

**Evaluation of damages induced by the spotted tentiform leaf miner
(*Phyllonorycter blancardella* F.) (Lepidoptera: Gracillariidae) on foliage
of some apple varieties**

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**Evaluarea pagubelor induse de molia minieră (*Phyllonorycter blancardella*
F.) în sistemul foliar al diferitor varietăți de măr**

Rezumat

Au fost studiate pagubele induse de molia minieră a mărilor (*Phyllonorycter blancardella* F.) asupra suprafeței foliare la câteva soiuri de măr. Rezultatele obținute în 1987-1998 conduc la concluzia că există diferențe de rezistență la atac între diferitele soiuri de măr, atât în cazul suprafeței foliare distruse, cât și ca biomasă larvară uscată.

Coefficientul de corelație r dintre suprafața foliară și numărul de mine este de 0,74-0,99, iar coeficientul g dintre biomasă uscată consumată și numărul de mine este de 0,98-0,99.

Abstract

The damages induced by the spotted tentiform leaf miner (*Phyllonorycter blancardella* F.) on foliage of some apple varieties has been investigated. The results obtained in 1987-1998 led to the conclusion that there are differences among cultivars on the attack extent as foliar area destroyed by the larval biomass consumed from leaf too.

Coefficient of correlations r between the foliar area and the number of mines is 0.74-0.99 and g between the biomass consumed and the number of mines, 0.98-0.99.

Keywords: Spotted tentiform leaf miner, damages on apple foliar area, mines.

For *Phyllonorycter blancardella* F. as for the other miners of apple foliage, literature does not contain data on damages expressed as fruit yield loss.

Mentions in literature refer to leaf area destroyed, with direct involvement in lessening photosynthesis rate, and indirect damages as foliage debilitation, which end in tree vigour loss, when annually repeated (DUTCHER & al. 1978, PROCTOR & al. 1982, REISING & al. 1982).

Severe outbreaks can lead to tree defoliation and reduction of buds for the subsequent year.

In order leaf mining species, such as *Leucoptera malifoliella* O. G. COSTA and *Stigmella*

mallella STT. Investigations have been performed by BAUFELD (1991), on lessening foliage area and dry matter loss, as depending on apple cultivar's.

In our investigations we attempted to quantify damages caused by *Ph. blancardella* to apple foliage and biomass, by cultivars, generation and attack intensity.

Material and methods

Samples of 100 leaves have been collected from each 4 cvars, following the orchard diagonal. Collections have been made in July, August and October, coincident with 2nd and 3rd pest generations. For the first generation (overwintering) the attack was not evident.

Data recorded have been presented by statistical methods, such as: analysis of variance, coefficient of correlation r and values of indices obtained were significant, after F (Fischer) and T (Student) tests for probabilities of 5%, 1% and 0.1%.

Results and discussion

The results of investigations on foliage reduction by *Ph. blancardella* larvae are shown in table 1. It was found that for all varieties there is close link between mine surface and their number on a leaf, values of coefficient of correlation r ranging between 0.74 (Florina cvar) and 0.99 (Golden cvar), distinctly and highly significant (F and T tests). Likewise, (Table 1) also reveals that a maximum number 8 mines / leaf has been recorded for Jonathan cvar, 9 mines / leaf in Florina and 10 mines / leaf in Golden and Generos, these corresponding to differences between leaf areas destroyed, more reduced in Jonathan and greater in Golden and Generos.

Table 1

Average foliar surface (mm^2) destroyed by *Phyllonorycter blancardella* F. in various numbers of mines per leaf and apple cultivars

No. of mines / leaf	Apple cultivars			
	Jonathan	Golden	Florina	Generos
	$\bar{x}(\text{mm}^2) \pm \sigma$	$\bar{x}(\text{mm}^2) \pm \sigma$	$\bar{x}(\text{mm}^2) \pm \sigma$	$\bar{x}(\text{mm}^2) \pm \sigma$
1	132.2±12.3	136.2±12.4	133.0±13.2	132.6±12.3
2	173.3±16.0	182.2±10.2	177.2±15.4	180.3±15.9
3	234.5±12.7	226.3±15.7	235.2±12.7	234.6±14.1
4	278.3±13.3	278.2±18.2	280.9±13.7	281.2±15.7
5	335.9±12.2	337.1±13.4	331.1±17.2	334.3±15.4
6	376.4±17.3	385.6±16.7	378.3±16.4	382.4±16.8
7	427.8±15.8	434.9±13.4	429.5±14.7	435.9±14.5
8	467.6±13.9	476.1±18.6	472.6±14.1	476.2±16.2
9	-	535.6±13.9	530.3±14.9	532.4±14.3
10	-	579.4±15.2	-	576.3±13.7

