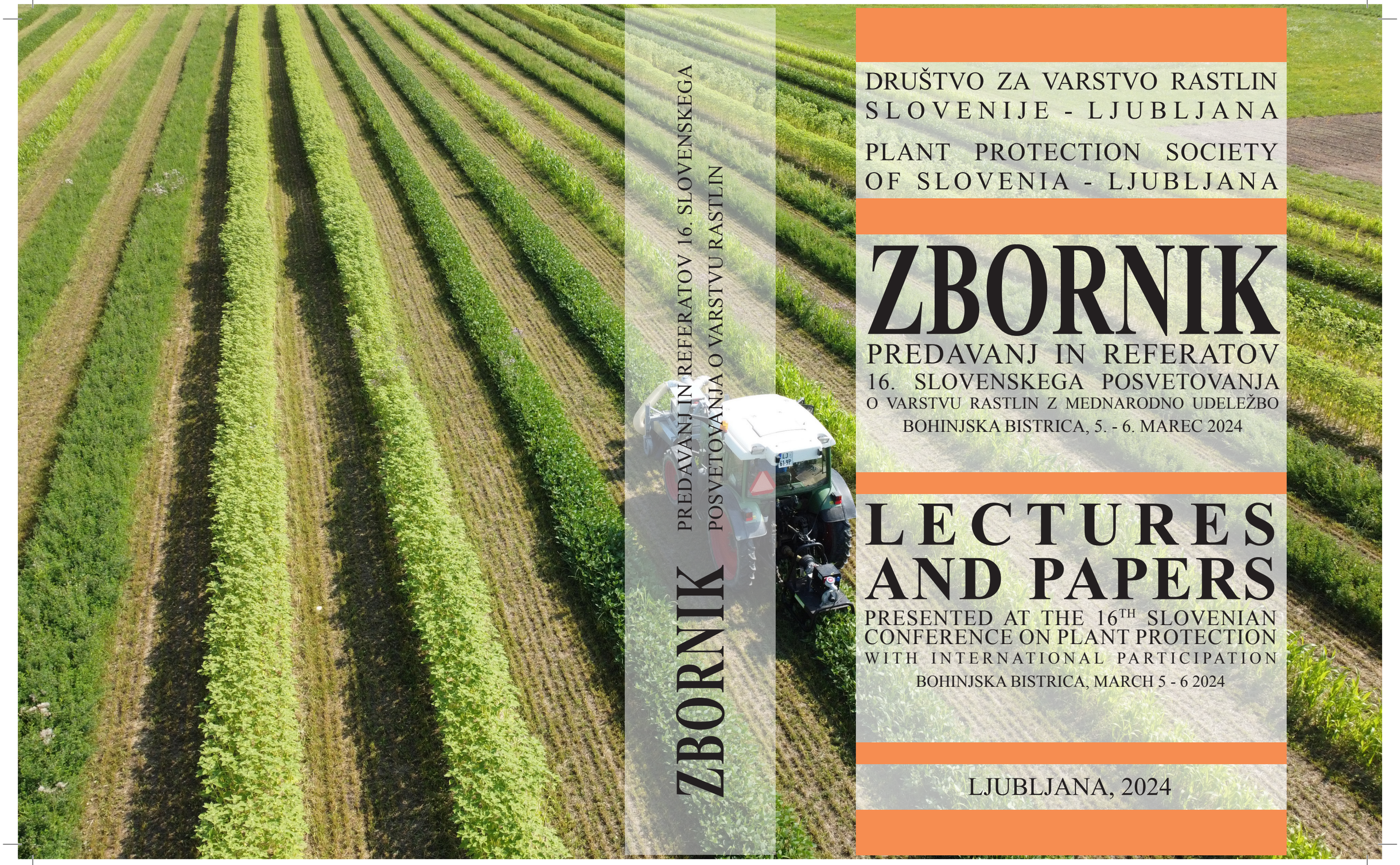

ZBORNIK PREDAVANJ IN REFERATOV 16. SLOVENSKEGA POSVETOVANJA O VARSTVU RASTLIN

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PLANT PROTECTION SOCIETY OF SLOVENIA - LJUBLJANA

ZBORNIK

PREDAVANJ IN REFERATOV

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LECTURES AND PAPERS

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SYRPHID RELEASING VS *Eriosoma lanigerum*: PRELIMINARY RESULTS

