CORVINUS UNIVERSITY OF BUDAPEST

ENVIRONMENTAL GRAPE GROWING IN THE DISTRICT OF FERTŐ-HANSÁGI NATIONAL PARK ESPECIALLY WITH REGARD TO PREDATORY MITES

Theses of Doctoral (PhD) Dissertation

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PhD School

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The applicant met the requirement of the PhD regulations of the Corvinus University of Budapest and the thesis is accepted for the defence process.

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Introduction, appointed aims

For decades, our grape growing has been characterised by using of fertilisers and pesticides to a great extent which has damaged the environment significantly furthermore it has narrowed down the presence and activity of beneficial living organisms. The overusing of pesticides has added to the descending role of natural enemies in controlling pest generations.

Integrated growing and pest controlling technologies introduced in the 1980s signified a change in viewpoint and meant real breakthrough. The aim of integrated grape production is to grow grapes economically with ecologically sustainable methods which are acceptable to the natural environment so that pest density stays under ecological damage threshold. At the same time profiting from natural controlling factors becomes dominant, too. Contrary to former type of grape control, in the future the professional and timely use of agrotechnological (e.g. nutrient supply, location, cultivation, choice of stock) and phytotechnological (e.g. appropriate pruning, timely cultivation) methods will become dominant. Pest controlling technologies based on forecast will come to the front using environmentally friendly pesticides. In integrated growing, the controlling role of zoophagous species will be appreciated significantly, and in some cases their settlement can take place. Settlement of predatory species is a costly method and its success highly depends on the adaptation ability of the settled species so the careful treatment of local beneficial fauna seems to be more effective.

A great part of Hungarian wine districts and areas where grape is grown is located in national parks, landscape protection areas, or their puffer zones. Although no intensive agricultural activity can be carried on in these areas, grape plantations of great value – as standing plantations – cannot be ceased from one day to the next. On the one hand they are of economic significance, on the other hand they play a remarkable part of landscape aesthetic. The fertilizer and pesticide overusing of the former years cannot be pursued in these environmentally valuable areas in behalf of environmental protection.

More and more researchers have been searching into the cause of dispersion of phytophagous mite species because of their increasing damaging in grape and fruit plantations. From the listed factors, the changes caused by the antropogen influences are considered the most significant in all cases. The overuse of N-fertilizer, the inappropriate timing of spraying, the use of herbicides, the inadequate cultivation method all added to the significant dispersion of pests, causative agents.

The aim of the Target Program of the Environmental Fund sponsored by the Environmental Department and launched in 1998 was to convert the cultivation technology of grape plantations situated in national parks environmentally. The environmental cultivation was first introduced on the grape fields of Soproni Wine District located in Fertő- Hansági National Park in nearly 350 hectares.

The populations of mite species in grape plantations can indicate the intensity of cultivation technology and overuse of pesticides. For that very reason, I have emphasised the research of phytophagous and predatory mites habitant in grape plantations in my project.

The aim of my research was to investigate the following questions:

- How does the change of cultivation method influence the mite population of the plantations?
- Which effects do the traditional and the integrated pest controlling treatments have?
- Are there any differences in mite populations of plantations dispersed with predatory mites (*Typhlodromus pyri*) or of the ones without dispersed mites?
- Is the dispersion of predatory mites in a given plantation necessary, or is it sufficient to follow strictly the prescribed cultivation technology in order that the natural zoophagous mite species multiply?
- How does the cultivation technology and the applied phytotechnology influence the vertical location on the grape shoot of phytophagous and zoophagous mite species?
- Last but not least I would like to present an overall picture about mite fauna of the Soproni Wine District in the hope that a more successful protection can be carried out with the cognition/familiarisation of mite species present in grape.

Materials and methods

An important part of Soproni Wine District is situated in Fertő-Hansági National Park so the issue of environmental pollution cannot be avoided. My research was started in the grape plantations of the Fertő-Hansági National Park in 1998 in connection with a tender (*KTM-KKA pályázat 021228)* of the Environmental and Water Conservancy Department won by the Green Agriculture Fund in Keszthely. From 1998 to 2000 the pilot survey of the plantations, the adjustment of the endurance, and the introduction of the elements of integrated cultivation technology (dispersion of predatory mites /members of the parent strain *Typhlodromus pyri* "Mikulov " from Czech Republic which are 200 times more resistant to organic phosphoric acid-esters/, use of green plant protection materials, omission of acaricides, installation of forecasting appliances /AGROEXPERT/, alternate row-alleys grassing down, trimmings crusher, plant protectional forecasting etc.) were carried out. Since 2001 I have been observing the mite species on the chosen grape plantations.

Characteristics of the observed areas

Treatment	Location	Grown cultivar	Cultivation method	Cultivation method
C/1	Around Kisboz in an area between the railroad, the road, and the Nagycenki Famous lime-alley	Kékfrankos	Single curtain	Integrated with dispersion of *T. pyri* strain „Mikulov”
C/6	1 km far from C/1 field, sloping towards Fertő lake	Kékfrankos	L-Moser	Integrated without dispersion of *T. pyri*
Sm.	Sopron-Présháztelep stock collection	Cabernet sauvignon	Umbrella	Integrated, with dispersion of *T. pyri* strain „Badacsony”
Scs.	Sopron - Présháztelep	Cabernet sauvignon	Umbrella	Integrated with dispersion of *T. pyri* strain „Mikulov”
F/34.	A field of number 0183/5., travelling from Sopron-Présháztelep to Fertőrákos on the shore of Fertő lake	Cabernet sauvignon	L-Moser	Integrated with dispersion of *T. pyri* strain „Mikulov”
F/36.	A field of number 0183/7., travelling from Sopron-Présháztelep to Fertőrákos on the shore of Fertő lake	Cabernet sauvignon	L-Moser	Integrated without dispersion of *T. pyri*
Conventional	2 km from Sopron-Présháztelep to Sopron	Kékfrankos	Single curtain	Conventional plant protection
Abandoned	To Fertőrákos around Tómalom on the shore of Fertő lake	Cabernet sauvignon, mainly the stock appeared	indeterminable	Uncultivated, unweeded plantation

Plant protectional treatments

”Conventional” plant protection

The cultivation technology of the treatment „Conventional Kékfrankos” follows the cultivation principles of former large-scale estates although this is a small-plot field of a private farmer. There is Kékfrankos grape type in this plantation which is cultivated with single curtain method, and was planted in the 1980s. The plantation is in good condition, healthy, without pests, causative agents and deficiency/shortage of wine-stock. It is characteristic that the soil is handled as fallow and weedless which is achieved with frequent harrowing.

Forecasting is not applied either in case of pests (European grapevine moths) or of causative agents (grape downy mildew, grape powdery mildew). The cultivation is proper and permanent. Artificial fertilizer is spread as nutrient supply. Its pest controlling is different from that of the large-scale estates to a certain extent, as overusing of OP’s compounds and dithiocarbamates is not characteristic, nor acaricides and herbicides are used. Ten sprayings were carried out with seven or eight active ingredients during the vegetation period. A decided difference could be observed in the using of sulphur as a spraying and powdering applications as it was used 8-10 times in larger amounts (8-10 kg per occasions, in 2002 8-20 kg/ha). Applications of sulphur did not decrease in the frequency only in the dosage in 2003 and 2004 when it was reduced to 5 kg/ha in active ingredients, besides the mankozeb was left. It was used 3-4 times in the former years.

