

THE RATE OF EGG LAYING AND HATCHING OF THE SLUG *ARION LUSITANICUS* MABILLE, A PEST OF ARABLE CROPS

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Abstract. The experiments were carried out in Rzeszów, a region of the *Arion lusitanicus* mass occurrence, and also in Poznań. The studies were performed under field conditions, in isolators dug into the ground. It was found that the slug began egg laying by the end of the first decade of August. The period of egg laying, depending on meteorological conditions, lasted for 2-3.5 months. The eggs were laid in clutches, each containing from 5 to 193 eggs. Most of eggs laid in August hatched before winter. For the eggs laid in mid-August the period of hatching was shorter than those laid at the turn of August/September, and the percentage of hatched eggs was lower. Eggs deposited at later dates (in September-November) did not hatch before winter.

Key words: *A. lusitanicus*, egg laying and hatching

I. INTRODUCTION

The slug *Arion lusitanicus* Mab. (*Gastropoda: Pulmonata: Arionidae*) is a dangerous pest of cultivated plants in many countries of central and western Europe (Davies 1987; von Proschwitz 1992, 1994; Briner and Frank 1998). In the last 10 years this species introduced into Poland to the area of Podkarpackie province (at the foot of the Carpathians), has become a troublesome pest of plants, especially vegetables (Kozłowski 1995; 1999; Kozłowski and Kozłowska 1998; Kozłowska and Kozłowski 1998). It occurs there most abundantly, mainly in gardens and parks as well as in scrubs on the river banks.

The aim of the conducted studies was to determine the dates of *A. lusitanicus* egg laying and hatching and the percentage of hatching eggs depending on meteorological conditions.

II. MATERIAL AND METHODS

Studies concerning dates of egg laying and hatching as well as fecundity of the slug *A. lusitanicus* were carried out under field conditions on the territory of Rzeszów in the years 1997-1999. Each year in June, 10 young immature slugs were placed into an isolation box 50 × 70 × 50 cm in size, made of metal angle sections, perforated sheet metal and mill gauze, which was filled with soil up to 1/3 height and dug into the ground. After copulation, the dates of oviposition, the number of clutches and the egg number in clutches were noted.

Egg clutches were subsequently transferred into closed plastic containers lined with damp lignin, and hatching dates and the number of hatching eggs were determined. For observations of the egg number, basic characteristics of egg position and disperse were determined.

In 1999, studies were also conducted on the relation of the percentage of hatched eggs depending on meteorological conditions. For that purpose, eggs from subsequently laid clutches were placed into separate plastic containers, 100 eggs per container, at 7 dates – from 18 August to 21 November (200-300 eggs at each date). The containers 15 × 10 × 12 cm in size were filled with soil up to 2/3 height, and their lids were provided with holes tightened with mill gauze. The containers were placed into the isolation boxes dug into the ground – 6 containers in Rzeszów and 12 in Poznań. Every two days the eggs were checked for the degree of their development, and the number of hatching slugs was noted. The air temperature (minimal at the ground surface and average diurnal) was obtained from the meteorological station in Jasionka (near Rzeszów) and Ławica station (in Poznań).

III. RESULTS AND DISCUSSION

Under conditions of field breeding in isolation boxes dug into the ground, the slugs laid eggs on 10 August at the earliest in 1998 and on 13 December at the latest in 1997 (Fig. 1). The period of oviposition lasted 104 days as a maximum (1997). A single individual, on the average, laid from 301.3 eggs (in 4.1 clutches) in 1999 to 476.1 eggs (in 6.7 clutches) in 1997. The eggs were deposited in clutches, containing from 5 to 193 eggs. At the initial period of egg laying (the first two weeks) the number of eggs per clutch was almost three-fold larger (on average, 112 eggs) than that in the last two weeks of oviposition (on average, 44 eggs). The first young slugs hatched a month after egg deposition. Further hatchings were subsequently observed until the temperature decline to about 5°C. Eggs, which hatched to the end of the year, constituted from 23.6% in 1997 to 36.5% in 1999 of all the eggs laid out by slugs.

