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OBSERVATION ON THE APPEARANCE AND THE DEVELOPMENT *TORTRIX VIRIDANA* L. (LEPIDOPTERA, TORTRICIDAE)

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During the six year research period (1990-1995), the appearance and development of the different stages of *Tortrix viridana* was affected by the temperature that prevailed in each particular year. The larvae appeared a few days after the emergence of the first leaves of *Quercus frainetto*, and only in 1995 they appeared a few days earlier. During the study, the deviation in the time of appearance of the different insect stages reached up to 35 days. The duration of the larval stage ranged between 20,6 and 25,3 days. That of the pupal stage was almost the same in all six years ranging from 9 to 9,7 days. The emergence of the adults lasted less in years when, due to unfavourable temperatures, there was a delay in the onset of it, and ranged between 17 and 42 days.

KEY WORDS: *Tortrix viridana, Quercus franinetto,* larval development, pupal stage

INTRODUCTION

Tortrix viridana is one of the most important defoliators of many broad-leaved forest species causing problems in many European, Asian Minor and Northern African countries (ESCHERICH 1931, DELLA BEFFA 1962, MEYRICK 1968, NOVAK 1976, BOGENSCHÜTZ 1978, PATOČKA 1980, DU MERLE 1983, MIHAJLOVIĆ 1986). It is a polyphagous species which, however, prefers oak trees while in its last stages, when food is scarce it may also attack other forest species like chestnut, beech, poplar, birch, lime, horn-beam, maple, medlar and even spruce

(ESCHERICH 1931, FANKHÄNEL 1961, MEYRICK 1968, NOVAK 1976, BOGENSCHÜTZ 1978, PATOČKA 1980, DU MERLE 1983).

In Greece, it is present in all oak forests (PELEKASIS 1962, KAILIDIS 1991, KALAPANIDA 1999). In many areas like Filyro - Thessaloniki, it often causes local outbreaks of *Quercus frainetto* (KAILIDIS 1991). The existing data in Greece on the biology of the insect are based on one year studies. The present work was undertaken in order to study the development of the different insect stages in the course of many consecutive years.

MATERIALS AND METHODS

The experiments took place from 1990 to 1995. Every year, *Quercus frainetto* branches were collected from Mount Chollomon several days before the emergence of the leaves, and were transferred to the Forest Research Institute at Vassilika - Thessaloniki at a distance of 40 Km. They were kept in water under outdoor conditions, until the emergence of leaves. They were checked every day, for hatched larvae and those belonging to *T. viridana* were collected. Samples of twenty larvae that have hatched the same day, were placed in plastic vessels of a size of 24 x 17 x 11 cm and were kept sheltered under outdoor conditions until maturation. The experiment involved 120 larvae per year, totalling to 720 in the six year study. The larvae were fed with oak leaves cut from neighbouring trees every second day. The pupae that were formed were collected on a daily basis, placed individually into test tubes and were kept under the same conditions until the emergence of the adults.

RESULTS AND DISCUSSION

In the course of the six year research, there has been noticed a 35 days deviation in the appearance of the different insect stages. The hatching of larvae in 1994 began on April 1st, while in 1992 it started on May 5th and in 1991, on May 3rd, that is 35 and 33 days later, respectively (Tab. I).

Table I. Emergence of *Quercus frainetto* leaves and of the *T. viridana* stages, in relation to time for the years 1990-1995.

Year	Emergence of leaves	Hatching of larvae	Pupation		Moth emergence	
			Start	End	Start	End
1990	9 Apr.	4 Apr.	16 Apr.	10 May	26 Apr.	7 Jun.
1991	2 May	3 May	17 May	3 Jun.	27 May	14 Jun
1992	25 Apr.	5 May	20 May	7 Jun.	29 May	15 Jun.
1993	21 Apr.	27 Apr.	14 May	24 May	24 May	10 Jun.
1994	28 Mar.	1 Apr.	18 Apr.	25 May	3 May	6 Jun
1995	10 Apr.	2 Apr.	17 Apr.	20 May	27 Apr.	30 May

The date of appearance of the first leaves is considered as date of their emergence. The difference observed is attributed to the weather conditions and especially to temperatures that prevailed before hatching. As it appears from the data of the Meteorological Station of the Forest Research Institute, during the years 1991-1993, February, March and April were cooler by a mean of 1,2°C, 0,8°C and 1,0°C, respectively, than those of 1990, 1994 and 1995 (Tab. II) resulting in a delay of hatching of larvae.