$$r=0.86$$

$$F=17.35^{xx}$$

$$t=4.16^{xx}$$

$$r=0.86$$

$$F=392^{xx}$$

$$t=17.79^{xxx}$$

$$r=0.74$$

$$F=845^x$$

$$t=2.91^x$$

$$r=0.98$$

$$F=192^{xx}$$

$$t=13.86^{xxx}$$

Observations in two years showed annual changes in size of destroyed areas. Based on analysis of variance (Table 2) shows that Jonathan cvar was the most resistant to *Ph. blancardella* attack, among all cultivars under study. At the end of the season, only Golden was highly distinctly different, having the greatest areas destroyed. In the order 2 cvar (Florina and Generos) the average leaf area consumed had highly significance over Jonathan only in 1997. In 1998 differences over Jonathan were significant for Florina and distinctly significant in Generos. Taking Golden as standard, it was noted that the other cultivars had values of leaf consumption highly distinctly significant in 1998.

Table 2

Annual fluctuation of damages induced to foliar surfaces induced by *Phyllonorycter blancardella* F. in various apple cultivars

1997			
Apple cultivar	Mines surface / leaf (mm ²)	Difference over Jonathan cvar \bar{x} ()	Difference over Golden cvar \bar{x} ()
Jonathan	245.5	-	-50.5 ⁰⁰⁰
Golden	298.0	+50.5 ^{xxx}	-
Florina	282.5	+35.0 ^{xxx}	-15.0 ⁰
Generos	297.7	+32.2 ^{xxx}	-18.3 ⁰
1998			
Jonathan	623.9	-	-208.8 ⁰⁰⁰
Golden	832.7	+208.8 ^{xxx}	-
Florina	670.9	+47.0 ^x	-161.8 ⁰⁰⁰
Generos	684.7	+60.8 ^{xx}	-148.0 ⁰⁰⁰
CL			
	5%	=	15.093
	1%	=	19.833
	0.1%	=	25.336
1998			
CL			
	5%	=	39.899
	1%	=	52.446
	0.1%	=	66.997

As for the foliar biomass consumed by *Ph. blancardella*, data in table 3 reveal concordance between weight of dry matter destroyed and increase of mine number on a leaf. A direct relationship is valid for all cultivars between the average biomass amount consumed and the number of mines on a leaf, values of the coefficient of correlation r are very high, ranging between 0.98 – 0.99 with very distinct positive significance.

Along the years (Table 4) a fluctuation has been recorded in foliar biomass consumption with clear differences between cultivars in 1997, with the average annual biomass destroyed had the least value in Jonathan, showing highly distinct differences over all other cultivars. Golden cvar recorded the highest biomass consumption, so that all other 3 cvs were negatively distinctly different from it.

Percentage of destroyed area was 10 – 20%. For a reasonable conclusion on a different behaviour of *Ph. blancardella* in 11.86% in 1997 and 24.82 – 29.9% in 1998 (Table 5), while the foliar biomass consumed was 1.63 – 2.42% in 1997 and 5.12 – 7.26% in 1998 (Table 6).

Table 3
Foliar biomass (mg) consumed by larval activity of *Phyllonorycter blancardella* F. at various numbers of mines per leaf and apple cvar