Integrated plant protection per examined areas

The plantations C/1 and C/2 with Kékfrankos owned and treated by Széchényi Corporation in Nagycenk, the ones marked Sm and Scs of Sopvin Ltd., the fields marked F/34 and F/36 of Vincellér MNPS Ltd. follow the principles of integrated cultivation technology from 1999-2000 in connection with a tender of KTM-KKA. It is common that the plantations are covered with grass in every second row by the aid of the native weed flora, the tillage is mild using cultivator, the nutrients are supplied based on soil- and leaf-sample tests, the plant protection is planned and aimed based on forecasting, predatory mites (*T. pyri*) are introduced depending on financial means (a cloth- bend is placed on every fifth vine-stock in the plantations C/1; F/36; Sm; Scs.)
Acaricides, OP’s compounds and pyrethroids were not applied, chitin synthesis inhibitors are mostly sprayed to control grapevine moths. There were 7-8 applications during the vegetation period, sulphur products were used in 2-3 sprayings, however the amount of the active ingredients per hectare was not more than 2 kilograms. The chemical weed control of the rows’ soil in spring was different every year and in every examined plantation.

Acarological surveys

Recording of mite species during dormant season

The overwintering mites and other species were collected from under the bark with the method of funnelling during the dwelling period. This method had to be completed by the microscopic examination of barks. This was needed because not all the animals left their wintering place after the funnelling, and with the help of this combined method a more accurate data of quantity and proportion could be collected about the overwintering animals.

50-50 pieces of scrubs of 10 cm and with 2-3 buds per examined plot were collected at the end of January, at the beginning of February for the funnelling during the dwelling. The scrubs per sample were put on a sieve in a funnel with cone (Berlese) and were warmed or rather dried with a bulb of 60 W for 24 hours. A Petri dish filled with the mixture of alcohol and glycerine was put to the bottom of the cone where the animals fell. After funnelling, the climbed animals were groomed onto slides (in solution of Berlese-Hoyer).

After funnelling, the samplings was reviewed by microscope, and the animals left on the bark and in the bark cracks were collected and groomed with the help of the Entomological Department of Corvinus University of Budapest.

Observation of phytophagous and zoophagous mite species during dwelling

Survey of injury of *Calepitrimerus vitis* NAL.

During the vegetation period in the second half of May, all the shoots of 10-10 randomly selected stocks in the examined plantations were examined. The degree of the damage of the rust mite (*Calepitrimerus vitis* NAL.) was estimated with the help of a mite damage scale of 1-4 grades.

4 graded mite damage scale

0: no damage

1: suck spots on 1-2 leaves of the shoots

2: suck spots on 40-50% of shoot leaves

3: suck spots on all the shoot leaves

Observation of occurrence of phytophagous and zoophagous mite species

150-150 pcs of randomly selected leaf samples per treatment were collected from the examined plantations every month to state the individual number of mites occurring on the grapevine foliage. The collected samples were examined under a microscope with the contribution of the colleagues of the Entomological Department (Antalné Gátmezei and Zsuzsanna Schmidtka). The found specimens were picked off and stored in AGA solution or rather in alcohol, then they were directly mounted.

Dates of sampling:

2001: 12/05, 12/06, 13/09

2002: 08/05, 06/06, 03/07, 05/08, 11/09

2003: 15/05, 18/06, 07/07, 11/08, 12/09

2004: 27/05, 29/06, 24/07, 31/08

One of the obligatory tasks of the cultivation technology is the topping of shoots. This work ensures the appropriate handling of grape plantations and a better efficiency of their pest control applications. Also the number of mites living on shoots is affected by this training application as the plant parts which are feeds for phytophagous mites were removed. Data were gained from the samplings of the vegetation period not only about the quantity and proportion of mites species but also about the vertical pattern of occurrence on shoots. The shoot length of the grape was segmented to 3 zones: the lower one (**1**), the middle one **(2)**, the top one (**3**). (The lower zone (**1**) of the shoots is the lower tierce from the bottom of the shoot to the 4^{th}-5^{th} leaf, the middle part (**2**) is from the 5^{th} up to the 10^{th} leaf, and the top part (**3**) is the top end of the shoot.) 50-50 pieces were collected from all the three leaf levels of the plantations, except for the uncultivated plantation where only 50 pieces of leaves were collected as no leaf levels could be divided because of the lack of the cultivation. The determination of the mite species was performed according to key of KARG (1993) which was fulfilled by Tamás Hegyi and Árpád Szabó.

Rating of the proportions and the calculation of the 95% confidence interval of these proportions were applied to analyse the dominancy relations of the mite species occurring in the wine region, based on the data of the samplings of the examined plantations. This type of estimate comes to statistically more reliable results than the point estimation. The data processing was carried out with the statistical computer programme SPSS.

Results

Recording of mite species during dwelling from 2001 to 2004

Funnelling and microscopic analyse of scrubs in 2001

5 mite species, 7 families and the eggs of *P. ulmi* could be identified during the recording after funnelling and microscopic analyse of scrubs. The families *Tydeidae* (67,2 %) and *Acaridae* (16,2%) were present in largest individual number from all the determined mites which appeared in smaller or larger number in the samplings of all the treatments. The family *T.pyri* was also present, although in a small number (4,8%) in almost all samplings in nearly the same amounts. The family *Bryobiae* could also be found everywhere except for 3 integrated treatments (C/1, C/6, F/34). The members of the family *Tarsonemidae* could be observed in the case of 3 treatments (Sm., Scs. Uncultivated). The species *Amblyseius (Euseius) finlandicus* occurred in low number (1,6%) in 4 cases, the *Zetzellia mali* in 2 cases, and the *Seiulus simplex* in 1 case.

Funnelling and microscopic analyse of scrubs in 2002

8 mite families, 3 mite species and the eggs of *P.ulmi* could be identified in the samplings collected during dwelling in 2002. The families *Acaridae* (58,7%), *Tydeidae* (19,1%), *T.pyri* (12,3%), and *Oribatidae* (8,1%) were present in largest individual number. The families *Bryobiae, Tarsonemidae*, *Cunaxidae*, *Zetzellia mali,* and *E. finlandicus* could be identified only with one-two individuals only in one-one sampling. Compared to 2001, the number of *Acaridae* increased by four times, the one of *T. pyri* increased by twice, and the one of *Oribatidae* rose by six times, while the number of *Tydeidae* decreased to its third although it was still the second large in number among all the collected mites. The individual number of the family *Bryobiae* decreased from 90 pcs of the last year to 2 pcs which is almost insignificant and occurred only in the treatment C/1 while it could be identified in five samplings of the 8 treatments earlier. The individuals of the families *Acaridae, Tydeidae, Oribatidae* and *T. pyri* could be registered in all 8 treatments. The individual number of *T. pyri* per treatment is almost the same, yet it is far the lowest in the cases of Sm (6 pcs) and F/34 (2pcs). The eggs of *P.ulmi* could be found everywhere in number of 1-23 except for the treatments of C/1. and F/36.

