

**First Record of the Sharp Awl Snail, *Opeas pyrgula* (Schmacker and Boettger, 1891)
and the Dwarf Awl Snail, *Opeas pumilum* (Pfeiffer, 1840) in Egypt
and their Response to Climatic Changes**

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ABSTRACT

The sharp awl snail, *Opeas pyrgula* (Schmacker and Boettger, 1891) and the dwarf awl snail, *Opeas pumilum* (Pfeiffer, 1840) (Family Subulinidae) were recorded for the first time in Egypt through this investigation. The first species was collected from plant nurseries at great-Cairo for the first time in September 1996, disappeared in 1997 and occurred again in greater numbers from August 2005. The second snail species was recorded in August 2006. Taxonomy, description, biology and behavior of both snail species and their susceptibility to infection with the snail parasitic nematode, *Phasmarhabditis tawfiki* Azzam were investigated through this work.

Key words: Sharp awl snail, *Opeas pyrgula*, dwarf awl snail, *Opeas pumilum*, behavior, life cycle, climatic changes.

INTRODUCTION

The sharp awl snail (*Opeas pyrgula* Schmacker & Boettger, 1891) is considered as one of the most widely distributed land snails in the world (Pilsbry, 1946; Neck, 1975 and Deisler and Abbott, 1984). It is very commonly found in potted plants (Lori, 1999) and widely distributed throughout North China (Suzuki, 2000). The dwarf awl snail, *Opeas pumilum* (Pfeiffer, 1840) is widely distributed in many tropical and sub tropical areas but it is originally from South America and has been collected from Florida (Dundee, 1971 and Baker, 2009). The two species were recorded in Louisiana (Minton and Perez, 2005) and s introduced species in Canada (Grimmt *et al.*, 2008) and earlier in America (Pilsbry, 1946) and in Japan (Auffenberg and Stange, 1988). The graceful awl snail, *Lamellaxis gracilis* (Hutton) closely resembles the sharp awl snail but is longer than it (Auffenberg and Stange, 1986). *Opeas javanicum* serves as intermediate host of rat lung nematode, *Angiostrongylus cantonensis* Chen which also infected human (Ash, 1976 and Grewal *et al.*, 2003), while *Opeas gracile* Cooke, is a pest of vegetables in Malaysia (Jambari *et al.*, 1999). In Egypt, *Rumina decollata* (Linnaeus, 1758) was the only species recorded from Family Subulinidae (Azzam, 1995).

This investigation was carried out to shed some light on the biology and behavior of these snails and their susceptibility to infection with the snail parasitic nematode *Phasmarhabditis tawfiki* Azzam, as a safe biocontrol agent for these snails.

MATERIALS AND METHODS

Samples of land snails were collected by hand from infested nurseries of the ornamental plants *i.e.* *Chrysanthemum frutescens*, *Chrysanthemum* sp., *Pelargonium zonal*, *Pothos aurus*, *Sterlizia reginae*, *Tegates erecta*, *Tradescantia fluminensis*, *Winka rosa*, *Zinia elegans*, *Calendula officinalis*, *Asparagus sprengi*, *Lolium prene*, *Monestra deliciosa*, *Euophorbia pelpus*, *Petunia hybrida* and *Rosa* sp. at great Cairo during 2005-2008. Collected snails were identified according to Auffenberg and Stange, (1988 & 2009); Cowie (2002) and Baker (2009). The snails of each species were kept in plastic pots (20 cm diameter), sterilized by 10% Hcl or 90% Ethanol, and then well washed by distilled water. The pots were substrated with sterilized clay to 10 cm height. The soil was first sterilized at 110-120°C for three hours and irrigated without submersion with dechlorinated water. Some lettuce leaves were introduced as a food source. The plastic pots were then covered with perlon gauze and tied with rubber band. After egg laying, the eggs were transferred gently with some soil into small sterilized Petri-dishes (9 cm) substrated with sterilized clay and examined twice daily for egg hatching. When the first generation became mature, twenty snails were kept individually in small plastic pots (10 cm diameter) substrated with sterilized clay and examined daily for egg laying and incubation period records. Snails were measured for description.

