REMARKS ON THE BIOLOGY OF THE FILBERT LEAF-ROLLER (*Archips rosanus* L.) IN CLIMATIC CONDITIONS OF POLAND

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A B S T R A C T

>From 1993 to 1997, the filbert leaf-roller began to hatch in the last ten days of April, when the sum of effective temperatures (above 8°C) reached 50-60°C, and when apple trees were in the green bud stage. About half of the caterpillars hatched when the sum of effective temperatures reached 60-70°C, at the end of the green bud stage. This is the best time to carry out control measures (Płuciennik and Tworkowska, 1992). Filbert leaf-roller caterpillars fed from the beginning of May to the middle of June. Pupation occurred during the first and second decades of June. Adult moths emerged from the second decade of June to the end of July. The caterpillar stages, from L_1 to L_5, lasted about forty days. The pupa stage lasted from eleven to fourteen days. The flight stage lasted from 30 to 53 days.

Key words: filbert leaf-roller, *Archips rosanus*, Tortricidae, biology, Poland

INTRODUCTION AND REVIEW OF LITERATURE

The filbert leaf-roller (*Archips rosanus* L.) is a pest of all fruit tree species as well as of other deciduous trees and shrubs. The filbert leaf-roller is one of the most cosmopolitan members of the family Tortricidae, and occurs in various parts of Europe, including Italy (Castellari, 1988), Albania (Kapidani and Duraj, 1991), Spain (Rubio et al., 1990), the Netherlands (Reede et al., 1985), Germany (Gottwald et al., 1986), Latvia (Myttus et al., 1987), the Ukraine (Skiba and Parii, 1989), and Russia (Grichanov et al., 1994). It also occurs in the Americas, including Canada (Smirle, 1993), the United States (Viggiani, 1994), and Chile (Martinez et al., 1992).

In Poland the species is widespread and common. Population size varies

from year to year, and from region to region, and has been rising since 1993 (Riedl, 1968; Krakowiak, 1974; Kośliń-ska, 1970; 1973; 1978; Płuciennik and Tworkowska, 1992).

The filbert leaf-roller is often the most numerous leaf-roller species in apple orchards. It also infests other fruit trees and bushes, particularly plums, pears and black-currants. The caterpillars damage not only leaves and flowers, but also fruits.

Many non-Polish researchers have reported on the biology of *Archips rosanus* (Baggiolini, 1956; Castellari, 1988; Myttus et al., 1987; Kapidani and Duraj, 1991; Grichanov et al., 1994; and Moreas and Netti, 1996). Polish researchers have published only fragmentary information (Razowski and Wiąckowski, 1959; Anasiewicz, 1963; Riedl, 1968; and Kośliński, 1982).

The aim of this study was to describe the biology of the filbert leaf-roller in Poland and to determine what effect environmental temperatures have on the developmental stages of the pest. The data may help in designing more accurate schedules for pest control.

MATERIAL AND METHODS

Investigations were conducted from 1993 to 1997 at the Institute of Pomology and Floriculture in Skierniewice. Caterpillars were collected from apple orchards during the spring and raised in beakers in an insectarium under conditions approaching natural conditions. Each beaker contained five caterpillars, which were fed apple leaves. Caterpillars were observed and food was changed twice a week. Specimens were put into separate test-tubes when they reached the pupa stage. Adult moths were observed every day. Of a total of 1460 caterpillars collected, about 1000 moths were raised.

To determine fecundity of females in the laboratory, adult moths were placed in 35 beakers containing apple twigs and leaves. To determine fecundity of females in the orchard, adult moths were placed in 30 gauze isolators set on the thicker branches of the apple trees. Each beaker contained one pair of moths, and each gauze isolator contained ten pairs.

In the spring, hatching of eggs laid by the females in the gauze isolators and eggs laid by females naturally occurring in the orchard was observed.

Flight dynamics of moths in the orchard was determined with pheromone traps produced by the Polish experimental plant, ”Chemipan”, as well as by the English company, ”Agrisense”.

Weather data during the growth season were obtained from the meteorological station ”Metos”, located in the institute’s experimental orchard in Skierniewice.

RESULTS

Hatching

>From 1993 to 1996, caterpillars began to hatch in the last ten days of April. In 1997, they hatched later, at

the beginning of May. The mean sum of effective temperatures (above 8°C) necessary to begin the hatch was about 60°C in 1993, 1995 and 1996, 50°C in 1994, and 30°C in 1997. In 1994 and 1997, April was a relatively cold month. Hatching always occurred when apple trees were in the green bud stage.