Funnelling and microscopic analyse of scrubs in 2003

8 mite families, 8 mite species and the eggs of *P.ulmi* could be identified during the dwelling in 2003. The families *T.pyri* (33,2%), *Acaridae* (45,6%), and *Tydeidae* (11,57%), were present in largest individual number similar to the previous years. The former species and families together with the families *Oribatidae* (4,7%) and *Tarsonemidae* (4,1%) could be found in all treatments. The

number of *Acaridae* increased by 20% compared to the year 2002, the *T.pyri* by more than three times, while the individual number of *Tydeidae* was the same.

Most *T. pyri* occurred in the integrated treatments C/1., Scs., Sm., and C/6, altogether 83%, while the lowest number was observed in the "Uncultivated" treatment, only 2%. The *Acaridae* was present in the highest number in the plots „Uncultivated" (44,6%) and F/34. (30,6%). The family *Tydeidae* could be identified in the samplings Scs. (49,4%) and Sm.

The occurrence of the eggs of *P. ulmi* was 92,9 % in the sampling of the treatment F/34.

Funnelling and microscopic analyse of scrubs in 2004

Compared the numbers of the identified mite species and families of the four examined years, the year 2004 was the poorest, 6 mite families and 2 mite species could be identified. The total mite number of the examined samplings decreased to the half (2001 and 2002), to the third (2003) with unchanged sampling number. Although *Z. mali* and *E. finlandicus* were present in a low number in all three years, they could not be found in the samplings of either treatment in this year. The families *Acaridae* (38,8%), *Tydeidae* (25%), *Oribatidae* (17,3%) and the *T.pyri* (12,9%) appeared constantly in the highest individual number and in almost every sampling. The *T. pyri* occurred in almost the same number in all samplings alike in the previous three years except for the treatment „Conventional" with 0 pcs and the treatment „Uncultivated" with only 9 pcs. There were the most *Acaridae* in the samplings F/34. (34,4%) and F/36.(33%), the fewest in the samplings C/1.(1 pcs) and Sm.(7 pcs). It is still interesting that an unexpectedly high individual number of *Oribatidae* could be found in the sampling of the „Uncultivated" plot in contrast to the previous years, 76,1% of all the collected *Oribatidae* individuals. The individual number of the family *Tydeidae* was significant in the samplings Sm. and Scs., 90% of the whole is present here. The family *Tarsonemidae* (5%) took the fifth place in the order.

Table 1: Total number of mite species and families per treatment during dwelling from 2001 to 2004

	Number of mite species and families				
Treatments	*2001*	*2002*	*2003*	*2004*	**Average**
Sm(Integr.T.p.Badacsony)	9	5	8	6	*7*
Scs(Integr.T.p.Mikulov)	7	6	7	4	*6*
Conventional	7	6	5	2	*5,25*
C/1.(Integr.)	6	8	6	4	*6*
C/6(Integr.T.p.Mikulov)	5	7	9	7	*7*
F/34(Integr.)	3	5	9	4	*5,25*
F/36(Integr.T.p.Mikulov)	5	7	5	5	*5,5*
Uncultivated	8	7	9	5	*7,25*

Results of acarological surveys during the vegetation period

Damaging in May of *Calepitrimerus vitis* per treatments from 2001 to 2004

During the damage survey at the beginning of the vegetation period ***in 2001***, a considerable damage of *C. vitis* could be stated only in the plot F/34. where a significant damaging (of grade 2-3) could be observed on more than 60% of the shoots. The damage level was similar in the also integrated plot C/6 (without dispersion), nonetheless it was lower (grade 3) there. Although grade 2 could be identified in more than 20% in the plot C/1 which was dispersed with *T.pyri* strain „Mikulov", no damaging occurred. There was no damage in the plot F/36 dispersed with *T.pyri* strain „Mikulov", the plot Scs, the plot Sm dispersed with *T.pyri* stock from Badacsony, and in the „Conventional" plot (**Figure 1**). None of the plots were damaged by the rust mite during the vegetation apart from the fact that whether mites were dispersed or not although treatments with acaricides weren't performed.

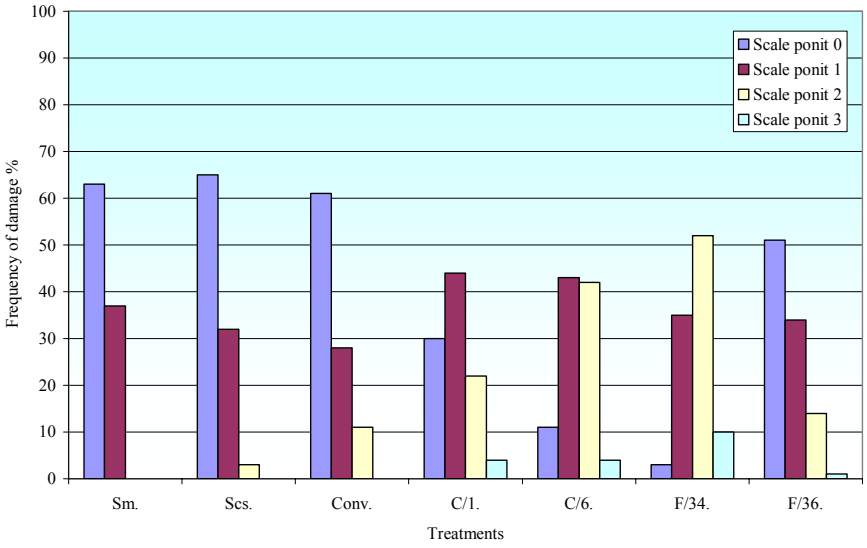

Figure 1: Damage of *Calepitrimerus vitis* NAL. on grape shoots in May 2001

In 2002 30-60 % rust mite damaging was observed in all treatments, but it was not stronger than 20 % regarding the examined shoots. 80 % of all the treatments could be characterised with 0 and 1 damaging scale grades. The lowest number of sucking spots was registered in the plot Sm. which was dispersed with *T.pyri* from Badacsony. There was no rust mite damage during the vegetation, an acaricide application was not needed this year either.

In 2003 no damage caused by *C. vitis* could be identified in either treatments. A control was not necessary during the vegetation.

In 2004 there were more grade 1 damages caused by *C.vitis* on the shoots in contrast to the previous year, but a significant damage could not be observed anywhere on the whole. Most of the infested shoots could be found in the dispersed plots Sm. and Scs., there were slightly fewer ones in the dispersed plots C/1 and C/6. The fewest could be found in the plot F/34. No predatory mites were dispersed in the plots C/6 and F/34 at the beginning of the programme. No acaricides were applied similar to the previous years, there was no damage during the vegetation (**Figure 2**).