To study the susceptibility of the two snail species to infection with the snail parasitic nematode *Phasmarhabditis tawfiki* Azzam, another group of 30 individuals from each mature and juvenile of each species were kept in six Petri-dishes (9 cm), five snails per dish. Twenty individuals of the nematode

infective stage/snail were added to every dish (100 I.S./dish) in 1-2 ml dechlorinated water using the same technique previously described by Azzam *et al.* (2009). The dishes were examined daily and the dead snails were treated as described by Azzam and Tawfik (2003). The snail parasitic nematodes, *P. tawfiki* were provided from the progeny of the original colony isolated from *Eobania vermiculata* (Müller) and *Limax flavus* Linneous, (Azzam 2003).

RESULTS AND DISCUSSION

This investigation the sharp awl snail, *O. pyrgula* and the dwarf awl snail, *O. pumilum* were recorded for the first time in Egypt. Virtually nothing is known about the behavior and life histories of both *O. pyrgula* and *O. umilum* (Auffenberg and Stange, 1988 & 2009).

Taxonomic information

Phylum: Mollusca

Class: Gastropoda

Order: Stylommatophora

Family: Subulinidae

Genus: *Opeas*

Species₁: *pyrgula* (Schmacker and Boettger, 1891)

Synonyms: *Opeas fragilis* Ping, 1929, *Lamellaxis pyrgula* Schmacker and Boettger, 1891.

Species₂: *pumilum* (Pfeiffer, 1840).

Synonyms: *Opeas hannense* (Rang, 1831), *Opeas goodalli* (Müller, 1822), *Helix goodalli* Férussac, 1821, *Opeas bulimus* and *Bulimus pumilum* (Pfeiffer, 1840).

Description

The snail shell is slender, turreted, 8.3 ± 0.68 (7-9.2) and 6.5 ± 0.47 (5.5 -7.1) mm in height and 1.97 ± 0.07 (1.85- 2.05) and 1.98 ± 0.11 (1.7-2.1) mm in width for *O. pyrgula* and *O. pumilum*, respectively (Table1) with 7-8 and 6 -7 whorls respectively, dextral with an obtuse apex, translucent with straight lip, columella straight slightly concave to the left over a small umbilical perforation not truncated. The aperture is elongated ovate with thin outer lip (Figs. 1a & 1b). Animal body yellow in color (Figs. 2a, 2b, 3a & 3b). Auffenberg and Stange (1988) described the two species from Japan. They have 7-8 and 6-7 whorls, respectively with an obtuse apex.

Habitat and behavior

In this investigation the sharp awl snail *O. pyrgula*, and the dwarf awl snail *O. pumilum* (Family Subulinidae) haven't been recorded in Egypt before. However, they been introduced with some imported plants or peat. The first species was collected for the first time in September 1996 and disappeared in 1997, probably because it was influenced by dryness and cold weather comparing to its tropical origin (Dundee, 1971). As a response to the global warming and climatic changes, the levels of temperatures and humidity in Egypt have been increased in the last few years. These conditions were suitable for this snail species, thus it began to appear again in August 2005. The second species began to appear in August 2006, adding a new pest for ornamental plants in Egypt.

Both *O. pyrgula* and *O. pumilum* are distributed in humid regions; hide under a cover of fallen objects or under the bottom of plant pots. Neck (1975) reported high-density of *L. gracilis* clusters in flower gardens bottom of Brownsville, Texas. The first species was more abundant than the second one. After irrigation, they were observed crawling on the surfaces of relatively open areas (Fig., 3a), feeding on plants, fallen leaves or debris. In the field or nursery, they were not observed crawling to the upper part of plants. In the laboratory, they were not seen crawling on the terrarium wall as other terrestrial snails do, but they were always found slipping on the ground or any surface (Fig., 3b). Although the sharp awl snail has been described from in Japan, its origin is unknown, while the dwarf awl snail is originated from South America and widely distributed in many tropical and subtropical areas and has been collected from Florida in Collier and lake counties (Auffenberg and Stange, 1988). Dundee (1970) mentioned that the closely resembles snail *L. gracilis* was rarely found in excess of 1cm from the ground. Both species (*O. pyrgula* and *O. pumilum*) are not tolerant to dryness and cold. In dry conditions, they hide at plant pots bottom and soil chinks but in cold conditions, they hide in the soil chinks. In the laboratory, they could not tolerate dryness and died within one week.

