

## **Rosy apple aphid (*Dysaphis plantaginea* Pass.): observations on population dynamics and experiences of natural control.**

L. Mattedi<sup>1</sup>, F. Forno<sup>1</sup>, R. Maines<sup>1</sup>, M. Varner<sup>2</sup>

### **Abstract**

*During the last 20 years, the rosy apple aphid was the subject of accurate visual observations, conducted in the open field (in both untreated plots and organic farms) and aimed to depict different behavioural aspects. Some of them (such as the duration of the reappearance period, the evolution, behaviour and mortality of the fundatrices, the evolution and spread of the colonies, the position on plant, the lifespan of fundatrices, the susceptibility of the different scab-resistant varieties, the possibility of a natural control) are summarised in this report. Fundatrices reappear gradually at the beginning of the season, during a period of about 24 days, are present mainly on flowers-clusters, and prefer the middle-lower parts of the trees.*

*Owing to preliminary observations, the fundatrices lifespan is at least two months. In 2008 the incidence of the mortality was studied, resulting in the 63% of the individuals in the climatic reference conditions.*

*Moreover, this paper documents the presence of the rosy apple aphid also on scab-resistant varieties (Florina, Goldrush, Golden Orange), previously considered unsusceptible to this phytophagous, and reports an experience of natural control, carried out in 2007 in an organic 18-ha farm.*

*These observations could support the practice in the organisation of the control strategies against *D. plantaginea*.*

**Keywords:** rosy apple aphid biology, useful insects, natural control

### **Introduction**

Rosy apple aphid (*Dysaphis plantaginea* Pass.) has been the protagonist for several observations within the organic agriculture up to now. The dangerousness deriving from its presence can be classified on the basis of the dimensions of organic farms. In farms measuring at least 9-10 ha the problem was eventually significantly reduced, with populations appearing constantly late in the season and being scarcely important, while in small-sized farms the problem showed the same trend as in the conventional ones, requiring the development of Neem (*Azadirachta indica*)-based treatments in order to achieve an efficient control. In a big-sized farm ("Maso del Gusto", 18 ha located in Nave San Rocco -Adige Valley – Trentino), from 1980 to 1999 the rosy apple aphid populations were constantly decreasing. This phenomenon seems to depend on the "lack" of fundatrices at the beginning of the season (Tab. 1), probably due to a premature senescence in plants at the end of summer – beginning of fall, which prevents the winged individuals from returning to mate, lay eggs and subsequently overwinter. The surveys easily revealed the quite total absence of this phytophagous even in years with high population levels in integrated orchards or organic small farms.

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Table 1: rosy apple aphid reappearance at the beginning of the season in organic and integrated farms

Year	Organic farms	Integrated farms
1991	29 <sup>th</sup> April	2 <sup>nd</sup> April
1992	27 <sup>th</sup> April	1 <sup>st</sup> April
1993	27 <sup>th</sup> April	29 <sup>th</sup> May
1994	26 <sup>th</sup> April	21 <sup>st</sup> March
1995	19 <sup>th</sup> May	31 <sup>st</sup> March
1996	3 <sup>rd</sup> June	24 <sup>th</sup> March
1997	19 <sup>th</sup> May	7 <sup>th</sup> March

From the end of the '90s, the farm embarked on a significant renewal process, during which new plants were planted on this surface that was almost untouched by aphids. The rosy apple aphid was thus reintroduced and showed its aggressiveness especially in the years 2001 and 2007.

The return of rosy apple aphid has been considered as another chance to study its establishment in our environment and, again, a possibility to follow its evolution in a particular situation.

### Material and Methods

Observations on *D. plantaginea* biology were carried out in orchards measuring at least 2000 m<sup>2</sup> (from 2000 m<sup>2</sup> up to 18 ha), untreated with insecticides, and regarded different apple ages, varieties and rootstocks. They started in 1995 and, until 1999, concerned constantly the Golden Delicious variety grafted on M7 and aged 18-25 years; in the following years data were confirmed on the same variety grafted on M9, with a variable age (between 1 and 10 years). Surveys were conducted by visual controls directly done in the field, by the same personnel, with a frequency from daily to twice per week. Flowers clusters with fundatrices were marked in order to follow the evolution of the individuals in the colony. In such conditions it was possible to reconstruct and confirm, during several years:

- the duration of the reappearance period, the evolution, behaviour and mortality of the fundatrices,
- the evolution and spread of the colonies,
- the position on plant,
- the lifespan of fundatrices (10 individuals in 2005 and 20 in 2008 were followed from birth to disappearance by moving them onto new flowers-clusters with a paint brush to avoid any confusion with the young forms, which can become very similar to the mother when grown),
- the susceptibility of the different scab-resistant varieties,
- the possibility of a natural control (experience conducted on a 1 ha plot and then confirmed on a 17 ha one).

