slug *Deroceras reticulatus* consumed in one night a leaf of 2 cm^2 (young rape plant), which is equivalent to 60 mg. He also found that the land snail *Helix pomatia* consumed in one night 50-70 cm^2 of *Datura starmonium* leaves and up to 5.2 g of lettuce.

Godan (1983) mentioned that damage caused by terrestrial gastropods was dependent not only their activity and population density but also on their feeding habit which differ from species to species.

Zedan (2005) reported that land snails caused high injury in lettuce leaves. Also, he mentioned that *M. cartusiana* snails was responsible for a damage in lettuce leaves of 17.25% at Mansoura district, Dakahlia Governorate.

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الكثافة العددية والاستهلاك الغذائي والخسائر التي يسببها القوقع الأرضي موناكا كانتيانا لبعض محاصيل الخضر في محافظة كفر الشيخ

وفاء عبدالحميد شهاوي ، نادية محمد مصطفى و هند سعد الطحاوي

معهد بحوث وقاية النباتات-مركز البحوث الزراعية الدقي- جيزة- مصر

يعتبر القوقع الأرضى موناكا كانتيانا واحداً من أكثر الآفات خطورة خاصة فى شمال وغرب الدلتا حيث أنه يسبب خسائر لأغلب المحاصيل فى محافظة كفر الشيخ. لذا ففى هذه الدراسة تم إجراء بعض التجارب على هذا القوقع وذلك لإلقاء الضوء عليه من حيث كثافته العددية ومعدل الفقد والخسائر التى يسببها لبعض محاصيل الخضر مثل البقدونس والخس والبصل والثوم والفلفل والملوخية. وقد أوضحت الدراسة أن أعلى معدل من تعداد القواقع قد تم تسجيله فى شهر مارس على محصولى البصل والفلفل بمعدل (56.6 و 19.0 قوقع/نصف متر مربع) بينما سجلت أعلى قيم التعداد فى شهر إبريل لكل من البقدونس والخس والثوم والملوخية بمعدل (68.6 ، 81.6 ، 74.6 و 7.0 قوقع/نصف متر مربع) وذلك خلال موسم 2015 ومن الملاحظ عامة أن القوقع موناكا كانتيانا قد سجل أعلى قيم للإصابة خلال شهر مارس وأبريل مقارنة بشهر مايو ولكن أعداد القوقع كانت أقل بوضوح فى موسم 2016 مقارنة بمثيلاتها فى الموسم السابق. وكان متوسط معدل الاستهلاك للقوقع موناكا كانتيانا للأوراق الطازجة لبعض محاصيل الخضر تحت الظروف المعملية كالتالى (0.564 ، 0.185، 0.320 ، 1.070 و 0.117 جم/10 أفراد / 5 أيام) بالنسبة لكل من محاصيل الخس والبقدونس والبصل والثوم والفلفل على التوالى. حيث كان من الواضح أن الخس كان أكثر المحاصيل تفضيلا للقوقع وكان الفلفل هو الأقل وفيما يتعلق بتقدير الخسائر الناتجة عن قوقع موناكا كانتيانا لأوراق الخس الطازجة تحت الظروف الحقلية وجد أن معدل النقص فى مساحة الورقة كان أعلى ما يكون (4.81%) فى منتصف شهر أبريل بينما كان أقل ما يكون (1.17%) فى نهاية نفس الشهر.