ECOLOGICAL ORIENTATED PEST MANAGEMENT VINE *(VITIS VINIFERA)* IN THE SLOVAK TOKAJ REGION

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Abstract: *Research of the ability to continue growing a vine in the* ***Tokay region of SR*** *focuses upon perfecting integrated protection of the vine (further as IPM – Integrated Pest Management). On farm research was carried out in the district of Malá Tŕňa. In this work, the results of research and implementation of integrated protection of European grapes in the vineyard area of Tokaj during 2004-2006 is presented. The results show that integrated protection of European grapes not only represents direct chemical protection, but also has a complex effect using all kinds of agro-technical measures such as suitable cutting of the vine, targeted green works, grassing between lines and integrated nutrition as part of the integrated production of grapes. The results of research show that targeted integrated protection of vines is more environmentally friendly, protects and improves the environment and provides hygienically flawless material for the production of quality Tokaj wines. Due to a reduction in the number of sprayings, an increase in the quality of grape production and a decrease in the burden on the environment, it brings significant ecological and economic benefits.*
Key words: *Tokay wine region, pathogens, IPM, environment, production and ecological benefits*

INTRODUCTION

Specialisation and intensification of agriculture, increased number of monocultures, simplified alternation of crops caused disturbance of the dynamic balance of nature, which led to an increase in disease, pests, weeds and contributed towards the acceleration of many environmental problems (Kováč, 1994). The vineyards in the Tokaj region (Slovakia) form a monoculture which has existed there for centuries. Only *Vitis vinifera* and three permitted varieties (cv. Yellow Muscat, cv. Lipovina and cv. Furmint) are cultivated here, which creates a greater premise for more aggressive behaviour of pathogens and an increased occurrence of epidemics (Eftimova, 2002). Conventional chemical protection of vines fulfils the requirements of quick and effective projection, stabilises the quality of the harvest but, at the same time, clogs the environment and can jeopardise human health (Vanek, Vaneková, 1977).

Negative effects of the monoculture in the Tokaj region should be lessened by planning and implementation of a new strategy of integrated protection and production of the varieties of vine and wines. By implementation of the directive for permanently maintainable use of pesticides, all EU member states should support agriculture by low use of pesticides, mainly integrated protection against pests and create conditions necessary for implementation of integrated protection technology. Integrated protection and production of grapes strengthens ecologically safer methods, minimises the adverse and harmful

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effects of agro-chemicals to perfect safety measures to protect the environment and human health (Malavolta, Boller1999).

MATERIALS AND METHODS

Description of the site - the Tokaj vineyard region, in accordance with the law regarding winery and wine production No. 182/2005, is the part located within Slovakia. It lays in the South Eastern to the South West slopes of Zemplinska Vrchovina (Zemplinske Hills), and to the south it is enclosed by the River Roňava. The Tokaj vineyard area is situated in the cadastres of the villages of Malá Tŕňa, Veľká Tŕňa, Bara, Černochov, Čerhov, Viničky and Slovenské Nové Mesto.

Climatic conditions - continental weather is typical for the Tokaj region. The region is warm, slightly dry with a long and sunny autumn and a cold winter. Spring frosts are rare, therefore there is no frost valley in the Tokaj fields. Atmospheric rainfall is unevenly distributed, most is in June, the least in September and October, which is important for creation of the cibeba-raisin.

Soil conditions - the basic principle for categorisation of the fields is a geological base, content of the skeleton and type of soil (Kolárik, 2004). Soils are formed on Mesozoic andesite and rhyolite turfs. Volcanic rocks, by erosion, provide heavier clay soils, rich in potassium which create shallow, gradually drying cover on the sloped areas. The occurrence of the skeleton creates a favourable thermal conditions and microclimate for vines. The most common soil type is brown earth, mainly at the foot of the slope (Vereš, 2002) .