Some of these observations were already presented in 2000 and during the following years they were repeated on young apple trees. Moreover, for the same variety (Golden Delicious), the same data were confirmed also on weak rootstocks. Therefore, this paper summarises observations carried out in 2007 and 2008 on three-year old Golden Delicious/M9 trees planted in the Farm "Maso del Gusto", located in Nave San Rocco (Adige Valley - Trentino).

In addition, an accurate survey activity conducted in 2007 regarded the development of 335 fundatrices and the useful insects present on flower fascicles infested by aphids.

## Results

### 1. Duration of the reappearance period, evolution, behaviour.

The earliest fundatrices of 2007 appeared the 3<sup>rd</sup> March (corresponding with the “green tips” phenological stage in the Golden Delicious variety); an intense renewal of activity was observed between the 14<sup>th</sup> and the 23<sup>rd</sup> March and the last fundatrices were found out the 27<sup>th</sup> March, which confirms that the reappearance period lasts around 24 days and anyway it was completed before blossoming (Fig. 1).

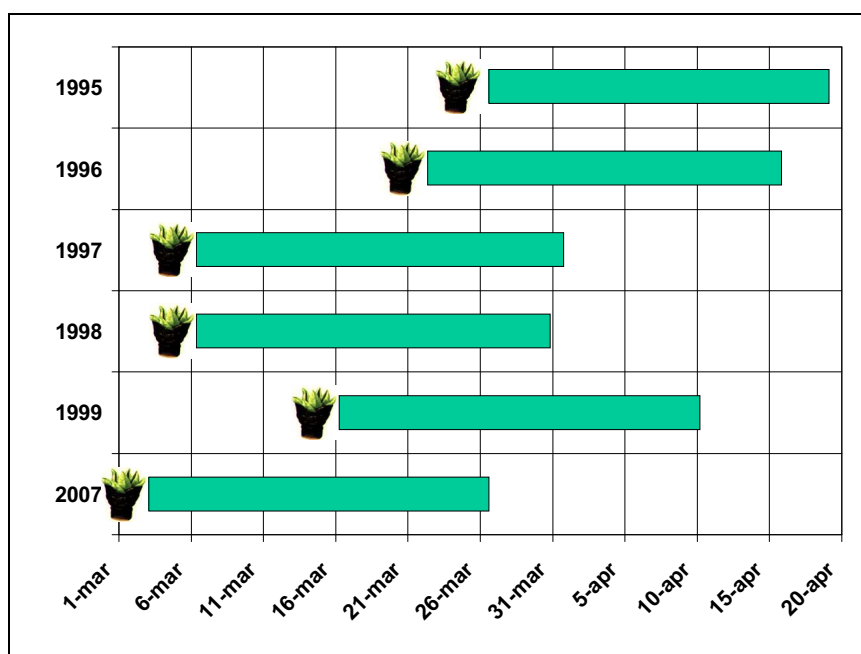


Figure 1: reappearance period of rosy apple aphid fundatrices in Adige Valley.

The earliest offspring was observed the 6<sup>th</sup> April, while the first movements of aphids along the young shoot of the flowers clusters that shelters the fundatrix were pointed out the 18<sup>th</sup> April. At the end of the month spreading regarded the neighbouring shoots of the same plant, giving rise to a little more generalised colonisation. April was characterised by a warm and dry climate that hampered the rosy apple aphid and favoured the activity of useful. This aphid needs in fact a fresh and wet climate, which confers a higher speed and intensity of growth, to develop aggressively.

A fresher weather, which characterised the beginning of May, allowed a renewal of the colonies and a slowdown of the useful insects' activity, even though the aphid development had already been irrecoverably compromised by the dry-warm climate of April.

The winged forms started to appear from the 12<sup>th</sup> May, gradually establishing their presence until the 15<sup>th</sup>- 20<sup>th</sup> June. The rosy apple aphid disappeared from apple trees since the 24<sup>th</sup> June.