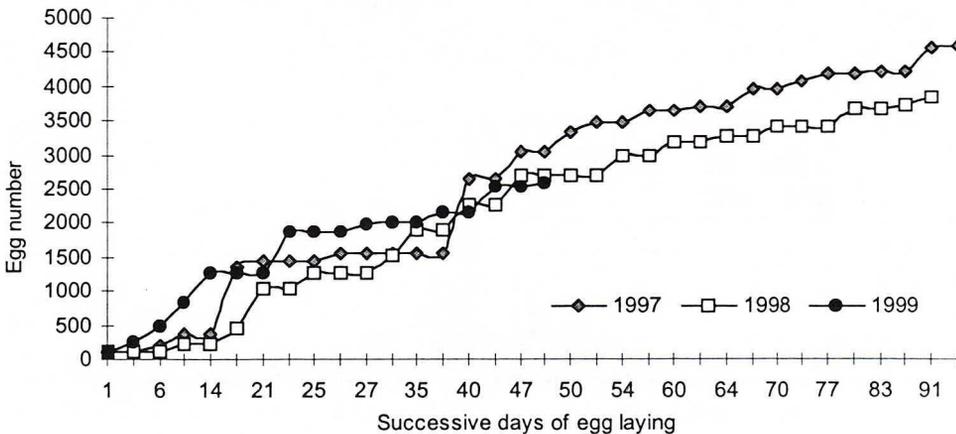


Fig.1. The cumulative number of produced eggs by *Arion lusitanicus* (10 individuals) under field conditions

Table 1

Percentage of hatching slugs from eggs laid in August 1999

Locality	Date of egg laying	Day number from egg laying to slug hatching							
		day 35		day 42		day 50		Final	
		from-to	\bar{x}	from-to	\bar{x}	from-to	\bar{x}	from-to	\bar{x}
Rzeszów	18.08.	20-34	27.0	34-63	47.5	43-64	53.5	43-65	54.0
	22.08.	4-10	7.0	58-61	59.5	75-81	78.0	75-84	79.5
	26.08.	7-12	9.5	66-67	66.5	74-78	76.0	74-78	76.0
Poznań	25.08.	19-47	36.3	53-75	67.3	55-88	75.8	56-93	77.8
	30.08.	6-51	23.7	53-73	66.0	67-92	82.0	73-97	86.3
Mean		4-51	23.3	34-75	62.8	43-92	44.2	43-97	76.1

In studies on egg hatching, which were conducted in the autumn/winter period of 1999, it was found that most of the deposited eggs hatched before the winter (Tab. 1). Single specimens, however, hatched from the eggs laid out in September (1% of the 300 studied eggs), whereas no slug hatching was observed from the eggs laid in October and November (the observations were made before January 2000). These eggs overwintered. According to Briner and Frank (1998) *A. lusitanicus* occurring in Switzerland deposits its eggs in late

