Mitteilungen Klosterneuburg 51 (2001): 254-258

Suitability of environmentally friendly vineyard management with the resistant grapevine cultivar 'Viktória gyöngye' in Hungary

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In a three-years' experiment the consequences of organic, integrated and pesticide-free production on quality and quantity of yield as well as phytosanitary parameters were investigated with the grape cultivar 'Viktória gyöngye'. In respect of infection by Plasmopara viticola on the leaves and bunches, as well as angular leaf scorch (Pseudopezicula tracheiphila)*, organic production with the application of sulphur, gave sufficient protection to the plants. The resistance of the cultivar was shown by the low degree of infection on grapes in spite of the high percentage of infected leaves or bunches. No positive effect of an intensive canopy management could be observed. Phytophagous mites in the organic and pesticide free plots were well controlled by the predatory mites, while the population of grape rust mite* (Calepitrimerus vitis) *rose considerably in the integrated plots. Grape erineum mite* (Eriophyes vitis)*, on the other hand, could be better suppressed by the application of sulphur than by the help of predatory mites. The experiences gained during the experiment confirm the necessity to treat the cover crop flexibly to minimize competitive stress.*

Untersuchungen über die Eignung umweltschonender Anbaumethoden mit der resistenten Rebsorte 'Viktória gyöngye' in Ungarn. *In einem dreijährigen Versuch wurden die Auswirkungen von ökologischen, integrierten und pestizidfreien Weinbaupraktiken auf Menge und Qualität des Lesegutes sowie den phytosanitären Zustand der Reben untersucht. Aufgrund des geringen Infektionsgrades von Blättern und Trauben mit Falschem Mehltau* (Plasmopara viticola) *sowie von Blättern mit Rotem Brenner* (Pseudopezicula tracheiplila) *kann festgestellt werden, dass die Anwendung von Schwefelpräparaten im ökologischen Anbau eine ausreichend schützende Wirkung aufweist. Die gute Widerstandsfähigkeit der Sorte zeigt sich in der geringen Befallsstärke von Trauben trotz prozentuell starker Infektion von Blättern und Trieben. Eine positive Wirkung der Laubarbeiten konnte nicht festgestellt werden. In den ökologisch bewirtschafteten Parzellen sowie in den pestizidfreien Parzellen wurden Kräuselmilben* (Calepitrimerus vitis) *durch den Einsatz von Raubmilben unter der Schadschwelle gehalten, während die Kräuselmilben-Population in der integrierten Produktion kräftig zugenommen hat. Pockenmilben (*Eriophyes vitis*) konnten besser mit Schwefel als mit Raubmilben bekämpft werden. Des weiteren bestätigen die gesammelten Erfahrungen die Notwendigkeit einer flexiblen Begrünungspflege, um Konkurrenzsituationen für die Rebe zu minimieren.*

Possibilité de l' application des méthodes respectueuses de l' environnement avec la variété de vigne résistante 'Viktória gyöngye' en Hongrie. *Dans une expérience de trois ans, les consequences possibles sur la quantité et qualité des raisins et diverse paramétres phytosanitaires de l' application de la production biologique, intégré et sans pesticides ont été examinés. L' utilisation du soufre dans le cas de la production biologique et la production intégrée a donné une protection suffisante contre l' infection par* Plasmopara viticola *sur les feuilles et les grappes, et l' infection des feuilles par le* Pseudopezicula tracheiphila*, En pratique, pas des effet d' une intense travaux verts pourrait tre observé. Les acariens phytophages étaient bien supprimés par les acariens prédateurs dans le traitement biologique et les parcelles de contrôle sans aucun traitement chimique. Au mme temps, la population de* Calepitrimerus vitis *est augmenté considerablement dans le cas de la lutte intégrée. Au contraire, l' utilisation de soufre était plus efficace*

contre le Eriophyes vitis *comme les acariens prédateurs. Les expériences gagnés pendant des années de recherche confirment la nécessité de maitriser l' enherbement selon les conditions climatiques.*