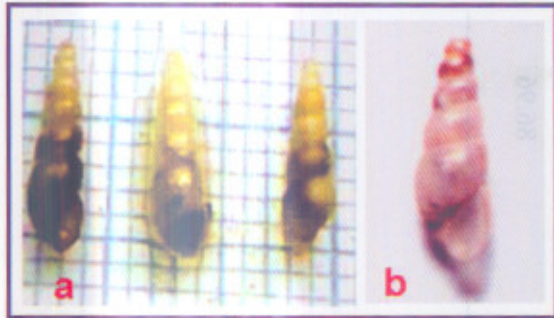


Fig. (1): Empty shell of immature snail
a) *Opeas pyrgula* b) *Opeas pumilum*.

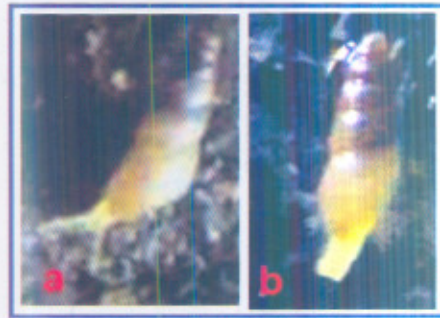


Fig. (2): Yellow animal inside the shell of
a) *O. pyrgula* b) *O. pumilum*

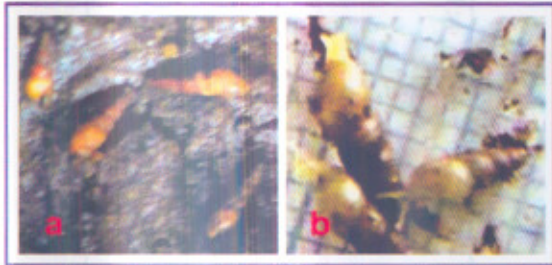


Fig. (3): a) Several individuals on the ground of both *O. pyrgula*-*O. pumilum*.
b) Yellow animal slipping on the bottom of Petri-dish (*O. pyrgula* and *O. pumilum*).



Fig. (4): Snail pale color in early spring, after emergence from hibernation
a) *O. pyrgula* b) *O. pumilum*

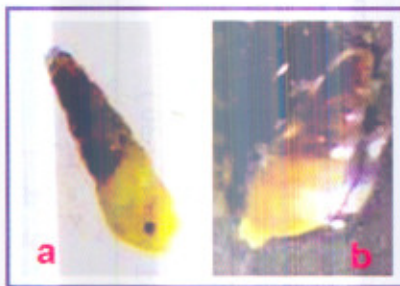


Fig. (5): Snail bright color in summer
a) *O. pyrgula* b) *O. pumilum*

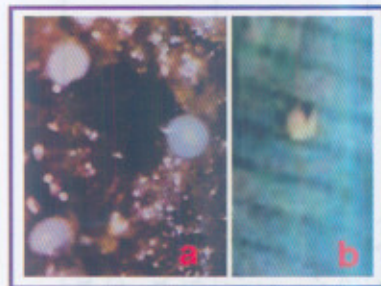


Fig. (6): a) Individual *O. pyrgula* eggs on the soil surface
b) Egg dimension of *O. pumilum* on ruler.