Composition of varieties - in accordance with the law regarding winery and wine production No. 182/2005, the basic varieties of European grapes (*Vitis vinifera* (Furmint, Lipovina, yellow Muscat and the newly permitted variety, Zeta, are allowed. Planted varieties in Tokaj fields should contain 65 - 75%, cv Furmint 15 - 20%, cv Lipovina and up to 10% of yellow Muscat.

Agro-technology - for all grown varieties of vine, Rheinish - hessen medium guidance is prevalent. Planting is spaced at 2.20 x 1m, with grass between the lines. For younger sowings, the spacing is 2.4m x 0.85m. Cultivation shape - horizontal cordon.

Research of integrated protection of vineyards took place in the areas of the vineyards in Malá Tŕňa in the location of Pahorok, which lays at an altitude of 150m above sea level. The variant contained three varieties: Furmint, Lipovina and yellow Muscat planted at a ratio of 70:20:10 in an area of 1 ha. Spacing of plants was 2.4 x 0.85m. Cultivation shape - horizontal cordon. Year of planting, 2001. Orientation of lines, north - south. Natural weed vegetation is maintained and cut between the lines.

As a **control sample,** non-treated varieties in an area of 0.05ha were used. On the trial parcel, chemical preparations suitable for integrated production were used. Chemical treatment was also carried out using Vinar towed sprayers (producer, Farm Union Prostejov), with a dose of water of 500 $l.ha^{-1}$.

In a semi-operational trial, we monitored and evaluated the following:

- Phenophases of the vine.
- Climate conditions and their influence on phenophases of the vine, occurrence of disease and pests.

- By diagnosis, we determined the disease, which we observed visually and microscopically during the vegetation period as well as after completion of the integrated protection.
- The influence of agro-technology upon the occurrence of disease.
- On the basis of fulfilled biotic and abiotic factors, we identified the disease of the vine and we suggested protection.

RESULTS AND CONCLUSIONS

Integrated protection of the vine means scientifically controlled complex protection against the negative influence of harmful organisms of all types (biotic and abiotic factors), shown in a decrease in the quality and quantity of production.

Integrated protection was created by the combination of chemical and biological plant protection with significant in the use of pesticides (but not their total exclusion). It is an organic part of agro-technology for all plants and therefore it must be implemented against individual harmful organisms on the basis of their diagnosis, prognosis, indications and complex protection.

Individual parts of protection must systematically and purposely be sympathetic with currently used agro-technological and special measures, used in the modern technology of plant cultivation. Protection elements must be specified and completed using new technology and the biological knowledge of the research, advanced experience for the particular ecological conditions of the site, agro-technology and biology of growth, in harmony with protection and improvement of the environment. Via analysis of the previous state of the winery in the Tokaj region, we discovered that that greatest expense for the vine production is the cost of its protection and that there is no direct dependence between consumption of pesticides and the amount and quality of production. Another very important factor which we did not observe during research was the negative effect of pesticides upon the environment and public health.

Only a vineyard company which reaches stability in quality of harvest, using reliable and financially less-expensive methods of protection against disease and pests could be profitable. The amount, stability and quality of production, as well as economics and effectiveness of cultivation and production of wine, depends upon the quality of protection of the vine.

During the trial years of 2004 - 2006, we monitored the influence of climatic factors upon the formation of phenophases of vines and its sensitivity towards attacks by disease and pests. We discovered that most important in the planning of new strategy in the battle against disease and pests, from an environmental viewpoint, is a thorough knowledge of their occurrence in the area. In the closed area of the Tokaj vineyards, where varieties of Furmint, Lipovina and yellow Muscat are repeatedly grown, regarding the appearance of disease, the European grape is more or less attacked by three significant diseases which are *Plasmopara viticola* (Berk. et Curt.) Berk. et de Toni, *Erysiphe necator* Schwein. A , *Botrytis cinerea* Pers. – teleomorphic stage *Sclerotinia fuckeliana* (De Bary) Whetzel.