### 2. Fundatrices distribution

Out of 335 observed fundatrices, 269 (80%) were on flowers-clusters, 53 (16%) on vegetative buds and 13 (4%) on root suckers (Fig. 2); 288 (86%) were placed in the middle-lower parts of the trees and 47 (14%) in the upper parts (Fig. 3), confirming the observations conducted in the '90s.

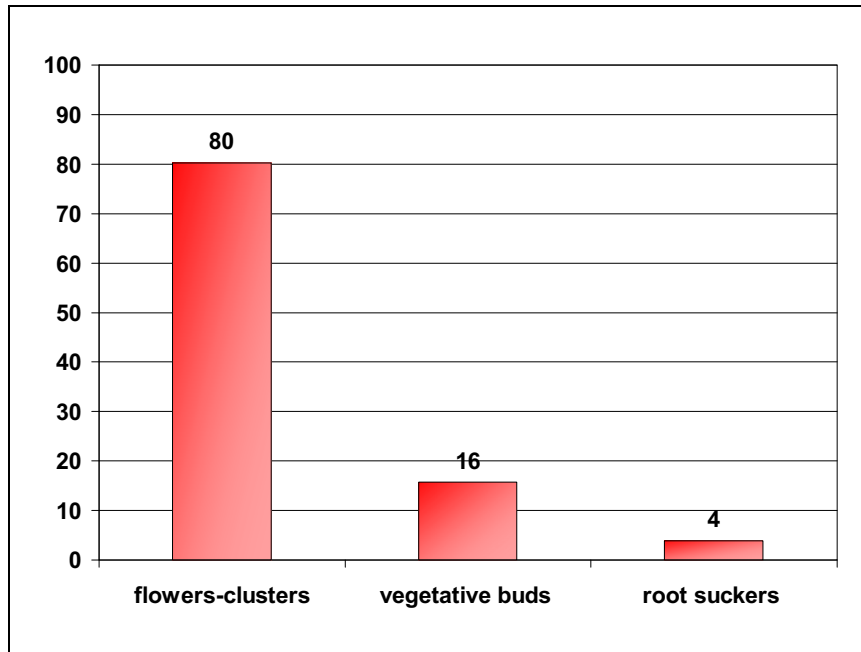


Figure 2: fundatrices position in the vegetation (%)

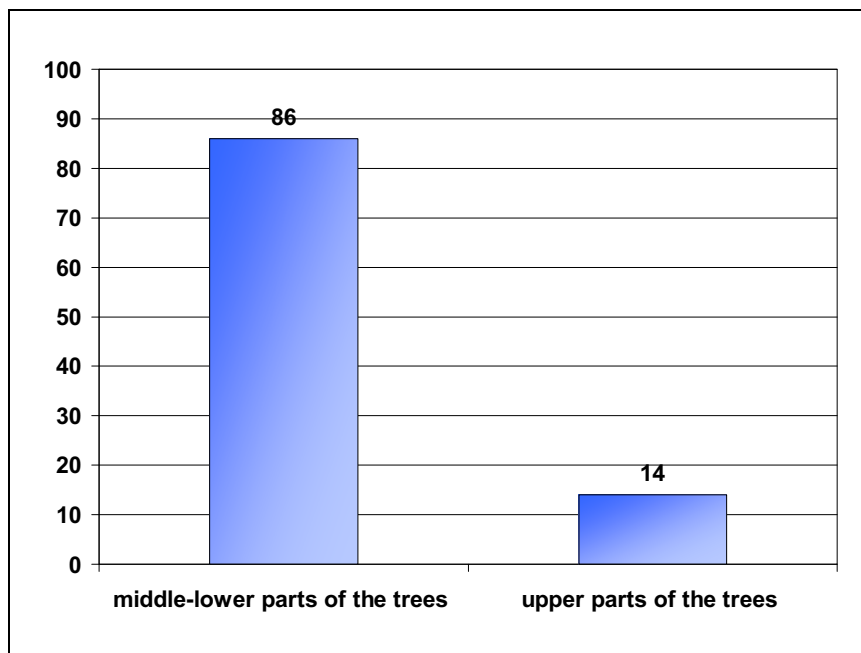


Figure 3: fundatrices position on the trees (%)

Moreover, 100 trees per row were inspected within 5 adjacent rows, starting from the edge, and again the aphids are mainly present on the plants located along the edges (Fig. 4).