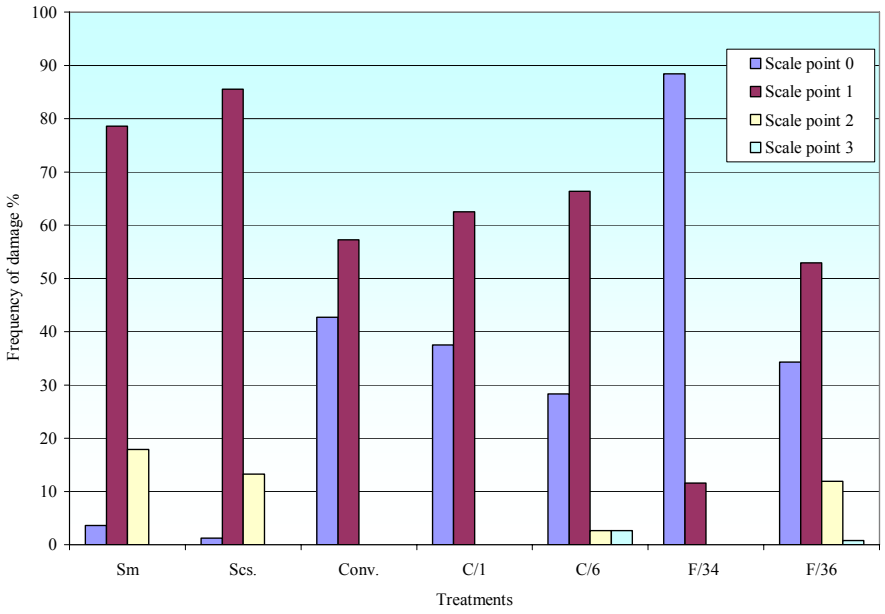

Figure 2: Damage of *Calepitrimerus vitis* NAL. on grape shoots in May 2004

Occurrence of mite species and families during vegetation from 2001 to 2004

During the vegetation period in 2001

6 mite species and 6 mite families could be identified. The dominancy of *T. pyri* among predatory mite species and the dominancy of *P.ulmi, E.vitis,* and *C.vitis* among phytophagous mites was characteristic. Regarding the species insensible to grapevine, a higher number of *Tydeidae* was observed in the plots. Individuals of *E. finlandicus, P.soleiger*, and *Cunaxidae* from the predatory mite species and families, the family *Tarsonemidae* from the phytophagous ones, and the individuals of *Oribatidae*, *Acaridae* and *Anystidae* from the mite families insensible to grapevine occurred at an observation level.

During the vegetation period in 2002

8 mite species and 7 mite families were identified. The dominancy of *T.pyri* from predatory mite species and the dominancy of *P.ulmi,* and *E.vitis* from the phytophagous mites were characteristic. The species *T.urticae* also occurred on the grape leaves of the integrated indispersed plot F/34. and in the weed flora of the "Conventional" plot. The dominancy of *P. ulmi* can be regarded as relative, as it appeared in significant high individual number only in the treatment of the integrated plot F/34. which was not dispersed with predatory mites. The number of *Tydeidae* from the mite species insensible to grapevine increased in the plots compared to the previous year. The individuals of *E. finlandicus, P.soleiger*, *D. juvenilis, a Cheyletidae, Trombiidae* and *Cunaxidae* from predatory mite species / families, the family *Tarsonemidae* from the phytophagous ones, and the individuals of *Oribatidae* and *Anystidae* from the mite families insensible to grapevine occurred at an observation level.

During the vegetation period in 2003

6 mite species and 5 mite families were identified. The dominancy of *T. pyri* from predatory mite species and the dominancy of *P. ulmi, E. vitis,* and *C. vitis* from the phytophagous mites were characteristic. While *E. vitis* occurred in al most every treatment, *P. ulmi and C. vitis* did only in the plot F/34. The individual number of *P. ulmi* decreased significantly compared to the previous years, on the other hand a rapid breeding could be observed regarding the two other phytophagous mites, especially in the case of *E. vitis*. An acaricide application was still not needed in either treatment.

An increasing number of *Tydeidae* from the species insensible to grapevine was characteristic of the plots. The individuals of *E. finlandicus, Z. mali*, and *D. juvenilis* from the

predatory mite species, the family *Tarsonemidae* from the phytophagous ones, and the individuals of *Oribatidae*, *Acaridae* and *Anystidae* from the mite families insensible to grapevine occurred at an observation level and only in the samplings of May.

During the vegetation period in 2004

4 mite species and 3 mite families were identified. This year was the poorest in families and species from the four examined years. The dominancy of *T. pyri* from predatory mite species was still characteristic, but only the dominancy of only *E. vitis* from the phytophagous mites was observed which can be explained mainly with the longer and longer drought spells during the vegetation period, not with the deficiency of the plant protection technology in my opinion. *P. ulmi* and *C. vitis* completely disappeared from the plantations. A slow multiplication of *T. pyri* began both in the treatment F/34. and the plot controlled conventionally which was in connection with strict observation of the required technology regarding the plot F/34 and the significantly reduced amount of sulphur in the "Conventional" treatment. A further increasing individual number of *Tydeidae* from the species insensible to grapevine was identified in the plantations. The individuals of *E. finlandicus* from the predatory mite species, the family *Tarsonemidae* from the phytophagous ones, and the individuals of *Oribatidae* from the mite families insensible to grapevine occurred at an observation level and only in the samplings of May.

Table 2: Total number of mite species and families per treatment during the vegetation period from 2001 to 2004

	Number of mite species and families				
Treatments	*2001*	*2002*	*2003*	*2004*	**Average**
Sm(Integr.T.p.Badacsony)	6	6	6	3	*5.25*
Scs(Integr.T.p.Mikulov)	5	3	4	4	*4*
Conventional	3	5	3	2	*3,25*
C/1.(Integr.)	4	5	2	3	*3,5*
C/6(Integr.T.p.Mikulov)	5	6	4	4	*4,75*
F/34(Integr.)	5	5	6	3	*4,75*
F/36(Integr.T.p.Mikulov)	4	6	5	3	*4,5*
Uncultivated	5	9	6	5	*6,25*

The vertical pattern of occurrence of *Typhlodromus pyri* and the phytophagous mites on the shoots

Two-third of both the *T. pyri* and the phytophagous mites were located in the lower (**1**) and middle (**2**) third of the shoots independently of treatment technologies, their number in the top (**3**) zone is not considerable. The same is characteristic of the pattern of occurrence of the eggs of *P. ulmi*. The damage of *C. vitis* was registered only once, in September of 2001, in the plot F/34., but despite the above it was identified only at the top of the shoots. A large number of the individuals of *P. ulmi* was registered only in the plot F/34. in September 2001 and July 2002. Its occurrence patterns that of *T. pyri*, they appeared mainly in the lower and middle zones of the shoots (**Figure 3**).

From 2002 on *E.vitis* was permanently present in the plantations in variable number. They usually occurred in the lower (**1**) and middle (**2**) third of the shoots in treatments both with cultivation methods Lenz Moser (F/34., F/36.) and single curtain (C/1., C/6.) (**Figures 4 and 5**), while they were dominant in the top (**3**) third of the shoots in the plots Scs. and Sm. with umbrella cultivation method (**Figures 6 and 7**). In the same treatments occurrence of *T. pyri* in the lower (**1**) and middle (**2**) third of the shoots is not as common as it was in the case of treatments with cultivation methods Lenz Moser and single curtain.