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ABSTRACT

In the last few years, one of the most worrying pests for apple production in the Southern Alps is woolly apple aphid (WAA), *Eriosoma lanigerum* Hausmann. It causes hypertrophy and tissue ruptures in roots and shoots of apple trees. This can reduce sap flow, vigour, tree productivity and fruit quality. Since the challenge facing agriculture in the coming years is to produce a good yield of healthy food using improved environmentally friendly practices, enhancing biological pest control is crucial. A great control of the WAA population is made by the parasitoid *Aphelinus mali* Haldeman but only for a short period of the season. Syrphidae is known to have high predatory potential on the population of aphids in orchards, i.e., *Ephisyrphus balteatus* De Geer is one of the most effective biocontrol agents against aphids in apple orchards. For these reasons, the ability of Syrphidae in controlling the population of WAA in apple orchards of Trentino (North Italy) was evaluated during the season 2023. The trial was carried out in three potentially high-infested orchards: two orchards were treated with beneficial insects, and one was non-treated (control). The orchards were organic managed, cultivated with Golden Delicious variety on M9 rootstock. In the treated orchards, pupae of *E. balteatus* and *Sphaerophoria ruepellii* Wiedemann of the Koppert B.V. company were released in March. WAA migration on trees and *A. mali* population were monitored on yellow sticky traps during the season. WAA infestation was assessed by visual observations of 50 marked shoots in each orchard from April to August, as well as the presence of predators. Preliminary results of one-year trial showed that Syrphidae release alone was not successful in reducing WAA infestation, but a positive effect could be observed as after one month from the release, Syrphidae abundance on WAA colonies was much higher in the treated orchards.

Key words: Syrphidae, woolly apple aphid, organic orchards, releasing, beneficial insects

1 INTRODUCTION

The challenge facing agriculture in the coming years is to produce a good yield of healthy food using improved environmentally friendly practices (Foley *et al.*, 2011, Wratten *et al.*, 2012). The main tasks of integrated protection include the development

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of parasites and predators and thus enhance pest control. Habitat management aims to meet both agronomic and ecological goals by regulating insect pests, including by intensifying the predator's natural impact and by preserving and promoting biodiversity (Altieri *et al.*, 2004, Simon *et al.*, 2010). Furthermore, biological control uses natural enemies to control pest populations, making it a sustainable and environmentally friendly alternative to chemical pesticides for a long-term pest control.

In the last few years, one of the most worrying pests for apple production in the southern Alps is the wolly apple aphid (WAA), *Eriosoma lanigerum* Hausmann (Hemiptera: Aphididae). This pest is one of the economically important and most widely distributed pests of apple, *Malus domestica* (Borkh.) and other species of Malus, Cotoneaster, Crataegus, Sorbus and Pyracantha (Eastop 1966, Hill 1983). A native of North America (Baker, 1915), it now occurs throughout the applegrowing countries of the world (Eastop, 1966). Both the nymphs and adults cause damage to apple by feeding on the roots and stems, particularly the tender places on the trunk and branches, new lateral growth and areas with damage caused by mechanical injury (Asante, 1995). Infestation of the aphid on apple roots and shoots has been shown to reduce survival of nursery trees and to weaken mature apple trees, leading to the loss of vitality and poor quantitative and qualitative yields (Sherbakoff & McClintock, 1935; Klimstra & Rock, 1985).

A great control of the WAA population is made by the parasitoid *Aphelinus mali* Haldeman but only for a short period of the season when the most damage on the plant and production was caused.

In the other hand, Syrphids (hoverflies) (Diptera, Syrphidae) play an important role among numerous entomophagous species that control phytophages abundance. They reduce the population of aphids (Hemiptera, Aphidoidea), economically important pests which year by year infest orchards in great numbers. The effectiveness of those entomophages as aphid control species is widely known (Wnuk & Medvey, 1986; Chambers & Adams 1986; Tenhumberg & Poehling 1991, 1995; MacLeod, 1999; Wyss *et al.*, 1999; Wnuk, 2000; Solomon *et al.*, 2000; MiËarro & Dapena, 2001; Ambrosino *et al.,* 2006). It is the larvae that are zoophages, while imagines belong to melitophages, feeding on pollen and nectar as well as plant juices and honeydew. Adult Syrphidae play an important role in biocenoses, as they pollinate plants. For these reasons, the ability of Syrphidae in controlling the population of WAA in apple orchards of Trentino (North Italy) was evaluated during the season 2023.