No. of mines / leaf	Apple cultivars			
	Jonathan	Golden	Florina	Generos
	$\bar{x}(mg) \pm \sigma$	$\bar{x}(mg) \pm \sigma$	$\bar{x}(mg) \pm \sigma$	$\bar{x}(mg) \pm \sigma$
1	2.2±0.8	2.3±0.7	2.2±0.7	2.2±0.8
2	5.0±1.2	5.2±1.1	5.0±1.1	4.7±1.2
3	7.4±1.2	7.8±1.3	7.5±1.2	7.1±1.3
4	10.2±2.4	11.1±2.1	10.1±1.9	9.0±1.7
5	13.3±1.7	13.9±1.4	15.2±1.2	14.9±1.4
6	16.4±1.4	17.7±1.2	17.4±1.4	17.2±1.5
7	19.2±1.4	20.1±1.4	19.8±1.4	19.1±1.3
8	22.0±1.2	22.5±1.3	21.1±1.3	21.9±1.3
9	-	25.9±2.0	23.9±1.8	24.1±1.8
10	-	28.8±1.4	-	26.7±1.6
	$\gamma=0.99$ F=294 ^{xx} t=17.15 ^{xxx}	$\gamma=0.98$ F=192 ^{xx} t=13.85 ^{xxx}	$\gamma=0.99$ F=343 ^{xx} t=18.52 ^{xxx}	$\gamma=0.98$ F=192.0 ^{xx} t=13.85 ^{xxx}

Table 4
Annual fluctuation of foliar biomass consumption (mg) by *Phyllonorycter blancardella* F. as depending on apple cvar

Apple cultivar	Average leaf consumption (mg)	Difference over Jonathan cvar (x)	Difference over Golden cvar (x)
Jonathan	8.6	-	-2.6 ⁰⁰⁰
Golden	11.2	+2.6 ^{xxx}	-
Florina	10.4	+1.8 ^{xxx}	-0.8 ⁰⁰⁰
Generos	10.1	+1.5 ^{xxx}	-1.1 ⁰⁰⁰
DL	5%	= 0.470	
	1%	= 0.618	
	0.1%	= 0.788	

Apple cultivar	Average leaf consumption (mg)	Difference over Jonathan cvar (x)	Difference over Golden cvar (x)
Jonathan	19.9	-	-8.5 ⁰⁰⁰
Golden	28.4	+8.5 ^{xxx}	-
Florina	22.2	+2.3 [·]	-6.2 ⁰⁰⁰
Generos	22.9	+3.0 [·]	-5.5 ⁰⁰⁰
DL	5%	= 3.858	
	1%	= 5.069	
	0.1%	= 6.475	

Table 5

Average apple leaf surface in some apple cultivars and the extend of consumption by *Phyllonorycter blancardella* F. at various times and in whole season

Apple cvar	Average leaf surface (mm ²) ($\bar{x} \pm \sigma$)	Leaf consumption (%) in:			Annual consumption (%)	
		July	August	October	1997	1998
Jonathan	2058.8±621.1	7.58	9.50	15.83	11.86	29.91
Golden	2840.3±885.3	5.62	9.35	14.35	10.49	29.32
Florina	2703.4±803.4	6.82	6.13	11.87	10.44	24.82
Generos	2737.8±733.6	6.48	7.02	11.51	10.20	25.01
	CL 5%		=	12.740		
	1%		=	18.249		
	0.1%		=	29.116		

Table 6

Dry foliar mass (mg) and extend consumed by *Phyllonorycter blancardella* F. in dependence of cvar, period and year

Apple cvar	x foliar biomass (mg)	Periodical consumption (%) 1995			Annual consumption (%)	
		July	August	October	1997	1998
Jonathan	274.2±10.4	1.13	1.86	4.27	2.42	7.26
Golden	409.8±31.6	1.02	2.32	3.59	2.31	6.93
Florina	425.3±32.7	1.18	1.31	2.73	1.74	5.22
Generos	447.4±34.1	1.14	2.30	2.68	1.63	5.12
	CL 5%		=	4.524		
	1%		=	6.693		
	0.1%		=	10.339		

Conclusions

- Occurrence of direct relationship between the foliar surface destroyed by the larvae and the number of mines on a leaf, expressed by the index of correlation g , with values from 0.74 to 0.99 distinctly and highly distinctly significant.

- Presence of a correlation with a coefficient g with very high values (0.98-0.99) between the dry foliar biomass consumed and the number of mines.

- Percentage of a foliar area destroyed from the whole leaf surface was up to 24-29%, while the percentage of dry biomass consumed represent 5.12-7.26%.

- According to the foliar area destroyed seasonally and annually, Jonathan cvar can be considered as more resistant, while Golden more sensitive to *Ph. blancardella* attack, however differences among cultivars are insignificant, by the estimated percentage from the whole leaf area.

- In the general context of the results referring to damages induced to foliage, both as leaf area and dry biomass consumed, it is difficult to establish EDT value, having to be considered for warning the control measures against this pest.

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