The most common pests in the Tokaj region are the grape leaf rust mite (*Calepitrimerus vitis*), grape leaf blister mite (*Colomerus vitis*), European Red Mite (*Panonychus ulmi*) and twospotted spider mite (*Tetranychus urticae*), grapevine moth (*Lobesia botrana*) and European grape berry moth (*Epoecillia ambiguella*). Caterpillars of the mentioned pests damage the blossom and berries of the vine, and create an entry gate for secondary pathogens.

Monitoring of the appearance of disease and pests has a significant role in the complex protection of European grapes. Successful implementation of protection of a vine also depends upon microscopic monitoring of disease, knowledge of their life cycles and their behaviour depending upon climatic conditions. This knowledge is the basis for preparation of a prognosis of the appearance of disease and pests, which provides sufficient time for planning protective treatment of vines.

The exact term for optimal treatment was specified by signals. For creation of long or short term prognoses as well as for signalling, we monitored the climatic conditions obtained from SHMÚ- Košice (Slovak Hydro Meteorological Institute) and by own measurement of temperature parameters, relative air humidity and humidity of leaves. Measurement was carried out using a device from Luft GMBh, which monitors the required parameters. For reliable prognosis of disease and influx of pests in the entire Tokaj region, it is necessary to build a network of meteorological stations, provide their transfer into a central process for the entire area.

We organised targeted research of vine protection in order to decrease admission in the wine bushes during the observed years. We gradually moved from conventional chemical protection to an integrated protection of European grapes (tab. 1, 2, 3, 4).

In 2004, on the trial parcel, we preventatively chemically treated the vines in accordance with the development phases, without considering the biology of phytopathogenic fungi. We used the GALATI Vitis computer program, used by Galafruit & Co. s.r.o. since 2002, which predicted diseases (perenospora, *Erysiphe* and grey mildew) and signalised the need for chemical protection. Agro-climatic characteristics were taken from the meteorological station at Somotor, which corresponds geographically with the Tokaj region. Rainfall was measured directly in Malá Tŕňa. Despite the fact that the GALATI Vitis computer program should reliably predict disease and term of chemical treatment, the production of grapes was a sub-standard quality due to decay of the grapes. We discovered that the GALATI Vitis computer program was unreliable for the particular company. It was also probably due to the fact that meteorological data did not correspond with the microclimate of the site in Malá Tŕňa and the program predicted creation of infection although in reality, the conditions for its creation did not exist.

The drawbacks of this method could be eliminated by building a network of meteorological stations in the area of the Tokaj vineyards, which would objectively and precisely give information regarding weather development, and should also measure the length of time of humidity of leaves. Despite intensive chemical treatment, the health of the vine was not satisfactory as some chemical treatment was carried out before or after the infection occurred. Similar results were recorded in Szaksárd (Hungary) where from 1993-1997 the GALATI Vitis program was applied. FUZI, (2003) discovered that in 1994 and 1996, the prognoses did not correspond to the real infection by *Erysiphe* and did not take into account primary ascosporic infections.

In the years following the research, in 2005 - 2006 we did not therefore use the “GALATI Vitis” program for protection of vines. For prognosis and signalisation we used data obtained from a LUFT GMBh device which monitors temperature, length of humidity of leaves and relative air humidity of the vine directly in the trial field. The used protection is shown in tab. 2.

In our research in 2006, we focused our attention upon the primary source of infection of *Erysiphe* on the trial vine land and we adjusted the protection of the vine in line with newly discovered facts. The exact term of optimal treatment maintained the trial varieties in good health whilst decreasing the number of sprayings in comparison with 2004. We managed to maintain very good health on the trial parcel thanks to good signalisation, suitably chosen preparations and mainly thanks to new active compounds which were not previously used in this area.

In 2005 - 2006, we gradually selected the chemical preparations in order that one preparation would repress both diseases and we would not exceed the limit stated in integrated production.