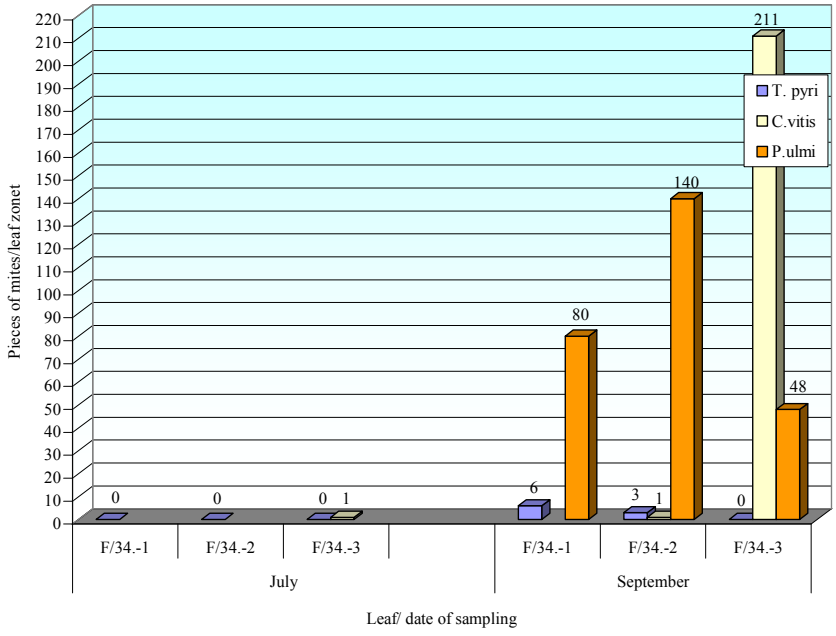

Fig. 3: Pattern of occurrence of T.pyri and the phytophagous mites per leaf zones in the plot F/34.(without mite dispersion) in 2001

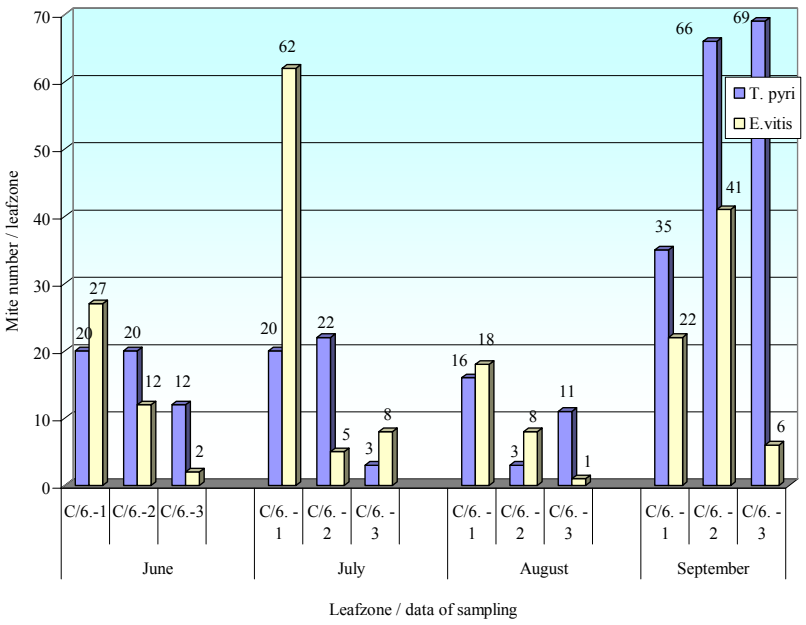

Figure 4: Pattern of occurrence of *T. pyri* and *E. vitis* per leaf zone in the plot C/6. (without mite dispersion) in 2002

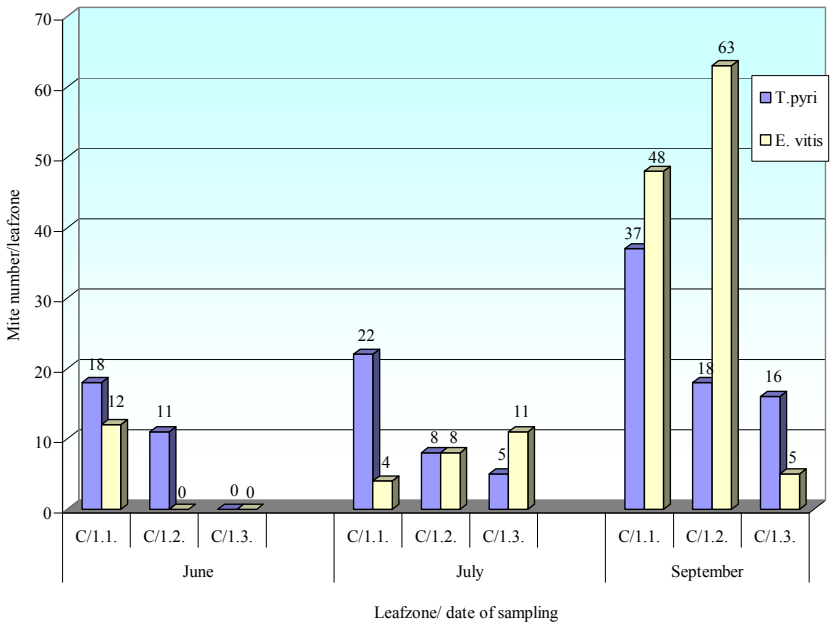

Figure 5: Pattern of occurrence of *T. pyri* and *E. vitis* per leaf zone in the plot C/1. (dispersed with *T.pyri* strain „Mikulov") in 2004

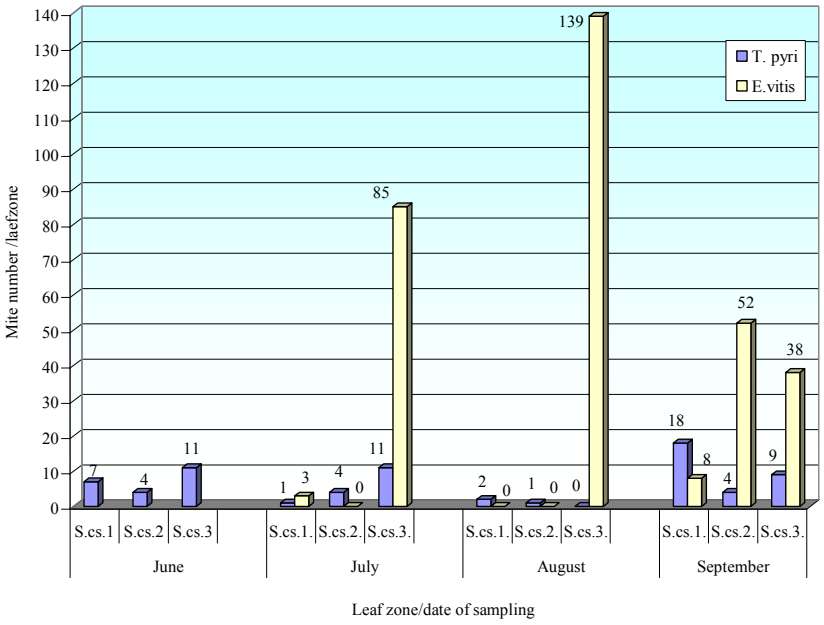

Figure 6: Pattern of occurrence of *T. pyri* and *E. vitis* per leaf zone in the plot Scs. (dispersed with *T.pyri* strain „Mikulov") in 2002