Comparing the dates of the emergence of leaves to those of hatching of larvae, it appears that from 1991 to 1995 hatching took place a few days after the emergence of leaves. This is considered usual in natural oak forests as well as in those of other broad-leaved species, where hatching of eggs of leaf eating insects which an early activity in spring, coincides with the beginning of emergence of the leaves (HEDDERGOTT et all. 1953, SCHÜTTE 1958, SCHWERDTFEGER 1981, MARKALAS AND KALAPANIDA 1999).

Table II. Mean monthly air temperature (°C) from January to June in the years 1990-1995.

Year	Jan.	Feb.	Mar	Apr	May	Jun	Feb - Apr
1990	4,5	6,9	11,3	14,5	19,4	24,8	10,8
1991	3,0	4,7	10,5	13,5	17,2	25,4	9,6
1992	5,5	5,7	9,6	13,8	18,8	24,2	9,7
1993	4,9	3,9	9,2	15,0	19,0	24,2	9,4
1994	4,9	6,1	10,9	14,3	20,7	24,4	10,4
1995	5,6	9,4	9,0	13,3	19,8	25,4	10,6
Mean 1978-1996	5,0	6,3	9,9	14,1	19,2	24,6	

When hatching takes place earlier than the emergence of the leaves, as in 1990, the young larvae feed on the expanded buds after boring their bracts (BOGENSCHÜTZ 1978, DU MERLE 1983, DU MERLE & MAZET 1983).

From the dates of pupation it appears that, in general, the same deviation was observed as in the hatching of larvae (Tab. I). In 1990 pupation began on the 16th of April, while in 1992 on the 20th of May, which is 35 days later. It is characteristic that during 1990, 1994 and 1995, when temperatures in the said period were similar, the appearance of the different insect stages was similar too.

In years with similar temperatures, the duration of the larval stage is also similar both as a mean and from the point of extreme values (Tab. III). On the contrary, in years with different temperatures an obvious difference is observed, especially in 1990 and 1991 when the duration of the larval stage was 25,3 and 20,6

days, respectively. The explanation lies on the fact that during May 1991 the temperature was more favourable for larval development (Tab. II and III).

The pupal stage, contrary to that of the larval, had almost the same duration in all years of the study and fluctuated between 9,0 and 9,7 days (Tab. III). The values observed are significantly lower by 14 – 21 days from those referred in other European countries (BOGENSCHÜTZ 1978, KAILIDIS 1991).

Table III. Duration of larval and pupal stages of *T. viridana* in the years 1990-1995.

	Larval stage (days)			Pupal stage (days)		
Year	**n**	**mean**	**Low - high**	**n**	**Mean**	**Low - high**
1990	107	25,3 ±0,23	20-30	97	9,5 ± 0,07	8-12
1991	99	20,6 ±0,18	17-26	82	9,2 ± 0,03	7-11
1992	97	22 ± 0,22	19-29	81	9,1 ± 0,06	6-11
1993	102	21 ± 0,19	17-27	85	9,0 ± 0,09	7-11
1994	112	24 ± 0,37	16-28	100	9,7 ± 0,01	7-15
1995	110	24 ± 0,41	15-30	97	9,6 ± 0,06	8-12

The beginning of flight depends mainly on the temperature that prevailed before and in the course of the larval stage, and not so much on the temperature under which the pupae developed. So, the difference in the beginning of flight remained at one month, which is approximately the same with the difference in hatching in the years 1990 and 1991, while for the rest of the years, the flight began almost the same time (Tab. I, Fig. I).

Contrary to the beginning, the end of the flight period showed a smaller difference (only 15 days) in all years of the study, because in years when the beginning of flight was delayed due to unfavourable temperature, the duration of the flight period was shorter and was concluded earlier (Tab. I). It is characteristic that in 1990 flight began on the 26th of April and lasted for 42 days, while in 1992 and 1993, when it began on 29th and 24th May respectively it lasted for only 17 days.

Table IV. Mortality of *T. viridana* in the larval and pupal stage in the years 1990-1995.