2 MATERIAL AND METHODS

2.1 Study orchards

The study was conducted in 2023 in three apples orchards located in the vicinity of Trento (North Italy). The orchards were organic managed, cultivated with 15-year-old apple trees Golden Delicious variety on M9 rootstock. The study sites included two adjoining apple orchards with different WAA infestation, named T1 and T2 (5148 and

5580 m^2 surface area respectively) and one apple orchard, named NT, (9985 m^2) located at 500 meters from the treated orchards.
In the orchard T1 and T2 were released at the end of April 400 pupae/ha of *Episyrphus balteatus* (EPISYRHUS-P, Koppert B.V. company) and one week later were released also 800 pupae/ha of *Sphaerophoria rupellii* (ROPHORIA-P, Koppert B.V. company). The NT orchard was used as a control wile no Syrphid was released.

2.2 Insects' population

To evaluate the insect's population during the season were selected 50 branches per orchards. Weekly were monitored the presence of beneficial insect and counted the number and dimension of WAA colonies. The dimension of WAA colony was divided in 3 classes: 1) New colony with one-two individual (CL-1); 2) until 0.5 mm diameter colony (CL-2); 3) more than 0.5 mm diameter colony (CL-3).
In April were installed the yellow sticky trap orchard and systematically monitored during the season to evaluate the *A. mali* population until September. During the same period was monitored the WAA migration with the white sticky bands trap positioned up tree trunks and replaced periodically.

2.3 Statistical analysis

The colonies were normalized by multiplying the number of the colonies by 1, 2, or 3 depending on the size.
One-Way ANOVA was used to determine significant differences between treated orchards (T1 and T2) and control for the WAA colonies during the season. A Multiple linear regression based on principal component analysis (Factor Analysis of Mixed Data FAMD) was applied to identify the correlating variables in order to make interpretation easier.

3 RESULTS

In the Figure 1 was represented the 54 % of data on the principal component (PC1 and PC2). The data showed a separation determined for the Syrphidae contributions after one month of the release. In particular, the NT orchard was separated than the other thesis for the presence/absence of Syrphidae (Dim-2); relative to the quantitative variables the major separation was obtained for the WAA normalized colony (Dim-1).

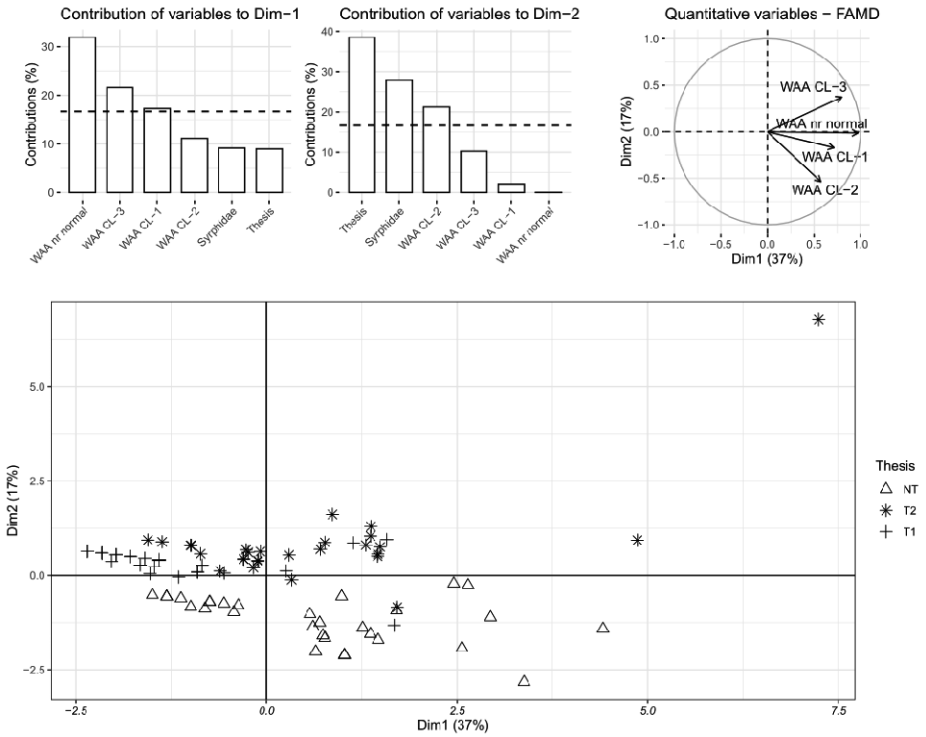

Figure 1: FAMD for separation data that showed 37% for Dim1 (WAA normalized colony) and 17% for Dim2 (thesis and presence/absence Syrphids).