The hatching period was relatively short, and lasted five to nine days. After three or four days, half of the caterpillars had hatched. The sum of effective temperatures (above 8°C) necessary for half of the caterpillars to hatch was about 70°C, and ranged from 57.8° to 90.5°C.

From 1993 to 1997, the percentage of hatched caterpillars was very high, ranging from 86.8% to 94.3%. The percentage of eggs parasitised by *Trichogramma* was between 5.7% to 13.4%. The low percentage of eggs destroyed by oophagous organisms helps explain why the population of the filbert leaf-roller was so high in Poland from 1993 to 1997.

Caterpillar development and pupating times

The larval stages, from L_1 to L_5, lasted about forty days, and ranged from 31 to 53 days. Pupation took place in June, peaking in the first or second ten days of the month (Tab. 1). In 1993 and 1996, years which had a warm spring, mass pupation took place in the first ten days of June. In the other years, pupation peaked in the second ten days of June. In 1993 and 1994, pupae were observed as early as the last ten days of May. In 1996, pupation occurred even earlier, in the second ten days of May. Only one single specimen pupated in July. The pupa stage lasted about 13 days, and ranged from 10 to 24 days.

Phenology of adult moths

The first moths were captured in the pheromone traps in June, and their flight lasted until the end of July (Fig. 1). Sporadic single moths were caught even in August. The flight period ranged from 30 to 53 days. 80-90% of the moths were caught in the first and second ten days of July. In 1996, a year with an early and warm spring, most of the moths were caught in the third ten days of June. In the remaining years, flight did not begin in earnest until July. Usually, flight began when the sum of effec-tive temperatures (above 10°C) reached 290°C (Tab. 2).

In the insectarium, flight occurred from the second ten days of June to the middle of July, and peaked in the second or third ten days of June. In the natural population of moths, flight began a few days later and lasted much longer, until the end of July. Thus, even though the caterpillars in the laboratory were raised under conditions approaching natural conditions, the timing of the stages in their life-cycles was different from wild moths. The beginning, peak and end of flight occurred earlier in laboratory moths than in wild moths. The times determined for the laboratory moths agree with those reported by Kośliński (1982).