Vineyards with wide row spacing are still common in Hungary. But these planting widths lead to over-loaded vines and therefore an intensive use of pesticides is necessary. Because of ecological and economic problems new technologies are being looked for *(*HAJDU and LAKNER, 2000*)*. Comprehensive studies on the feasibility of organic and integrated grape production have been carried out at several locations (HOFMANN, 1991; KAUER, 1993; DESCOTES et al., 1998a; DESCOTES et al., 1998 b). The paper presented summarizes the major results of an experiment comparing different environmentally friendly techniques under Hungarian conditions. The main objective of this investigation was to compare the effects of different plant protection treatments and canopy management measures on various parameters of the vine.

Material and Methods

The investigations were carried out between 1995 and 1997 in Szigetcsép in the wine region „Kunság", at the research station of the Szent István University. Both the sandy soil and the arid climatic conditions of the site represent well the prevailing conditions of the vineyards of the Hungarian Great Plain. The training system (single curtain) and the cover crop (rye) are also typical for the former state-owned large-scaled wine farms still found in Hungary.

The cultivar used is 'Viktória gyöngye', a result of resistance breeding ('Seyve-Villard 12 375' x 'Csaba gyöngye') done by the Department of Viticulture of the university. It shows relatively good resistance to fungal diseases like powdery and downy mildew as well as botrytis.

Three plant protection treatments were installed:

- integrated production
- organic production
- pesticide free production

Additionally two canopy management systems were applied to each of the three plant protection variants:

- intensive canopy management
- extensive canopy management

There was a 4-fold repetition, resulting in a total of 24 plots.

During the experimental period, vigour, yield quantity (kg) and quality of berrries (sugar content and acidity) were measured. Nutrient contents of the leaves, strength of fungal infections, the presence of benign and malign organisms as well as the composition of the flora were recorded. The results were evaluated by variance analysis under assistance of the SPSS program (NORUSIS, 1998).

Results and discussion

At an average 81 % of the buds developed into shoots. During the evaluated period the number of dormant buds was highest with the pesticide-free plots, probably due to some foliage damage with this variant. The number of fertile shoots showed similar tendencies. These fertility parameters were in close relation with the vintage year. The values of these parameters as well as grape yield were the lowest in the year 1996, possibly influenced by the intense downy mildew infections in the year 1995. On the other hand fertility parameters and yield were the highest in 1997, as a result of the long vegetational period of the year 1996. Examination of several other parameters (e.g. shoot ripening, shoot yield, shoot diameter), showed that vintage characteristics usually have a greater impact on fertility and yield than plant protection treatments or canopy management.

The slowest shoot ripening was observed with the pesticide-free treatment, no significant differences were found between the integrated and organic production variants. By the end of the vegetational period the longest canes were found with the pesticide-free plots, though differences between the variants were not always significant. These examinations proved that shoot ripening at a particular vegetational stage may demonstrate well the differences between different treatments, but this does not determine how long the canes can ripen. In case of favourable weather conditions, even after a late start of shoot ripening, well-ripened canes may be obtained.

With the examined training system (single curtain) a positive impact of an intensive canopy management compared to an extensive canopy management on these parameters could hardly or not be confirmed. In each of the three experimental years, the yield was the lowest with the non-sprayed plots. The grape yield (Table 1) was in inverse proportion to the content of sugar and acidity in the must. During the experimental period the

highest sugar content was measured in the year 1996, while in 1997 the sugar content was very low both with the organic and integrated production (Table 2). This may be explained by a weakening of the vines (plants) due to overloading caused by drought and lack of fertilisation. In the vineyard with the intensive canopy management usually the yield was lower and the sugar content higher, though differences were not always significant.