Detailed measurements and more precise characteristics of individual types of fungi occurring in Tokaj varieties of vine confirmed that effective protection against *Erysiphe* should be controlled on the basis of the changed dynamic of the development of *Erysiphe* whilst taking into account the dominance of cleistothecia. A change in the dynamics of the development of *Erysiphe* via ascospores which are released from cleistothecia and are a source of infection, to date only existed in Slovakia on a hypothetical level. The results of our research from 2004 - 2006 proved their existence since in 2005 and 2006, they became the primary source of infection. The results proved that the cleistothecia form as a primary source of infection of Erysiphe plays and important epidemiological role in protection of the vine. Massive creation of cleistothecia, mainly on the face of the leaves at the end of summer continued, and became a source of early spring infection. Therefore, early identification of its commencement via the prognosis is very important. It was only in 2004 that we discovered a strong appearance of *Erysiphe* from mycelium in buds. The abovementioned research corresponded with the results in Hungary, published by DULA (2005). The authors PEARSON and GADOURY (1987) reached a similar result, which confirmed that the primary sources of *Erysiphe* infection in New York are ascospores released in the spring period from hibernating cleistothecia. Similarly in Italy, CORTESI and Co. (1999), in a three-year trial, discovered that in monitored planting, there was cleistothecia on 86%, on 7% *Erysiphe* did not occur and on 33% of planting both forms of hibernation, mycelium and cleistothecia were present.

In trials in 2005 - 2006, we verified Gubler's method of statement of a primary *Erysiphe* infection and confirmed its reliability. Other conidia infections were calculated using an index method. On the basis of this knowledge, the occurrence of *Erysiphe* infection can be reliably predicted and the vine can be maintained in good health using a suitably selected preparation. The key task during protection of the vine is the determination of the primary source of infection, as this conditions the different methods of protection.

When planning chemical protection focused on repression of *Erysiphe*, new technology should be designed which would reliably protect the bunches against disease and at the same time eliminate autumn cleistothecia infections on the leaves. For the future, it would suitable to also try autumn application of exterminating sprays which are applied against scabbing of apple trees (Eftimová,1998).

During application of spraying compounds reliable, effective technology is required which provides perfect application of the preparation in order to cover the entire vine. In 2005 - 2006, we were satisfied with the addition of wetting agent Silwet L-77 into the spraying preparations with which we achieved perfect covering of the leaves. From the achieved research results, we recommend use of contact preparations before blossoming and during the period of closing of bunches. It is also very important to alternate the active compounds to avoid fungicidal resistance.

Grassing between the lines also helped with operative management of protection, which at the same time becomes a significant creator of a favourable microclimate which partially eliminates failure in cultivation of vines in a monoculture. Natural weed flora is present in the vineyards, which are mulched. In order to rationally maintain the weeds under the level of their harmfulness, we consider the technology of a combination of mechanical and herbicidal methods of repressing and removal of weeds as the most suitable. The diversity of freely living organisms in vineyards is influenced by the technology of cultivation of vines. Implementation of a system of integrated production of vines in the Tokaj region, which maintains and extends the area of semi-natural biotopes therefore creates conditions for maintainable development of the environment, the layout of the countryside, keeps and increases soil fertility, increases biodiversity of flora and fauna on the vineyard land in the Tokaj region.

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Tab.1: *Chemical attendance of vine in 2004,Varietes : Furmint, Lipovina, Muškát žltý in the area -Pahorok- Malá Tŕňa*

Vegetative stage	**Spraying date**	**Diseases**	**Chemical preparate**	**Active substance** (producer)	**Dose per ha (kg, l)**
Shouts 0.4-0.5m	18.5.2004	powdery mildew downy mildew	Kumulus WG Mancosan 80WG	Síra, BAS Mancozeb, DAS	3,50 2,00
Before flowering	8.6.2004	powdery mildew downy mildew	Shavit71,5WP	Folpet,triadimenol, ART	2,00
Flowering	17.6.2004	downy mildew	Acrobat MZ WG	Dimetomorph mancozeb	2,00
At the end of flowering	23.6.2004	powdery mildew downy mildew	Falcon 460EC Folpan 80WDG	Spiroxamine, tebukona-zole,triadimenol, BAY folpet, ART	0,30 2,50
Grapes of peas size	8.7.2004	powdery mildew botrytis bunch rot	Bayleton 25 WP Euparen multi	Triadimefon BAY Tolylfluanid,BAY	0,20 2,50
Bunches closing	20.7.2004	powdery mildew downy mildew	Falcon 460EC Folpan 80WDG	Spiroxamine, tebukona-zole,triadimenol, BAY folpet, ART	0,30 2,00
	4.8.2004	powdery mildew downy mildew	Cuproxat SC, FW Karathane LC	CuSO4 FNA Dinocap DAS	5,00 0,50
Before grapes softening	24.8.2004	botrytis bunch rot powdery mildew	Ronilan WG Kumulus	Vinclozolin,BAS Síra, BAS	1,00 5,00