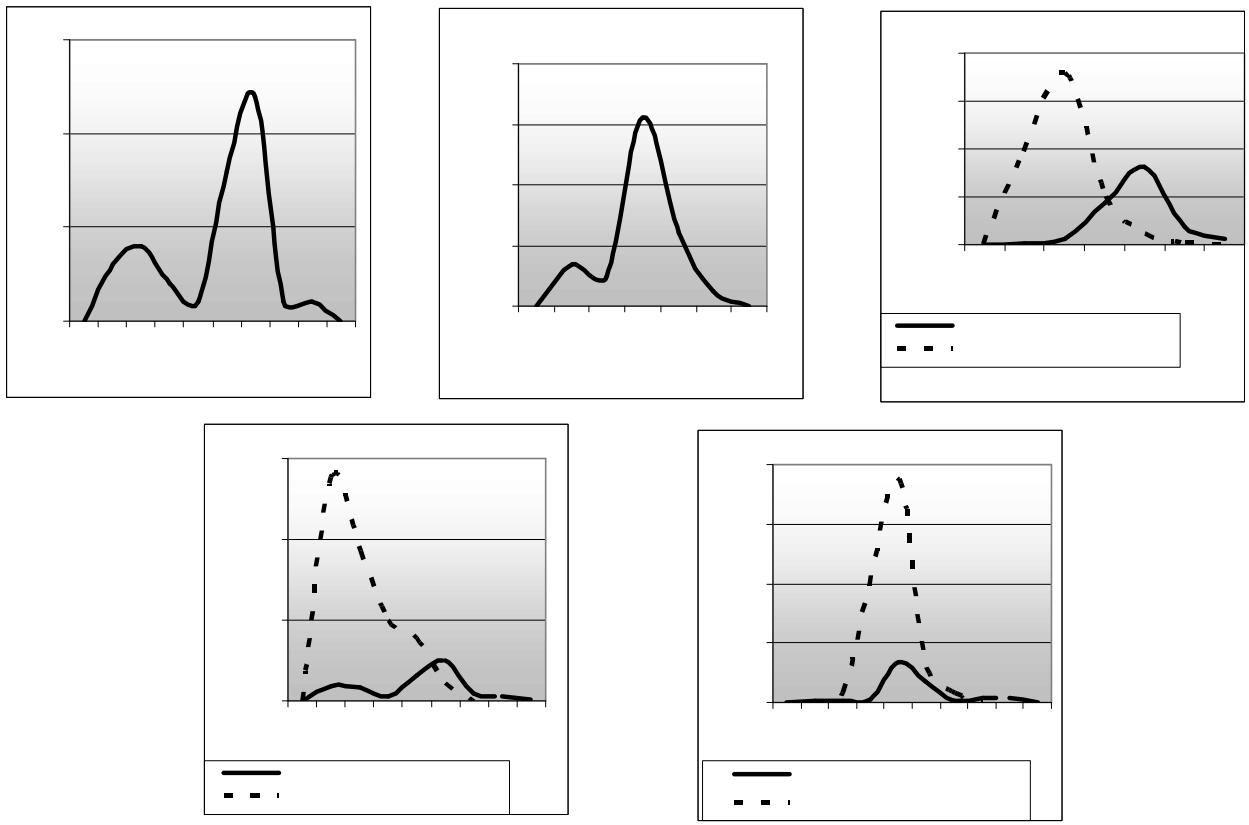

Figure 1. Dynamics of moth flights in filbert leafroller over 1993-1997

T a b l e 1 . Pupation times of filbert leaf-roller caterpillars

Year	Number of caterpil-lars	Numbers of pupae [%]					
		ten days of May		ten days of June			ten days of July
		II	III	I	II	III	I
1993	52	-	1.9	80.8	15.4	1.9	-
1994	37	-	2.7	24.3	70.3	2.7	-
1995	393	-	-	25.7	64.6	9.2	0.5
1996	563	7.1	14.4	54.7	21.3	2.5	-
1997	416	-	-	14.9	63.2	19.5	2.4

T a b l e 2 . Sums of effective temperatures for periods from January 1 until the occurrence of a particular developmental stage of filbert leaf-roller

Year	Sum of degree-days (above 8°C)		
	beginning of caterpillar hatch	50% of caterpillars hatched	beginning of moths flight
1993	April, 27 – 62.4	April, 30 – 90.5	June, 7 – 295.6
1994	April, 25 – 51.3	April, 28 – 65.9	June, 27 – 288.6
1995	April, 28 – 61.0	May, 4 – 66.7	June, 23 – 322.9
1996	April, 26 – 59.6	April, 29 – 71.1	June, 10 – 285.2
1997	May, 2 – 29.1	May, 6 – 57.8	June, 27 – 261.5

T a b l e 3 . Egg laying by the filbert leaf-roller

	Number of females	Number of egg clusters	Number of eggs laid	Number of egg clusters [mean]	Number of eggs per female [mean]
Orchard (gauze isolators)	292	372	3944	1.3	48
Insectarium (beakers)	19	49	1860	2.6	98

The proportion of females in the population averaged 47.3%, ranging from 43.2% to 55.2%). Females emerged two to seven days later than males.

Egg laying

Each female laid an average of 98 eggs in the beakers, and 48 eggs in the gauze isolators (Tab. 3). Clusters ave-

raged 30-40 eggs, ranging from just a few to 130. The lower number of eggs laid in the gauze-isolators is probably due to the fact that some females did not lay any eggs. In 1995, the percentage of females that did not lay any eggs was 14.3% in 1995, 50.0% in 1996, and 55.6% in 1997. This, in addition to parasites and predators, may account for the strong fluctuations in filbert leaf-roller populations observed in their natural habitats.

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BIOLOGIA ZWÓJKI RÓŻÓWECZKI (*Archips rosanus* L.) W WARUNKACH KLIMATYCZNYCH POLSKI

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S T R E S Z C Z E N I E

W latach 1993-1997 początek wylęgu gąsienic zwójki różóweczki obserwowano w ostatniej dekadzie kwietnia przy sumie temperatur efektywnych (powyżej 8°C) 50-60°C. Termin ten zbiegał się w czasie z fenologiczną fazą zielonego pąka u jabłoni. Około 50% gąsienic wylęgało się przy sumie temperatur efektywnych 60-70°C, co z kolei przypadało na koniec fazy zielonego pąka. Termin ten jest optymalny do wykonania zabiegu zwalczającego (Płuciennik i Tworkowska, 1992). Okres żerowania gąsienic zwójki różóweczki trwał od początku maja do połowy czerwca. Masowe przepoczwarczanie gąsienic obserwowano w I i II dekadzie czerwca. Stadium gąsienicy trwało ok. 40 dni, a stadium poczwarki 11-14 dni. Lot motyli obserwowano od II dekady czerwca do końca lipca. Okres trwania lotu wynosił od 30 do 53 dni

Słowa kluczowe: zwójka różóweczka, *Archips rosanus*, Tortricidae, biologia, Polska