Table 1:
Grape yield (kg/m^2)

	1995	1996	1997
Pesticide free production	0.84 a	0.59 a	1.25
Organic production	1.36 b	1.06 b	1.92 b
Integrated production	1.19 b	1.04 b	1.58 ab
Intensive canopy management	1.04 a	0.87 a	1.40 a
Extensive canopy management	1.22 b	0.93 a	1.76 b

Table 2:
Sugar content of the grape must (g/l)

	1995	1996	1997
Pesticide free production	195 a	203 b	189 b
Organic production	190 a	191 a	155 a
Integrated production	186 a	206 b	146 a
Intensive canopy management	194 b	200 a	166 a
Extensive canopy management	186 a	200 a	161 a

Table 3:
Sugar yield (g/m^2)

	1995	1996	1997
Pesticide free production	122.85 a	90.16 a	177.89 a
Organic production	193.93 b	151.94 b	223.20 a
Integrated production	166.01 b	160.97 b	173.45 a
Intensive canopy management	151.42 a	131.07 a	174.69 a
Extensive canopy management	170.76 b	139.50 a	212.52 b

Sugar yield (Table 3) decreased with the intensive canopy management, showing that the production of lateral shoots could not compensate the losses of assimilating surface by removal of leaves and twigs. Both with the plant protection systems and the different canopy treatments, it was primarily the quantity of the yield and not the sugar content of the berries (must), which correlated with the sugar production. That means that treatments which caused a higher sugar content and lower yield did not result in a higher sugar production, while sugar production was increased by variants that had a higher yield (kg) but lower sugar content. The analytical parameters and the organoleptic characteristics of the resulting wines did not show a linear tendency correlated to the different treatments.

During the experimental period, the leaf mite (*Calepitrimerus vitis*) population increased considerably. While in the year 1995 the presence of leaf mites could not be observed, in the years 1996 and 1997 leaf mite damages were easily detected. At the end of July 1996, the number of leaf mites was the same in the organic and the integrated plots, later in the year, their population was by far higher with integrated production (Table 4).

Eriophyes vitis could be observed only sporadically in the first two years (1995, 1996), but from July 1997 on, some vines showed leaf rolling due to infection. By the end of August 1997, the percentage of infected leaves was 9 % with the pesticide-free treatment, while it was just 0.75 to 2 % with both the other variants. The presence of predatory mites - even in high population density - proved to be insufficient to prevent a strong propagation of *Eriophyes vitis*. Sulphur containing agents proved to be more efficient both with the organic and the integrated production system.

The predatory mite species *Amblyseius finlandicus*, *Amblyseius andersoni*, *Typhlodromus subsoleiger*, *Typhlodromus pyri* and *Zetzellia mali* were identified in the plantation. The population of mites belonging to the Phytoseiidae was highest in the pesticide-free plots. On the contrary, the abundance of *Zetzellia mali* was sometimes the highest in the integrated plots and the lowest with the organic variant. The largest number of Tydeidae species was observed in the pesticide-free plots, while the least individuals were found with the organic variant.

Additionally several other species were identified in the plantation. So it was possible to detect a species belonging to the gall midges (Diptera, Cecidomiidae) in the Hungarian vineyard fauna for the first time. Furthermore a parasitoid of the larva of *Boarmia gemmaria*

Table 4:
Number of leaf mites *(Calepitrimerus vitis)* trapped in spring 1997

	Mites per sticky tape				
	7. V	16. V	23. V	30. V	average
Pesticide-free production	9.63 a	6.00 a	18.88 a	24.63 A	14.78 a
Organic production	63.75 ab	197.63 b	245.75 b	116.13 A	155.81 b
Integrated production	152.75 b	140.50 ab	112.00 ab	79.88 A	121.28 b
Intensive canopy management	70.42 a	87.42 a	133.17 a	62.17 A	88.29 a
Extensive canopy management	75.37 a	142.00 a	117.92 a	84.92 A	106.29 a

(*Mesochorus sp*., Ichneumonidae, Mesochorinae) was identified. Besides the elimination of insecticides, the abstention of mechanic soil cultivation and the biodiversity of the cover crop, including flowering plants, contributed to the high abundance of benign organisms. During the year 1995 there was a country-wide epidemy of downy mildew (*Plasmopara viticola*), and also in the experimental vineyard a strong infection was observed. In case of the pesticide-free plots the infection of the bunches was always the strongest (the majority of bunches were infected), while there were practically no significant differences between the two other variants. The strength of infection, i.e. the percentage of infected surface on the bunches, however, remained low in all treatments, even in the pesticide-free plots. Also on the leaves, the highest infection with downy mildew was observed with the pesticide-free variant (Table 5 and 6).