	Number of insects			Mortality in %		
Year	Larvae	Pupae	Moths	Larval stage	Pupal stage	Larval and Pupal stage
1990	120	107	97	10,83	9,35	19,17
1991	120	99	82	17,5	17,17	31,67
1992	120	97	81	19,17	16,50	32,5
1993	120	102	85	15	16,67	29,17
1994	120	112	100	6,67	10,71	16,67
1995	120	110	97	8,33	11,82	19,17

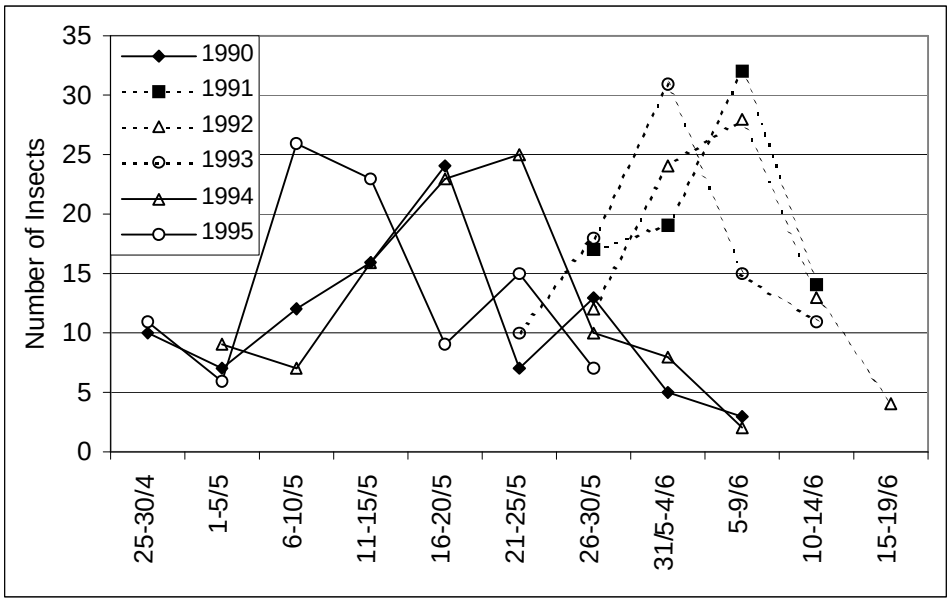

Fig. 1. Flight of *T. viridana* in the years 1990-1995.

The mortality of larvae and pupae ranged from 6,67% to 19,17% and from 9,35% to 17,17% respectively (Tab. IV). The mortality percentages of both stages of development were relatively low and this is due to the conditions of the experiment during which the action of different parasites and predators was not possible.

CONCLUSIONS

During the six year research period (1990-1995), the appearance and development of the different stages of *Tortrix viridana* was affected by the temperature that prevailed in each particular year.

The larvae appeared a few days after the emergence of the first leaves of *Quercus frainetto*, and only in 1995 they appeared a few days earlier.

During the study, the deviation in the time of appearance of the different insect stages reached up to 35 days. The beginning of hatching ranged from 1st April to 5th May, that of pupation from 16th of April to 20th of May, while adults flied from 26th April to 29th of May. The duration of the larval stage ranged between 20,6 and 25,3 days. That of the pupal stage was almost the same in all six years ranging from 9 to 9,7 days. The emergence of the adults lasted less in years

when, due to unfavourable temperatures, there was a delay in the onset of it, and ranged between 17 and 42 days.

The mortality of the larval and pupal stage ranged between 6,67% - 19,17% and 9,35% - 17,17% correspondly.

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УТВРЂИВАЊЕ ПОЈАВЕ И РАЗВОЈНИХ СТАДИЈУМА *TORTRIX VIRIDANA* L. (LEPIDOPTERA, TORTRICIDAE)

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И з в о д

За време шестогодишњег истраживања (1990-1995), проучавано је развиће појединих развојних стадијума зеленог храстовог савијача (*Tortrix viridana*) у зависности од утицаја температуре у свакој години истраживања. Неколико дана после појаве првих листова сладуна (*Quercus frainetto*), долазило је обично до еклозије ларви, осим у 1995. години, када су се ларве јавиле неколико дана пре листања. Током истраживања је установљено да одступање у времену појаве различитих стадујума зеленог храстовог савијача достиже до 35 дана. Почетак еклозије варира од 1. априла до 5. маја, а појава стадијума лутке од 16. априла до 20. маја. Лет имага је забележен од 26. априла до 29. маја. Дужина ларвеног стадијума је варирала од 20,6 до 25,3 дана. Дужина трајања стадијума лутке се није мењала у скоро целом шестогодишњем периоду истраживања и износила је од 9 до 9,7 дана. Лет имага је трајао краће у годинама када је, због неповољне температуре, каснио почетак еклозије и варирао је од 17 до 42 дана. Смртност у стадијуму ларве је била од 6,67% до 19,17% и лутке од 9,35% до 17,17%.

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