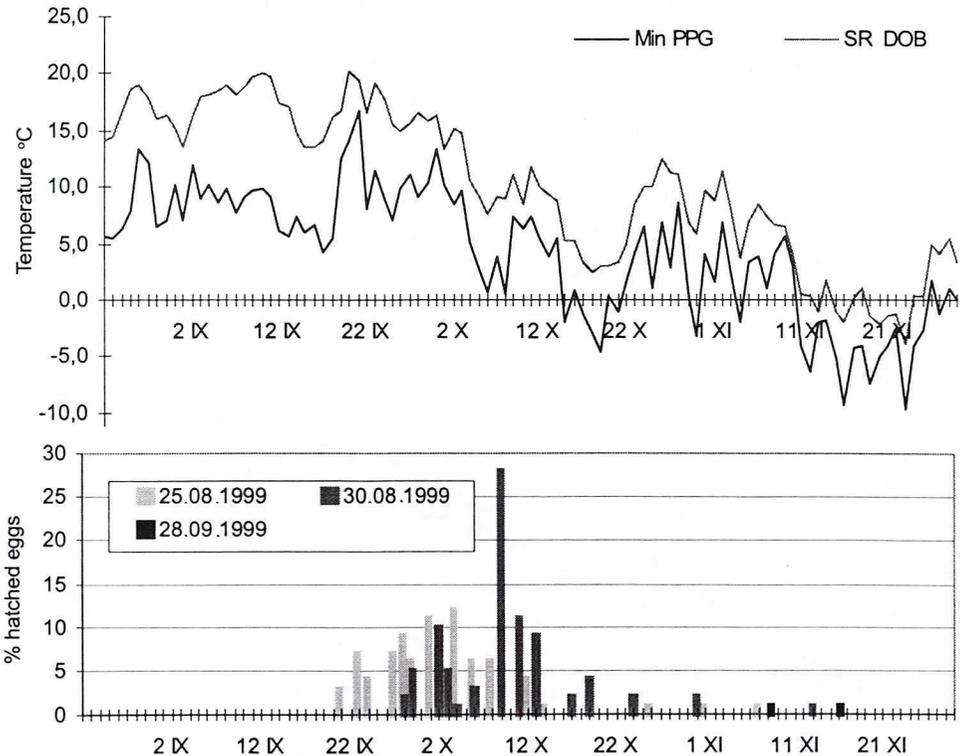


Fig. 2. Percentage of hatching *Arion lusitanicus* eggs laid out on 25, 30 August and 28 September 1999 and mean diurnal (SR. DOB.) and minimal temperature at the ground surface (Min PPG) – Poznań

Table 2

Day number from egg laying in August 1999 to slug hatching

Locality	Date of egg laying	Mean day No.	Standard deviation	Variability coefficient
Rzeszów	18.08.	38.1	0.425	1.12%
	22.08.	41.2	1.740	4.22%
	26.08.	43.3	4.707	10.88%
Poznań	25.08.	37.5	1.826	2.20%
	30.08.	40.4	1.699	4.20%

summer and autumn, and these eggs hatch in late autumn and spring as in Poland. In the studies carried out in Rzeszów it was found that hatching was shorter for eggs laid on 18 August than for eggs deposited on 22 or 26 August, but the percentage of hatched eggs in the first case was lower. Similar relations were found in the studies conducted in Poznań, but they concerned later dates of oviposition (25 and 30 August). The reason of a shorter hatching of eggs laid in August was higher air temperatures by the end of August and in the first half of September in comparison to the later period. However, the temperature decline below 5°C inhibited the development of eggs (Figs. 2 and 3). Totally, in the both localities

