Short Paper

The biological effect of *Sepedon* (Diptera: Sciomyzidae) fly larvae living on *Lymnea* snails

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Summary

The present work was carried out to investigate first, the ecology of the *Sepedon* flies as well as species of *Lymnea* snails and secondly, the biological effects of *Sepedon* fly larvae living on *Lymnea*. In this regard, the life cycle, death rate and compatibility of *Lymnea* species, as well as the life cycle of *Sepedon* flies in breeding cage and the activity of the new larvae in the same ecological condition were investigated. The results showed that *Lymnea truncatula* needs more sophisticated ecological and feeding conditions than other species of the snails. *Lymnea stagnalis* was found sensitive to temperature variation and this may lead to gradual or sudden death. *Lymnea pregra* and *Lymnea palustris* could well adapt with laboratory conditions. The killing effect ($P<0.001$) of the third-stage larvae on snails (3 to 4 weeks) was more than the effect of first- and second-stages larvae. This effect was more in a container with 2 cm water depth than a container with 5 cm depth.

Key words: Biological control, Sciomyzidae, *Sepedon*, *Lymnea*

Introduction

The digenic trematodes or flukes are parasites of vertebrates and to complete their larval stages need one or more intermediate hosts. These parasites need specific species of intermediate hosts to complete their life cycle. Therefore various species of trematodes have become adapted to a single or at most a few species of snail hosts. In some localities the introduction of natural enemies, such as ducks, fishes, crustaceans and predators has proved useful in reducing the number of snails (Belding, 1965).

Many predators were used as biological agents against different species of snails, but few groups such as sciomyzidae fly, hirudinea and crustacea are known among specific predators of snails (Berg, 1953; Echblad, 1973; Gronveld *et al*., 1996). Sciomyzidae is the most important Diptera that is specifically snail-eating and its different species are particularly important as biological control agent (Belding, 1965).

Berg (1953) observed for the first time the larvae of six species of sciomyzid flies feed on nine species of acquatic and land snails. The possibility of using these flies in biological control was suggested by Berg (1953). Up to now, 600 species of these flies are known to be living in northern hemisphere and tropical areas. Berg (1973) and Knutson *et al*., (1973) studied throughly the biology and classification of sciomyzidae. Among the family of sciomyzidae, the genus of *Sepedon* is of particular importance because of its numerous species, great population and distribution (Mclauphling and Dame, 1989; Madsen, 1990). Ten genus and 19 species of sciomyzidae was reported in Iran. Among these, *Sepedon sphegea* and *Sepedon spinipes* were reported more than the others, particularly in the northwest and the

southwest of Iran (Knutson *et al*., 1973; Tirgari, 1978). The objective of the present study were first, to investigate on some ecological conditions of *Sepedon* fly and some species of *Lymnea* and secondly to study the biological effects of *Sepedon* fly larvae living on the *Lymnea*.

Materials and Methods

The snails for this study were selected from *Lymnea truncatula*, *L. pregra*, *L. palustris* and *L. stagnalis* species. Some samples of all mentioned species were collected and transported to the Parasitology Department of Razi Institute.

Five snails from each species were kept at 22 to 25ºC of laboratory conditions in four identical plastic dishes (with 30 cm width, 10 cm length and 5 cm depth of water) and their death rates, life cycle duration and ovipositions were investigated. The adult snails were taken out from the plastic dishes after oviposition and the rest of their life cycles were followed up. Some *S. sphegea* adult flies were collected from Mazandaran province in north of Iran and transported to the Parasitology Laboratory of Razi Institute. The live adult flies were kept in the conditions almost similar to the natural conditins in 50 × 50 cm cages containing 14 × 2.5 cm petri dishes at 22 to 25ºC and feeded with food made up of sugar and smashed snail. Then their behaviour under above conditions in the laboratory was investigated.

The adult flies started their oviposition around the petri dishes. The larvae were put near the snails. The killing effect of larvae on the snails at different levels of water in dishes was investigated. Data were analysed by x^2 test.

Results

The results of this study show that, *L. truncatula* snail needs more complex ecological conditions than other species. Therefore the laboratory conditions have not been suitable for breeding *L. truncatula. L. stagnalis* is very sensitive to temperature variations, while *L. pregra* and *L. palustris* species adapted very well to the laboratory conditions. The results obtained from the study of snails' life cycles under laboratory conditions (22 to 25ºC and feeding on sterilized letus powder) are as follows:

The duration of egg hatching in *L. pregra* and *L. palustris* snails lasted 12 days and for *L. stagnalis* lasted 13 days. The mean egg colony in a given duration for different *Lymnea* were *L. palustris* > *L. pregra* > *L. stagnalis.* The average number of eggs in each colony were 41 ± 2, 27 ± 1 and 28 ± 1 for *L. palustris, L. pregra* and *L. stagnalis*, respectively. The duration of life cycle from one stage of oviposition to another lasted 2.5 months for *L. pregra* and 3 months for *L. palustris*. *L. stagnalis* died gradually because of sudden changes in temperature in winter (Table 1).