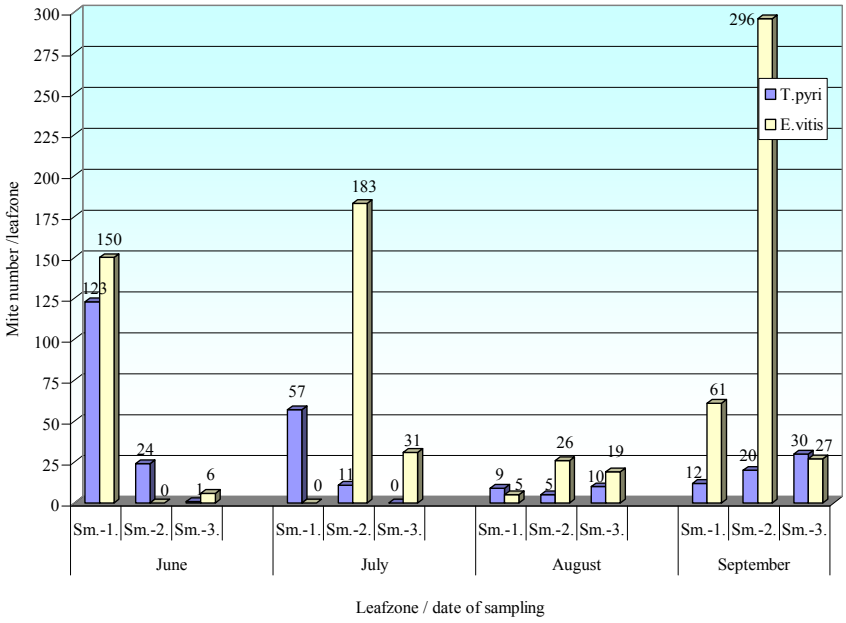

Figure 7: Pattern of occurrence of *T. pyri* and *E. vitis* per leaf zone in the plot Sm. (dispersed with *T.pyri* strain „Mikulov") in 2003

The change of individual number of *Typhlodromus pyri* and *Eriophyes vitis* per leaf

The dominancy of *T. pyri* from the predatory mites and that of *E.vitis* from phytophagous mites was characteristic of all plots.

A certain rhythm could be observed also in the case of population change of *T. pyri* and *E. vitis*. Regarding both species two multiplication peaks could be identified, one in June and one in September. The June one was followed by a drop in July then a significant increase in individual number was stated at the end of August, at the beginning of September which was probably due to the overwintering.

Effect of the sulphur amount per application on number of *T. pyri*

The plantation controlled „Conventionally" was characterised by high dosage spraying of sulphur per certain treatments, 8 to 10 times during a vegetation period. Now and then 10 kg, in some cases 20 kg/ha of a.i. were powdered or sprayed. In June and July application to control powdery mildew was carried out 3 to 4 times which had only a little effect on phytophagous mites but was very harmful for the populations of predatory mites (**Figure 8**). In 2003 and 2004 the amount of the applied sulphur decreased significantly and was over 5 kg/ha only in some treatments. There was an increase in the density of *T. pyri*. June 2004 was very remarkable when no sulphur was used in control at all, the number of *T. pyri* rose while in July it decreased by the fourth as result of the total 40 kg/ha of sulphur sprayed 5 times.

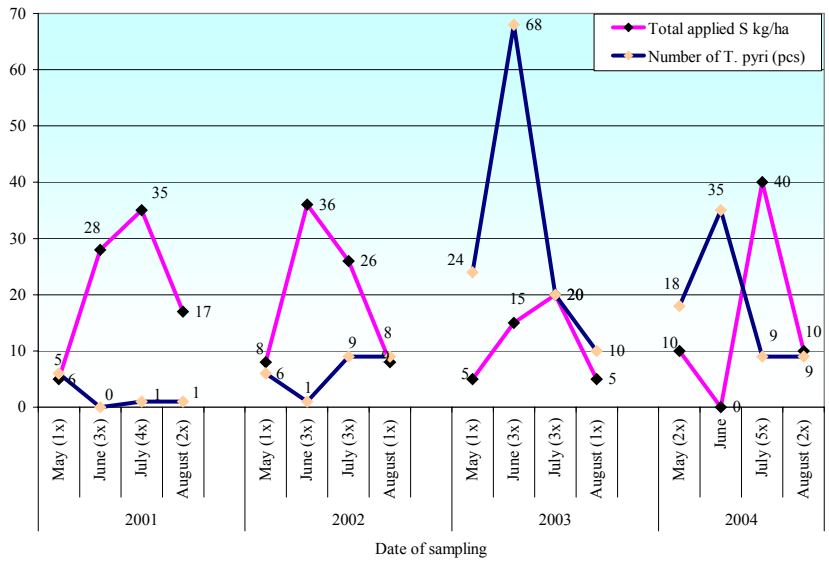

Figure 8: The effect of the total amount of sulphur per month on the individual number of *Typhlodromus pyri* in the "Conventional" treatment

Occurrence of the 5 most frequent mite species per treatment in the Soproni Wine District from 2001 to 2004

The *T. pyri* among the five most frequent species could be characterised with 31,86% dominancy, based on counted galls the *E.vitis* had a 36,07% dominancy, the *P.ulmi* 15,92 %, the *Tydeidae* sp. 12,42 %, the *C.vitis* 3,7 %.

From the five species, the *T. pyri*, the *E.vitis*, and the *Tydeidae* families occurred in all the samplings every year, except for *P. ulmi*, which was present with an extremely high number in 2002 and only in the integrated plot F/34 which was not dispersed but it was not present in the other ones, or its number was at observation level.

C. vitis is also an exception whose individual number is low compared to the individual number of all the collected mites and which could be registered in only 2 years and also only in the plot F/34.

It was also observed that *P.ulmi* almost disappeared from the plantations by 2004 similar to the phytophagous nite species *C. vitis*. The number of *T. pyri* was almost a balanced from year to year, *Tydeidae* multiplied by 4,5 times during 4 years, *E. vitis* by 14 times.

Despite the integrated treatment, F/34. was the only plot where the phytophagous mites (*P.ulmi*, *C.vitis*) were dominant, the other integrated plantations (Sm., Scs., F/36, C/1., C/6.) were characterised by the dominancy of *T. pyri* regardless the dispersion with predatory mites. The slow multiplication of *T. pyri* could also be observed in the case of the „Conventional" treatment which was due to the plant protection applying less and less sulphur. *Tydeidae* occurred in all treatments, except for the „Conventional" and F/34. plots. All the five from the five most frequent mites appeared in the plots Sm. and C/6., four in the plots Scs., F/34., and F/36, three in the plots C/1. and Uncultivated, and two in the „Conventional" plot.

The smallest fluctuation in individual number was registered in the „Uncultivated" plot, and the largest one in the plot F/34 in average of the four years. There were the most mite species in the „Uncultivated" plantation, the fewest in the „Conventional" treatment (**Figure 9**).