Tab. 2: *Chemical attendance of vine in 2005,Varietes : Furmint, Lipovina, Muškát žltý in the area-Pahorok- Malá Tŕňa*

Vegetative stage	**Spraying date**	**Diseases**	**Chemical preparate**	**Active substance** (producer)	**Dose per ha (kg, l)**
Shouts 0.4-0.5m	16.5.2005	powdery mildew downy mildew	Kumulus WG Mancosan 80WG	Síra, BAS Mancozeb, DAS	4,00 2,00
Before flowering	7.6.2005	powdery mildew downy mildew	Falcon 460EC Folpan 80WDG	Spiroxamine, tebukona-zole,triadimenol, BAY folpet, ART	0,50 2,50
At the end of flowering	28.6.2005	powdery mildew downy mildew	Cabriotop Silwet L 77 Harmavit	Metiram,pyraclostrobín, BAS Heptamethyltrisiloxal,Cl Liquied fertiliser	2,00 0,25 3,00
Grapes of peas size	11.7.2005	powdery mildew downy mildew	KumulusWG Shavit71,5W P Siwet L 77 Harmavit	Síra, BASF Folpet,triadimenol, ART Heptamethyltrisiloxal, CRO Liquied fertiliser	2,00 2,50 0,25 2,50
Bunches closing	28.7.2005	powdery mildew botrytis bunch rot	Falcon 460EC Euparen multi	Spiroxamine, tebukona-zole,triadimenol, BAY tolylfluanid, BAY	0,30 2,50
Before grapes softening	10.8.2005	Botrytis bunch rot downy mildew	RonilanWG Cuproxat SC	Vinclozolin,BAS CuSO4 FNA	1,00 4,00

Tab. 3: *Integrated protection of vine in 2006,Varietes : Furmint, Lipovina, Muškát žltý in the area -Pahorok- Malá Tŕňa, type A*

Vegetative stage	**Spraying date**	**Diseases**	**Chemical preparate**	**Active substance (producer)**	**Dose per ha (kg, l)**
3 lleaf	9.5.2006	powdery mildew downy mildew	Thiovit Jet Folpan 80WDG	Síra 80%, SYS Folpet ,ART	6,00 2,00
6-leaf	22.5.2006	powdery mildew downy mildew Colomerus vitis	Talendo Tanos50WG OrtusSC, Harmavit	Proqinazid DUP Cymoxanil famoxadone DUP Fenpyroximate,BRA Liquied fertiliser	0,50 2,50 1,00 3,00
Before flowering	1.6.2006	powdery mildew downy mildew	Thiovit Jet Cabriotop Silwet L 77 Harmavit	Síra 80%, SYS Metiram,pyraclostrobín,BAS Heptamethyltrisiloxal,CRO Liquied fertiliser	5,00 2,00 0,25 3,00
At the end of flowering	26.6.2006	powdery mildew downy mildew	KumulusWG Shavit71,5WP Silwet L 77 Harmavit	Síra 800g/kg,BAS Folpet,triadimenol,ART Heptamethyltrisiloxal,CRO Liquied fertiliser	4,00 2,00 0,50 3,00
Grapes of peas size	10.7.2006	powdery mildew downy mildew	Shavit71,5WP Siwet L 77	Folpet,triadimenol,ART Heptamethyltrisiloxal,CRO	2,00 0,25
Bunches closing	25.7.2006	powdery mildew downy mildew botrytis bunch rot	KumulusWG Shavit71,5WP	Síra, BASF Folpet,triadimenol,ART	5,00 2,00
Before grapes softening	15.8.2006	botrytis bunch rot downy mildew	Ronilan WG, Champion 50 WP	Vinclozolin,BAS hydroxid Cu ARA	1,00 4,00