Table 1: Egg production, hatching and growth duration of some species of *Lymnea* in laboratory condition

Species	No. of egg colonies deposition	Mean eggs in each colony	Hatching (days)	Egg to adult duration (month)
L. palustris	47	41 ± 2	12	3
L. pregra	18	27 ± 1	12	2.5
L. stagnalis	13	28 ± 1	13	*

*Did not reach to adult; *L: Lymnea*

Table 2: Life cycle, hatching and growth of *Sepedon* fly (laboratory condition)

No. of flies	No. of egg colonies and its structures	Mean eggs in each colony	Hatching to larvae (days)	No. of pupa
2	18, compact, boat like	7 ± 0	12	3

Table 3: Killing effect of *Sepedon* larvae on snail (laboratory condition)

Depth of water	No. of snails	Alive snails	Died snails
2	11	0	11
5	11	8	3
>5 control	11	11	0

The adult flies of *S. sphegea* and snails were kept under conditions almost similar to natural conditions. The flies started oviposition, 3 days after they had been transported to laboratory. The shape of eggs was like boat and conglomerate. The number of colonies increased in the following days and totally were 18 colonies and 126 eggs (with average of 7 eggs in each colony) showed in Table 2. The first-stage larvae came out of eggs after 12 days. The oviposition continued for some days and among them only 53 eggs hatched to larvae. The larvae of the first-stage had rapid movement. Then larvae were placed beside the snails with different levels of water. But they showed no effect on snails during the first 24 hrs. The killing effect ($P<0.001$) of the third-stage larvae on snails (3 to 4 weeks) were the highest compared to larvae of the first- and second-stages. Moreover, this effect in plastic dishes with 5 cm of water was less than dishes with 2 cm of water. Only 3 out of all larvae produced, transformed into pupas after 23 days in laboratory conditions. Two of these pupas were placed in a bowl containing water and one kept in a cage, but none of the pupas emerge to adult.

By use of Table 3 and analytical x^2 test because calculated x^2 (29.27) is greater than critical x^2 (10.8) and regarding to 2 degree of freedom (2fd), so the differences are significant and we can conclude that at 2 cm depth of water larvae are effective in killing the snails but in 5 cm depth snails mortality is less ($P<0.001$).

Discussion

The results obtained from breeding snails in laboratory have indicated that *L. truncatula* needs more sophisticated living and feeding conditions than other snails. *L. stagnalis* was very sensitive to temperature variations of living conditions and any changes in this factor led to sudden and gradual death. While, *L. pregra* and *L. palustris* species were adapted well to the laboratory conditions. The life cycle obtained in this study is almost confirmed by the research that have been done in the past (Annual report of Razi Institute in 1377-1379, Section Parasitology).

The species of the fly trapped was confirmed to be *S. sphegea*. Regarding the life cycle stages of fly and above descriptions, the shape of eggs and the act of oviposition around the bowl were similar to previous studies by other scientists (Berg, 1973; Tirgari and Masood, 1981). These eggs were placed at 3 cm distance near the surface of water, beside and/or on the vegetables in the bowl. These specifications were confirmed by previous studies (Geckler, 1971; Berg, 1973; Mclauphling and Dame, 1989). The larval and pupal stages were completed after 12 days. This duration was confirmed by (Echblad, 1973; Knutson *et al*., 1973; Tirgari, 1978). The first-stage larvae had a very fast movement; these larvae were placed in different plastic dishes (30 × 10) contained 2 and 5 cm depth of water. But no killing effect were observed. The expectation that these larvae have slug-eating capability was mistake because, they can live without food for 48 hrs. Also it was proved that the fly larvae in high depth of water has no strong snail-eating capability (Geckler, 1971). The snail-eating capability of third-stage larvae was very obvious. After placing 11 snails near 5 larvae, all were killed after 9 days. As a controling measure a bowl containing snails without larvae was set (Table 3).

The information obtained in this research was confirmed by the research of Knutson *et al*., (1973) and Geckler (1971). Three (%6) out of all larvae changed into pupa (Gormally, 1985). Although, the percentage of eggs hatched to larvae and the emergence of larvae to pupa was too low, but this study is informative for its data on developmental process of fly and snails and monitoring living behaviour at laboratory conditions. For better and almost complete study on above title more appropriate devices and equipment is needed.

The results were indicated that biological control against snails by *Sepedon* fly as a predator at laboratory condition is possible. Moreover, in future the research on biological control of fresh-water snails must be focused on research about pathogens and microparasites of these snails. Also the possibility of the use of pheromones and

genetic manipulations for biological control of intermediate hosts is considered and needs more studies (Gormally, 1988).

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