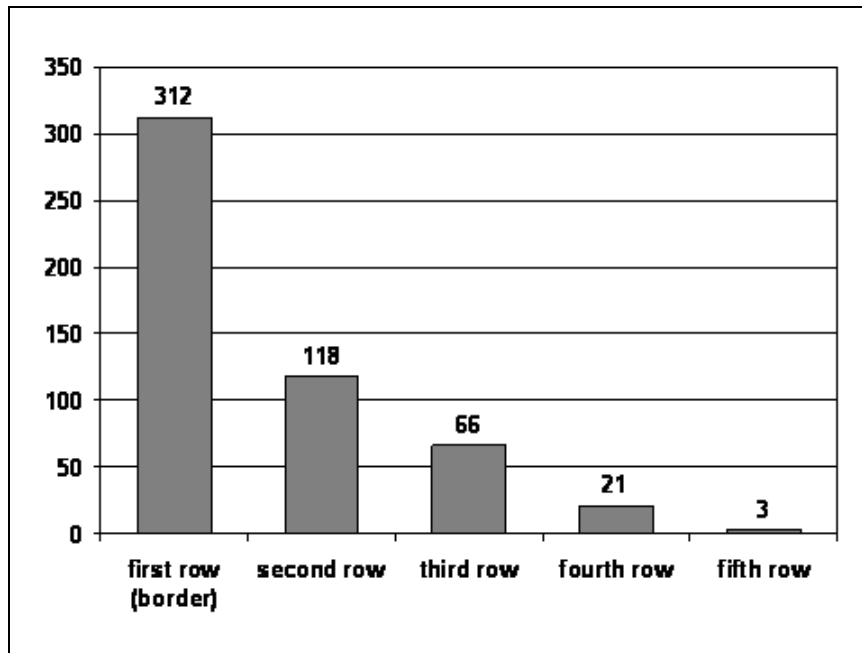


Figure 4: distribution of rosy apple aphid fundatrices in April 2007 on 5 adjacent rows, starting from the edge

### 3. Fundatrices mortality

An interesting annotation done in 2008 regarded the natural mortality of fundatrices in consequence of the climatic trend of April; a reduction up to the 60% (observed in the fundatrices marked in March) and a very slow population development were noticed in three different farms (Fig. 5).

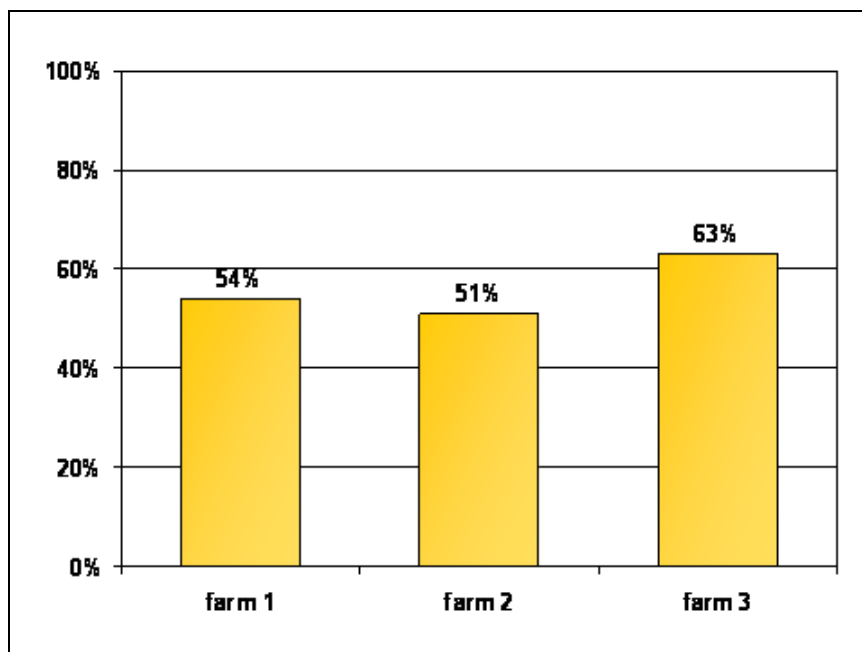


Figure 5: natural mortality of the fundatrices, in three farms, in consequence of the climatic trend, registered in April 2008

### 4. Fundatrices lifespan

A frequent question is: “How long will a fundatrix live?” To answer this point, some years ago we conducted an experience that, surprisingly, gave us the following indications: 10

fundatrices, marked between the 4<sup>th</sup> and the 12<sup>th</sup> March, 2005, did survive until the 3<sup>rd</sup> May (6 were followed for 60 days and 4 for 52 days); after that date they got lost.