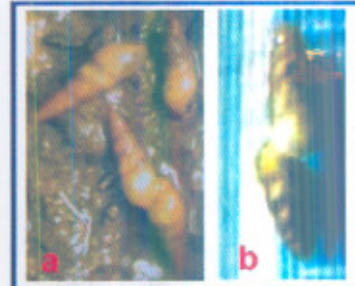


Fig. (7): Mating process of
a) *O. pyrgula*
b) *O. pumilum*

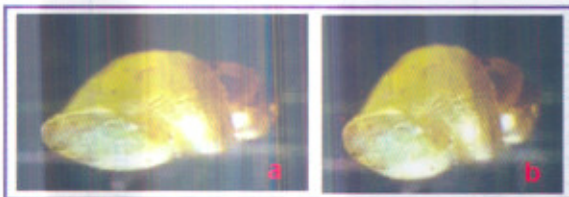


Fig. (8): Newly hatched snail aged one week
a) *O. pyrgula*
b) *O. pumilum*

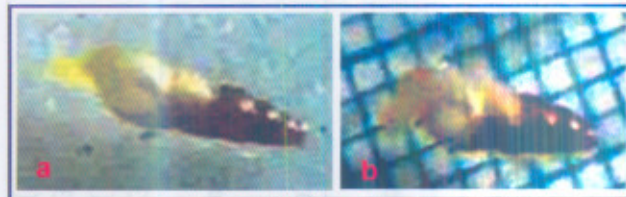


Fig. (9): Mature egg inside mature snail before egg laying
a) *O. pyrgula* b) *O. pumilum*

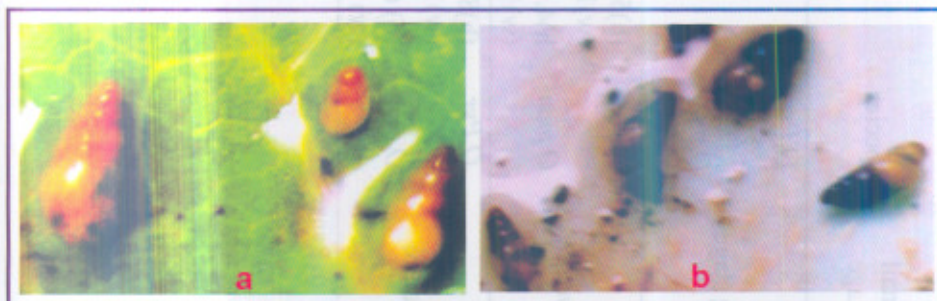


Fig. (8): Different individuals of juvenile
a) *O. pyrgula* b) *O. pumilum*

Table (1): Dimensions and durations of different stages of *Opeas pyrgula* and *O. pumilum* snail species and their mortality rates after infection with the snail parasitic nematode *Phasmarhabditis tawfiki* Azzam

Snail stage	Species	Dimensions	Period	Susceptibility to infection with <i>P. tawfiki</i> nematode	Mortality % of infected individuals	Ability of infected individuals to recovering nematodes	%of dead individuals that released nematodes
Egg stage	<i>O.Pyr</i>	1mm(d)	1.91±0.73 (1-3) (day)	-	-	-	-
	<i>O.pum</i>	1mm (d)	3.1 ± 0.83 (2 -4) (days)	-	-	-	-
Juvenile	<i>O. pyr</i>	(h)5.02±1.12 (3-6.7) mm (w)1.76±0.14 (1.5-2) mm	26.5±3.46 (22-32) (week)	+	73.33	+	81.81
	<i>O.pum</i>	(h)4.08±0.77 (3.1-5.1)mm (w)1.82±0.17 (1.5-2)mm	22.09 ± 5.71 (20-29) (week)	+	70	+	76.19
Mature	<i>O.Pyr</i>	(h)8.3± 0.68 (7-9.2) mm (w)1.97±0.07 (1.85-.2.05) mm	15.45±2.6 (11-20) (month)	+	80	+	87.5
	<i>O.pum</i>	(h) 6.5± 0.47 (5.5 -7.1) mm (w) 1.98±0.11(1.7-2.1) mm	12.3 ±1.95 (9-15) month	+	76.67	+	86.96
() : Range		d: Diameter	w: width			h: Height	

Table (2): Oviposition records of both *Opeas pyrgula* and *O. pumilum* snails under laboratory conditions

Snail species	Oviposition period	Number of eggs	Hatchability %	Incubation period
<i>O. pyrgula</i>	6-12 month	30.48 ± 2.34 (27-34)	81%	1.91 ± 0.73 (1-3)
<i>O. pumilum</i>	6-12 month	23.5 ± 4.72 (22-30)	80%	3.1 ± 0.83 (2 - 4)

In winter, most of the snails died at 11-14 °C, while some of them succeeded to burrow in the clay and emerge in spring when the temperature increased to 20°C. When the snails appeared again in early spring, they looked pale in color (Figs. 4a & 4b). This may be due to their empty intestine after hibernation. They began to be bright after few days of feeding (Figs. 5a & 5b). Dundee (1970) found dead individuals of *L. gracilis* after only 5 days of being deprived from water. He estimated a lower lethal temperature of 15°C for specimens under experimental conditions. However, this species buried itself in the soil as a mean of escaping from the cold weather. They were frequently found buried in groups. The same author also observed specimens at 7.6cm depth in the soil, when atmospheric temperature fell to 5°C.