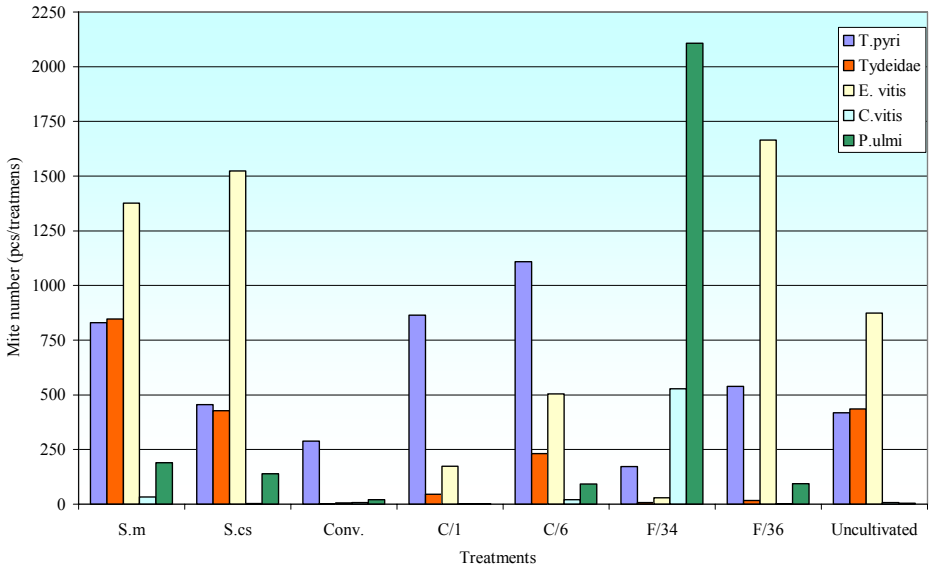

Figure 9: The five most frequent mite species per treatment occurring in the Soproni Wine District from 2001 to 2004

Statistical analysis of acarological surveys

Evaluation of dormant season data from 2001 to 2004

12 family and 8 species of mites could be recognized from the samples collected in the dormant season of the years 2001-2004. The year 2003 was the most plentiful in mite species when both the number of collected animals (2255 specimens) and the collected families (15 family) were the most numerous. The year 2004 was the modest when the number of the overwintering mites and families was the lowest. The dominancy and plentiful presence of the family *Acaridae*, T*ydeidae*, *Oribatidae,* and to a slighter degree the subdominancy of the family *Tarsonemidae*, the *T. pyri*, and the eggs of *P. ulmi* in the overwintering fauna could be stated on the grounds of the data of the 4 years. The differences of these dominancy values were definitely proved by the confidence analysis.

The occurrence of the more frequented mite families and species during the vegetation period from 2001 to 2004

16 mite species and families could be recognised during the vegetation periods of 2001-2004. Among the predatory mites the *T. pyri*, among the herbivorous mites the *C. vitis*, the *E. vitis* and the *P. ulmi,* and among the indifferent mites the family *Tydeidae* were the most numerous depending on the treatments.

The occurrence of the *T, pyri*. and *E. vitis* was significantly affected by the treatments. *T. pyri* occurred in the largest number in the plot C/6, which was not released, and in the fewest number in the plot F/34 which was not released either. In the plot 'Conventional' its occurrence was also scarce.

A demonstrable proliferation of the *T.pyri* began in all the plots (Sm., Scs., C/1., C/6., F/36.,) except orf the plot F/34 where insecticides with reduced risk were applied regardless whenever predatory mites were released or not, however the extent of its proliferation was different. The relative frequency of *T. pyri* exceeded in the plot C/6 which was treated according to the integrated control but no predatory mites were released there in contrast to the other plots (**Figure 10**).

The occurrence of the family *Tydeidae* per treatments showed a similar tendency to the one of *T. pyri*. The "Conventional" plot and the integrated plot F/34. which was not released were the exceptions also in this case where its occurrence did not achieve the observation level.

The over dominancy of *E.vitis* among the phytophagous mites was characteristic of the wine district. *E.vitis* occurred in all plantations except for the "conventional" one. Its number was low in the integrated treatment C/1 where *T. pyri* „Mikulov" stock was released and in the plot f/34. where no predatory mites were released. Considering the relative frequency, Its occurrence was remarkable in the plot F/36. where no mites were released, but it did not differ significantly either from the plot Scs where the stock "Mikulov" was released or from the treatment Sm. which was released with the stock *T. pyri* from Badacsony.

The relative frequency of *C.vitis* and *P.ulmi* was remarkably high in the plot F/34. while it could hardly be found in the other plots regardless from the type of plant control. A significant difference cannot be proved among the other treatments (**Figure 11**).