Tab. 4: *Integrated protection of vine in 2006,Varietes : Furmint, Lipovina, Muškát žltý -Pahorok- Malá Tŕňa, type B*

Vegetative stage	**Spraying date**	**Diseases**	**Chemical preparate**	**Active substance** (producer)	**Dose per ha (kg, l)**
3 lleaf	9.5.2006	powdery mildew downy mildew	Thiovit Jet Folpan 80WDG	Síra 80%, SYS Folpet ,ART	6,00 2,00
6-leaf	22.5.2006	powdery mildew downy mildew Colomerus vitis	Talendo Tanos50WG Thyplodromus pyri Harmavit	Proqinazid DUP Cymoxanil famoxadone DUP Dravý roztoč(introdukovaný) Liquied fertiliser	0,50 2,50 3,00
Before flowering	1.6.2006	powdery mildew downy mildew	Thiovit Jet Cabriotop Silwet L 77 Harmavit	Síra 80%, SYS Metiram,pyraclostrobín,BAS Heptamethyltrisiloxal,CRO Liquied fertiliser	5,00 2,00 0,25 3,00
At the end of flowering	26.6.2006	powdery mildew downy mildew	KumulusWG Shavit71,5WP Silwet L 77 Harmavit	Síra 800g/kg,BAS Folpet,triadimenol,ART Heptamethyltrisiloxal,CRO Liqeuid fertiliser	4,00 2,00 0,50 3,00
Grapes of peas size	10.7.2006	powdery mildew downy mildew	Shavit71,5WP Siwet L 77	Folpet,triadimenol,ART Heptamethyltrisiloxal,CRO	2,00 0,25
Bunches closing	25.7.2006	powdery mildew downy mildew botrytis bunch rot	KumulusWG Folpan80WDG Ibefungin	Síra, BASF Folpet ,ART Bacilus subtilis,k-711-subtilin	5,00 2,50 4,00
Before grapes softening	15.8.2006	downy mildew	Champion 50 WP	hydroxid Cu ARA	4,00

EKOLOGICKÁ ORIENTÁCIA OCHRANY VINIČA HROZNORODÉHO *(VITIS VINIFERA)* VO VINOHRADNÍCKEJ OBLASTI TOKAJ

Zhrnutie

Výskum udržateľnosti pestovania viniča v tokajskej oblasti SR je zameraný na program zdokonalenia integrovanej ochrany viniča a zníženia dopadu pesticídov na environment. Poloprevádzkové pokusy (on farm research) sa realizovali v katastri Malá Tŕňa. V príspevku sú prezentované výsledky výskumu a implementácie integrovanej ochrany

viniča hroznorodého vo vinohradníckej oblasti Tokaj v rokoch 2004-2006. Z výsledkov vplynulo, že integrovaná ochrana viniča hroznorodého predstavuje nielen priamu chemickú ochranu, ale pôsobí komplexne s celým radom agrotechnických opatrení ako je vhodný rez viniča, cielené zelené práce, zatrávnenie medziradia a integrovaná výživa ako súčasť integrovanej produkcie hrozna. Výsledky výskumu ukázali, že cielená integrovaná ochrana viniča je k prírode šetrnejšia, chráni a zlepšuje životné prostredie a zabezpečuje hygienicky nezávadnú surovinu pre výrobu kvalitných Tokajských vín. Vzhľadom na redukciu počtu postrekov, zvýšenie kvality produkcie hrozna a zníženie záťaže prírodného prostredia prináša značné ekologické a ekonomické benefity.

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