Table 1: Number of normalized colonies on 50 shoots during the season in different orchards. Different letters indicate statistical difference between orchards per control (Anova, Tukey's HSD, $p<0.05$).

Control	Normalized WAA colony ± S.E.		
	NT	T1	T2
17/04/2023	0	0	0
09/05/2023	1.28 ± 0.22 a	0.7 ± 0.10 b	1.28 ± 0.14 a
17/05/2023	3.1 ± 0.39 a	1.22 ± 0.23 b	2.78 ± 0.35 a
24/05/2023	4.62 ± 0.65 a	2.44 ± 0.40 b	4.48 ± 0.70 ab
30/05/2023	7.18 ± 1.0 a	2.7 ± 0.4 b	7.84 ± 0.98 a
13/06/2023	21.32 ± 2.56 a	8.24 ± 1.36 b	19.78 ± 2.64 a
28/06/2023	23.94 ± 2.96 a	10.98 ± 2.06 b	18.3 ± 2.16 a

07/07/2023	33.28 ± 5.68 a	25.7 ± 3.87 a	11.74 ± 2.99 b
18/07/2023	14.72 ± 2.6 a	6.28 ± 1.34 b	19.32 ± 2.53 a
26/07/2023	4.92 ± 1.46 b	3.06 ± 1.44 b	10.78 ± 1.84 a
02/08/2023	1.44 ± 049 b	0.74 ± 0.40 b	5.72 ± 1.13 a
09/08/2023	0.16 ± 0.13 b	0.08 ± 0.08 b	1.36 ± 0.43 a

Table 2: Percentage of WAA shoots infestation and percentage of shoots with at least one Syrphid monitored during the season in the three different orchards.

Control	Shoots with beneficial insect (Nr)			Shoot with Syrphidae (%)			WAA shoots infestation (%)		
	NT	T1	T2	NT	T1	T2	NT	T1	T2
17/04/2023	0	0	0	-	-	-	0	0	0
09/05/2023	0	0	0	-	-	-	60.0	52.0	72.0
17/05/2023	0	0	0	-	-	-	88.0	52.0	84.0
24/05/2023	6	3	4	50.0	33.3	100.0	94.0	78.0	90.0
30/05/2023	12	13	18	41.7	92.3	72.2	100.0	84.0	100.0
13/06/2023	18	17	16	100.0	94.1	93.8	100.0	94.0	100.0
28/06/2023	10	6	16	60.0	100.0	93.8	100.0	94.0	100.0
07/07/2023	10	7	1	50.0	85.7	100.0	96.0	100.0	88.0
18/07/2023	32	18	24	40.6	50.0	45.8	68.0	76.0	96.0
26/07/2023	31	16	28	29.0	25.0	39.3	30.0	30.0	60.0
02/08/2023	28	5	28	21.4	40.0	14.3	24.0	14.0	62.0
09/08/2023	14	0	14	0.0	-	7.1	4.0	2.0	24.0

4 DISCUSSION AND CONCLUSION

The WAA migration started on the second week of May with a peak at the end of June. The ascent stopped at the end of July. His parasitoids started the flight with a small peak during the first week of June, but the maximum presence was during the first week of August when the climate condition was favourable.
During the trials the orchard used as a control showed a higher number of normalized WAA colonies without statistical difference than the orchard T2 until the middle of July. In the orchard T1 the WAA population was lower than the other orchards and the shoot infestation was delayed. The reduction of infestation in NT orchard was

attributed to the abundance of A. mali at the end of the season, that was higher than the orchard T1 and T2. In the orchard T1 the infestation level was lower during all the season, than the T2, and the presence of Syrphidae has been partly responsible to control this infestation. In fact, the abundance of Syrphidae population in T1 e T2 was higher than the orchard used as a control. The T2 and NT orchards reached a WAA infestation value higher than T1 also for the colony dimension because the major number of bigger colony (CL-3) was difficult to predate for the beneficial insects.
In conclusion, the results of one-year trial showed that Syrphidae release alone was not successful in reducing WAA infestation, but a positive effect could be observed as after one month from the release, Syrphidae abundance on WAA colonies was much higher in the treated orchards. For this reason, is necessary another experimental year to validate the effects.

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