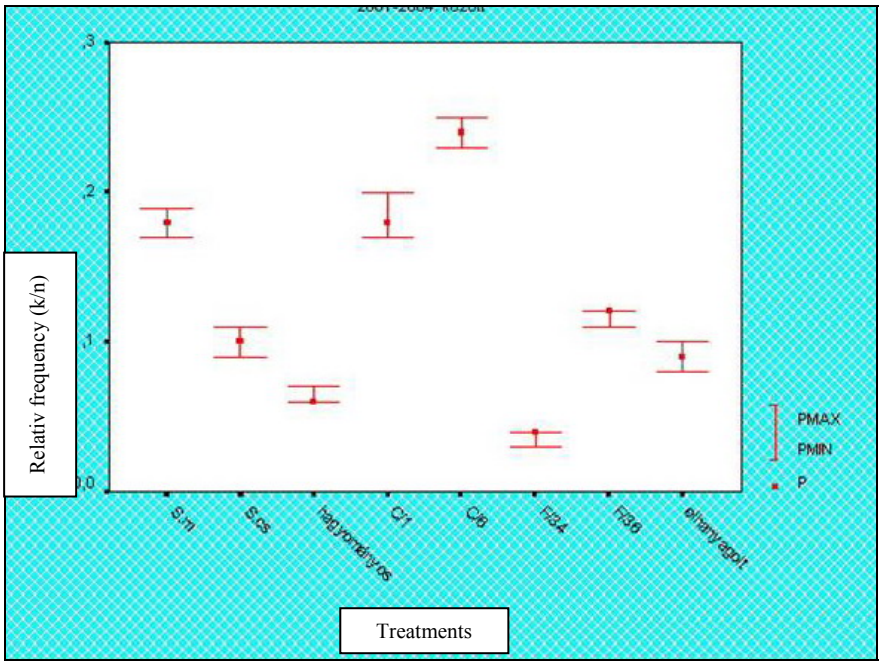

Figure 10: The relative frequency of *T. pyri* per treatment from 2001 to 2004

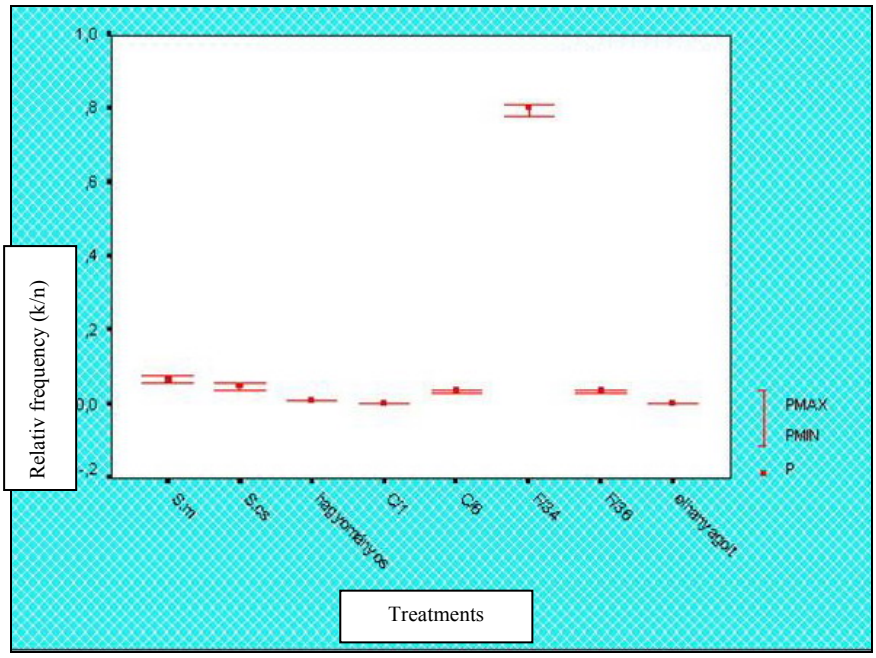

Figure 11: The relative frequency of *P.ulmi* per treatment from 2001 to 2004

New scientific results

The following new results emerged both for the production and for the research regarding the data of surveys in the Soproni Wine District from 2001 to 2004

1. The mite species occurring in the Soproni Wine District were identified.
2. The significant dominancy of the predatory *Typhlodromus pyri* and of the phytophagous mite species *Eriophyes vitis* in the wine district was proved.
3. The mite species *Amblyseius neobernhardi* (ATHIOS-HENRIOT), *Amblyseius wainsteini* (GOMELAURI), *Anthoseius richteri* (KARG), *Anthoseius rivulus* (KARG) which have not been found and described in the vineyards of Hungary so far were identified.
4. It was recognized that the predatory mites occur in the lower and the middle thirds of the grape shoots as a result the topping as a compulsory technological element does not harm their individual number during the vegetation period.
5. The negative effect of sulphur on zoophagous mites was confirmed on the grounds of the results of the "Conventional" plant protectional treatment.
6. In the case of observing the principles of the integrated production technology, there is a chance that the native predatory mite species multiply and therefore the release of predatory mite species can become unnecessary.
7. *T. pyri* subsisted also in the plots (C/1.,C/6) applying integrated production technology due to grassing even in absence of adequate food.
8. From the results it emerges that the amount of *Tydeidae sp.* grows from year to year when integrated treatment is applied, their role in plant control can increase.

Conclusion

During the **funnelling of scrubs** collected in February of 2001-2004 76% of mites left their overwintering shelter on the average, the remaining 24% could be collected after the microscopic examination. On the grounds of the average of four years it was assessed that the funnelling itself did not produce reliable results about the overwintering mite stock, it has to be supplemented by microscopic survey.

The number of species and families alters from year to year and per treatments. 5-7 species and families on average occur in a treatment.

No considerable difference in overwintering mite stock could be stated among the different treatments. There was no connection between the mite populations collected in winter or summer either.

The number of mite species and families collected during the **vegetation period** is lower (16) than that during the winter (20). During the four years 4 mite species and 1 mite family were dominant in the vegetation period considering their amount. The families *T. pyri,* az *E. vitis,* and *Tydeidae* among these have surely a dominance. The dominancy of *P. ulmi* és a *C. vitis* can be stated in certain period and as dependent on certain technologies.

The damage of *E. vitis* was present already in the samples of May. By the end of August or the end of September it multiplied in all plots except for the "Conventional" and the F/34. plots regardless of the *T.pyri* release. The increase of population number was remarkable not only during one vegetation period but there were significant differences in its number between the certain years, it increased by 14 times by the end of the fourth examined year. This tendency was due firstly not to the effect of the applied plant protection technology but to the warmer and warmer summer months which supported its multiplication.

Compared the different years, the individual number of *T. pyri* in the single treatments showed hardly any fluctuation in the integrated plantations (except for the plot F/34.), it was balanced. Its number per leaf was 0,4-3,6 pcs depending on the treatments and the vegetation period. In the "Conventional" treatment the number of both the pest and the zoophagous mites was near the observation level, their number was under it in some cases which is firstly due to the excessive use of sulphur. The amount of sprayed sulphur was remarkably decreased in the years 2003 and 2004 (5 kg/ha). As a consequence a slow increase of the *T. pyri* population began, and the 0 pcs/ leaf individual number rose to 0,5-1 pcs/leaf.

Observing the dynamics of the populations of *T. pyri* and *E. Vitis,* both species own two multiplication peaks, one in July and one at the end of August, at the beginning of September.

It was characteristic of the **vertical placement** of the mite species that two third of both *T. pyri* and *E.vitis* mites occurred in the lower and middle third of the shoots independent of the treatment, and the same was characteristic of the occurrence of the *P. ulmi* eggs. As a result the topping as a compulsory technological element does not harm the individual number of predatory mites during the vegetation period. In the case of *E. vitis* only the integrated treatment Scs. Meant an exception where it occurred in the top third of the shoots. This is due to the umbrella cultivation method where the vine stocks are bent in the form of an arch. There was Lenz Moser and single curtain cultivation method in the other plantations.

The population density of the phytophagous and zoophagous mites is usually low in uncultivated plots which is attributed to the positive controlling activity of the zoophagous (acarophagous) species. It was also observed that the family *Tydeidae* was present in higher individual number in plots infested strongly with powdery mildew.

Circumstances which support the existence and the multiplication of the mites realising from the neighbourhood should be established in the plantations instead of the costly release of predatory mites. If the mite fauna had been estimated in advance, the costs of the release of *Typhlodromus pyri* „Mikulov"stock from abroad would have been saved.

In July and August 2002 a large amount of *Tetranychus urticae* population was found on the shoots of *Convolvulus arvensis* in the "Conventional" treatment. As result of a delayed herbicide application the mites can crawl in large amounts onto the grape foliage which cannot be controlled by the predatory mite stock present on the grape. Before herbicide applied to control the weeds, the foliage of weeds has to be surveyed and if it is needed the herbicide should be applied together with the appropriate acaricide.

Contrary to the other Hungarian wine districts, the *T. pyri* was dominant in the Soproni Wine District. The reason for this is to be found in the ecological circumstances.

Both in the integrated treatments and in the "Uncultivated" plot, more and more *Parthenolecanium corni* larvae were found in all the four examined years. Its population grew constantly till September, but their damage could not be detected. Nevertheless their presence cannot be disregarded because of their virus vector role.

Not yet in the years 2001 and 2002 but since 2003, the filoxera present on the foliage could be registered on the cv. Cabernet sauvignon in the integrated plot F/36. which was released with predatory mites.

Recommendations:

- To carry on the started project, it is needed to clarify the role and significance of *Tydeidae* occurring in higher and higher number.
- The species compartment of the flora present near the plantations has to be identified to recognise the habitat and territory of the mite species.
- The weeds occurring in the plantations and the mite fauna of the ground zone should be mapped to develop the most appropriate and most environmental friendly weed controlling technology.
- To observe the lifestyle and habits of the other animals occurring in vineyard, to look for connection between their individual number and the applied plant protection technology.

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