Life cycle

Both snail species (*O. pyrgula* and *O. pumilum*) laid little number of eggs (3-5) on the soil surface, within 3-7 days for *O. pyrgula* and 1-2 week for *O. pumilum*. They repeated the egg laying several times through the year except in winter. But when the temperature increased suddenly as happened during February 2010 up to 30 °C for few days, the snails emerged from their hibernation and laid eggs in winter on contrary of their habit.

The egg is spherical in shape white in color and very small in size (about 1 mm in diameter) (Figs. 6a & 6b). Eggs hatch after 1.91 ± 0.73 (1-3) days for *O. pyrgula* and 3.1 ± 0.83 (2 - 4) days for *O. pumilum* under laboratory conditions of 27-30 °C and 65-75 R.H. % (Table, 2). Rate of egg hatchability under these conditions was 81. and 80% for the two species, respectively (Table, 2). The newly hatched snails were whitish yellow in color and transparent, ovate in shape and about 1 mm height (Figs. 8a & 8b). After 4-6 weeks, the juvenile snails become 3-4 mm in height with pale yellow color (Figs. 10a & 10b). The juveniles became mature and started laying of eggs at the age of 22-32 week for *O. pyrgula* and 20-29 week for *O. pumilum*. Although the courtship and mating were observed in laboratory (Figs., 7a & 7 b), the snails could lay hatchable eggs without mating thus, they behave as hermaphrodite .The individual snail could lay about 30.48 ± 2.34 (27-34) eggs (*O. pyrgula*) and 23.5 ± 4.72 (22-30) (*O. pumilum*) within a year (Table, 2). The mature egg could be seen inside the mature snails before deposition through the transparent shell (Figs. 9a & 9b).

Opeas. gracile was reported to lay 1- 4 eggs..within three days and hatched within 24 hours (Jambari et.al.1999). Moreover, it breeds continuously under favorable conditions from March to October (Raut, 1984). However, *L. gracilis* deposited 10 eggs at one time and a total of 79 eggs per year (Dundee, 1970).

Susceptibility to infection with the nematode, *Phasmarhabditis tawfiki* Azzam

When individuals of *O. pyrgula* and *O. pumilum* were exposed to infection with the snail parasitic nematode *Ph. tawfiki* in the laboratory, 80 & 76.67% of mature snails and 73.33 and 70% of juvenile snails were dead, respectively. About 87.5 and 86.96% of the mature dead snails and 81.81and 76.19% from the juvenile dead individuals, respectively released the infective stage of the nematode (Table, 1). Thus, *Ph. tawfiki* may proof in future as a successful biocontrol agent against these two species of snails.

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الملخص العربي

تسجيل فوقي للمثقاب القزم (*Opeas pyrgula* (Schmacker and Boettger)) وللمثقاب الحاد (*Opeas pumilum* (Pfeiffer)) لأول مرة في مصر

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في هذه الدراسة تم تسجيل وجود نوعين من القواقع، المثقاب الحاد والمثقاب القزم لأول مرة في مصر. بدأ ظهور القواقع الأول في بعض المشاتل بالقاهرة الكبرى خلال شهر سبتمبر عام 1996 ثم اختلف في عام 1997 ثم عاد للظهور مرة ثانية في أغسطس 2005 بينما بدأ ظهور القواقع الثاني في أغسطس 2006، وقد تم وصف القواقع والوضع التصنيفي لهما وكذلك بيولوجية وعادات وسلوك القواقع. إضافة إلى دراسة قابليتهما للإصابة بالنيماتودا *Phasmarhabditis tawfiki* Azzam المتطفلة على القواقع.

كلمات مفتاحية: قواقع، المثقاب القزم (*Opeas pyrgula* (Schmacker and Boettger))، المثقاب الحاد (*Opeas pumilum* (Pfeiffer))، مصر.