The infection of angular leaf scorch *(Pseudopezicula tracheiphila)* could be detected in the experimental vineyard every year. When the climatic conditions were favourable for this fungus, the cultivar 'Viktória gyöngye', which is quite resistant against downy mildew and powdery mildew, was heavily infected in spring and summer by red fire disease. The strength of infection was the lowest with organic production and the highest in the pesticide-free plots.

Table 5:
Strength of infection of the bunches by downy mildew *(Plasmopara viticola)*

	Percentage of the bunches infected (%)					
	1995		1996		1997	
	10. VII	17. VIII	23. VII	25. VIII	7. VIII	10. IX
Pesticide-free production	80.75 b	91.13 b	71.25 b	66.00 b	52.75 b	70.38 c
Organic production	62.50 a	4.75 a	17.13 a	8.13 a	32.32 a	25.66 b
Integrated production	51.88 a	6.00 a	19.00 a	7.63 a	36.38 a	5.38 a
Intensive canopy management	62.58 a	34.25 a	37.00 a	26.17 a	41.46 a	33.61 a
Extensive canopy management	67.50 a	33.67 a	34.58 a	28.33 a	39.50 a	34.00 a

Table 6:
Strength of infection of the bunches by downy mildew *(Plasmopara viticola)*

	(%)					
	1995		1996		1997	
	10. VII	17. VIII	23. VII	25. VIII	7. VIII	10. IX
Pesticide-free production	14.75 b	5.79 b	4.09 b	2.52 b	0.83 a	1.94 b
Organic production	8.61 a	0.08 a	0.30 a	0.12 a	0.45 a	0.41 a
Integrated production	6.78 a	0.14 a	0.38 a	0.09 a	0.75 a	0.05 a
Intensive canopy management	8.97 a	2.25 a	1.43 a	0.77 a	0.63 a	0.70 a
Extensive canopy management	11.12 a	1.75 a	1.75 a	1.05 a	0.71 a	0.90 a

In the pesticide-free variant the percentage of leaves infected by downy mildew and red fire disease was always at about 90 to 100 %. But the strength of infection did not exceed 26.1 %. This fact, that even with a large number of infected leaves, the damage was restricted to a relatively small part of the leaf surface, demonstrates the good resistance of the cultivar.

The infection strength of *Botrytis cinerea* was significantly correlated with rainfall, but no significant differences between the different variants could be detected. Similar to other fungal diseases, the percentage of infected bunches was relatively high (48 to 77 % on average), while the infected surface remained small (0.7 to 4.8 % on average).

Generally, no positive effects of an intensive canopy management could be confirmed in respect to infections by fungal diseases. Furthermore it can be stated that in this experiment with the cultivar 'Viktória gyöngye' the organic variant showed almost the same result as the integrated variant. Nevertheless, the elimination of fungicides in the pesticide-free treatment had severe consequences.

In the experimental vineyard, alternatively, perennial cover crop and rye covered the spaces between the rows.

Since it was an objective to examine the consequences of such a soil covering method, the cover crop was not disturbed even when it led to a competition with the vines especially in dry periods. Though several advantages of the cover crop could be observed, e.g. prevention of deflation and improved biodiversity (66 plant species were identified in the vineyard - results not shown). The experiences gained during the experiment confirm the statement that it is unfavourable to treat the cover crop without flexibility. Probably, it would have been useful to break up the plant cover at least temporarily or loosen the soil in the experimental vineyard to reduce the competition for water and nutrients.

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Manuskript eingelangt am 31. Jänner 2001