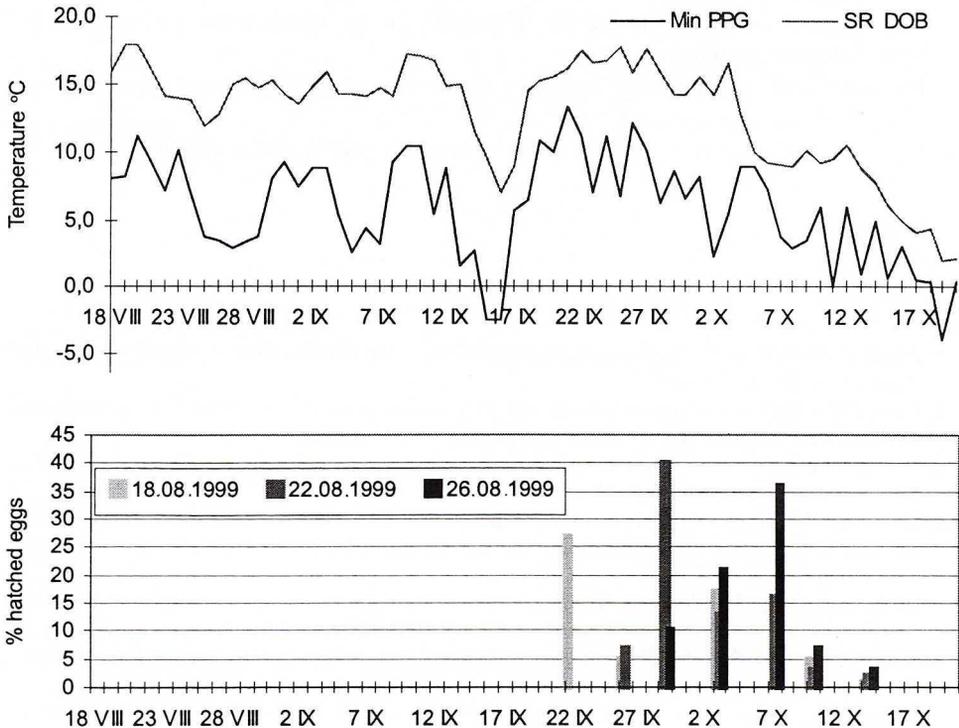


Fig. 3. Percentage of hatching *Arion lusitanicus* eggs laid on 18, 22 and 26 August 1999 and mean diurnal (SR, DOB.) and minimal temperature at the ground surface (Min PPG) – Rzeszów

under study, slugs hatched from the eggs oviposited on 18-30 August, 1999 constituted from 54% to 86% – on average, 76% (Tab. 1, Figs. 2 and 3). The average day number from egg laying to slug hatching ranged from 38 to 43 (Tab. 2).

As follows from the performed observations, the time of oviposition as well as the rate of *A. lusitanicus* egg hatching largely depend on the air temperature. Lower temperature have a marked impact on the elongation of slug development, especially in the embryonal period. This regularity also concerns many other slug species (Kosińska 1980; Wiktor 1989). Of smaller importance for slug development are atmospheric precipitations, which determine air humidity and soil moisture. Slugs are well adapted to further drought periods. They can survive under various shelters and continue their development (Wiktor 1989). In late autumn with frost occurrence, the period of embryonic development and hatching is interrupted. The slug overwinters at the stage of hatched juveniles and as eggs, which hatch the following spring.

IV. CONCLUSIONS

1. The duration of egg laying by *Arion lusitanicus* Mabilie depends on meteorological conditions from mid-August to the second decade of December.
2. Only eggs deposited before the end of August, i.e. on average, about 30% of all laid eggs, hatch before winter.
3. Hatching of the first laid eggs is shorter, but the percentage of hatched eggs is lower in comparison to eggs laid later.
4. Eggs laid from September to November overwinter and hatch the next spring.

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TEMPO SKŁADANIA I WYLĘGANIA JAJ ŚLIMAKA *ARION LUSITANICUS* MABILLE, SZKODNIKA ROŚLIN UPRAWNYCH

STRESZCZENIE

W latach 1997-1999 prowadzono badania dotyczące terminu składania i wylęgania jaj *Arion lusitanicus*. W okresie jesienno-zimowym 1999 roku obserwowano także tempo wylęgania jaj złożonych w różnych terminach, procent wylęglých jaj i długość okresu wylęgania. Doświadczenia założono w Rzeszowie, w rejonie masowego występowania ślimaka, oraz w Poznaniu. Badania prowadzono w warunkach polowych, w izolatorach wkopanych w ziemię.

Stwierdzono, że ślimak rozpoczął składanie jaj pod koniec pierwszej dekady sierpnia. Okres składania jaj w zależności od warunków meteorologicznych trwał od 2 do 3,5 miesiąca. Jaja były składane w złożach – od 5 do 193 jaj w jednym złożu. Do końca roku wylęgało się około 40% jaj.

W badaniach jesienno-zimowych w 1999 roku stwierdzono, że większość jaj złożonych w sierpniu wylęgała się przed zimą. Dla jaj złożonych w połowie sierpnia okres wylęgu jaj był krótszy niż dla jaj złożonych na przełomie sierpnia i września, a procent wylęglých jaj był niższy. Jaja złożone w późniejszych terminach (wrzesień-listopad) nie wylęgały się przed zimą.