Twenty fundatrices, born between the 3<sup>rd</sup> and the 24<sup>th</sup> March (5 the 3<sup>rd</sup>, 6 the 16<sup>th</sup> and 9 the 24<sup>th</sup>) were marked the 6<sup>th</sup> April, 2008. Insects were gently transferred onto new shoots using a thin paint brush to avoid mixing them up with the new offspring. As result, 10 aphids were disappeared the 12<sup>th</sup> and 10 other the 17<sup>th</sup> May. Therefore, this means a lifespan of at least two months for rosy apple aphid fundatrices.

## 5. Rosy apple aphid and scab-resistant varieties

Some scab-resistant apple varieties have been reported to show also a reduced susceptibility to this aphid since many years. However, when observations, carried out in the lab and in small plots, are transferred to wide surfaces (larger than 1000 m<sup>2</sup>), these remarks definitely lose their validity. This remark had already been made in the past and here we can confirm it again: Florina, as well as Golden Orange and Goldrush, shows significant attacks with fruit damages due to the rosy apple aphid (Tab. 2).

Table 2: Scab-resistant varieties and rosy apple aphid

Date	Locality	Variety	Number controlled trees	Number affected tress	% affected trees
31.05.07	Cagnò	Florina	100	43	43
16.05.07	Nave S. Rocco	Goldrush	400	164	41
21.05.07	Spagolle	Goldrush	200	67	33.5
21.05.07	Spagolle	Golden Orange	100	31	31

## 6. Activity of the useful insects

In spite of the substantial and widespread presence of rosy apple aphid, the owner of the farm decided not to apply specific insecticides, relying on a climate more favourable to the auxiliary insects' development than to the phytophagous. As the presence of useful insects can be easily singled out, it is possible to state that in the '90s natural control was in fact successfully applied. Therefore, it was possible to plan an accurate study, which is summarised in Table 3. The useful insects present the 6<sup>th</sup> April, 2007, were: Diptera: Syrphidae (adults and eggs), Coleoptera: Coccinellidae (adults, eggs and early larval instars) and Hymenoptera.

Table 3: state of the natural control of rosy apple aphid in 2007 in an organic farm

Date	total N° of colonies	N° of active colonies (> 50 aphids)	N° of partially active colonies (1-50 aphids)	N° of colonies with useful insects	N° of clean colonies	% of clean colonies
6 <sup>th</sup> Apr	335	123	212	55		
18 <sup>th</sup> Apr	335	10	41	206	194	58
26 <sup>th</sup> Apr	335	13	143	248	179	53.4
5 <sup>th</sup> May	335	19	144	207	172	51
12 <sup>th</sup> May	335	29	141	189	165	49
18 <sup>th</sup> May	335	13	130	267	192	57
28 <sup>th</sup> May	335	10	109	276	216	64.5
2 <sup>nd</sup> Jun	335	5	114	285	216	64.5
19 <sup>th</sup> Jun	335	2	55	335	278	83
24 <sup>th</sup> Jun	335				335	100

The useful species showed a huge increase in the number of both species and active stages during the season. Besides the ones mentioned above, also the presence of Neuroptera: Chrysopidae (eggs, larval instars and adults), Hymenoptera: Chalcidoidea and Ichneumonoidea: Braconidae, Orius spp., Diptera: Cecidomyiidae, Acarina: Trombididae and other spiders was recorded. Among all the species considered, larval instars and adults of Coleoptera: Coccinellidae, larval instars of Diptera: Syrphidae and parasitoid Hymenoptera resulted to be the most efficient.

## Discussion

These observations were aimed to increase the knowledge of *D. plantaginea* behaviour in our environmental conditions, thus contributing to its management. Regarding this phytophagous, two different situations can be found in organic agriculture of Trentino:

- 1) Big-sized farms (at least 9 ha): specific treatments against rosy apple aphid were stopped more than 20 years ago. Plot renewal within these situations shows an early *D. plantaginea* reappearance that could require specific treatments or, such as at Maso del Gusto, important populations of useful insect to achieve an efficient control.
- 2) Small-sized farms, in which the study of the behaviour could help *D. plantaginea* management. It would be important to organize the control in consideration of the gradual renewal of activity of the fundatrices, their distribution on the plant and within the plot.

Some scab-resistant varieties checked in our environment result to be susceptible to rosy apple aphid attack.

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