



SZENT ISTVÁN UNIVERSITY

WEED PLANTS OF VINEYARDS ON THREE VOLCANIC  
WITNESS HILLS

PhD thesis's propositions

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## 1. PRELIMINARIES OF THE RESEARCH, OBJECTIVES

At present approximately 9 % of Hungary's territory is subject to nature conservation, which is almost 830,000 ha. On these areas intensive production is replaced by other landscape functions (maintenance of natural assets, ecotourism, promotion recreational activities, landscape protection). Our protected areas are mainly forests and grasslands but the proportion of areas under agricultural production (arable lands, gardens and orchards) should not be disregarded. Vineyards on protected natural areas cover 4,648 ha and are mainly concentrated to the Balaton Uplands.

In order to protect wildlife habitats and their biodiversity Act LIII. of 1996 on nature conservation orders that all activities must be carried out with regard to the protection of natural assets and areas. In order to achieve this and to maintain natural assets and biological diversity on natural areas nature conservation authorities may initiate the restriction and prohibition of use of certain pesticides and chemicals affecting soil fertility.

However, it is a fact that the currently cultivated *Vitis vinifera* varieties can not be grown economically without continuous plant protection measures. At present chemical weed control – mainly due to logistic reasons – happens in more and more cases in addition to the regular treatment with fungicides and insecticides. Although at present the number of herbicides permitted is relatively high, their application brings the required result only occasionally. Using improperly chosen chemicals and leaving out of consideration the weed composition and other characteristics of the area should be pointed out among the reasons. According to the above mentioned, the basis of rationale and environmentally sound weed control is exclusively weed control planned and carried out on the basis of preliminary weed surveys, which in case of chemical weed control includes the selection of the appropriate herbicide.

Hungary's wine growing area is divided into 22 wine regions, the ecological characteristics of which are extremely different. Vineyards throughout the country are characterised by differing cultivation methods, weed control interventions and temperature, precipitation and soil conditions. Therefore, diversity can be seen in the weed flora of the areas.

The Plant Protection Department of the Szent István University's Faculty of Agricultural and Environmental Sciences in Gödöllő has been carrying out weed flora surveys in several significant

wine regions of Hungary for many years. I have joined this work and in my thesis I am dealing with the weed plants of vineyards on Ság, Somló and Badacsony witness hills. The common characteristics of the three areas are besides the geological and climatic conditions, the facts that they are subject to a certain degree of protection and the traditional land use type of all areas is viticulture.

The following objectives were set during the weed flora survey in the vineyards of the three volcanic witness hills:

**1. Study of the weed flora of vineyards**

- a) percentage survey of weed cover per species
- b) determining the importance of weed plants
- c) identification of the weed flora of vineyards on each hill
- d) identification of weed plants of the spring, summer and autumn seasons
- e) determining the ratio of weed species of certain life forms and flora element groups

**2. Study of the weed flora in vineyards with different intensity of cultivation and type of cultivation**

- a) effect of the intensity of cultivation (younger than 4 years; older than 4 years and regularly cultivated, older than 4 years but not cultivated regularly; older and uncultivated, neglected) on the weed flora of vineyards and assessment of succession processes
- b) effect of different cultivation (stake vine-stock cultivation, cordon cultivation) on the weed flora of vineyards

**3. Study of the effect of soil cover experiment on weed flora carried out by the Badacsony Research Institute of Viticulture and Viniculture**

- a) survey of the number of weed species and their percentage coverage on a control vineyard
- b) survey of the number of weed species and their percentage coverage on a vineyard with soil cover

**4. Conclusions of the research results to be used in practice, recommendations**

## 2. MATERIALS AND METHODS

The aim of the weed survey was to get an overview of the weed conditions of the areas because their precise knowledge is essential when planning effective weed control. The Balázs-Ujvárosi mapping method was used for my survey, according to which the rate of coverage of certain species within the designated quadrates (generally 2x2 m) is estimated. In vineyards where weeds are found along the rows in a width of 60-80 cm and in vine-stock cultivation also around the vine-stocks, quadrates can be used hardly or just to a smaller extent and the halving technique gives worse results than the percentage estimation of the coverage. During my samplings, as a consequence of the above, I surveyed the weed coverage percentage of the single areas. During the preliminary research it became evident that the 2x2 m area can not be clearly surveyed, therefore 1x1 m quadrats were used for the survey. When applying the method which was modified in this way I have chosen 5 sampling squares of 1x1 m in each vineyard and the plant species and related coverage percentages were recorded. The samplings were carried out on 36 vineyards. The location of the studied plantations was recorded also with GPS (Geographical Location System).

Basic studies for the present research were done monthly in the vegetation period between November 1997 and October 1996 but at that time only on one witness hill, the Ság Hill. In the first phase of the research the preliminary survey of the area was done and the sites where I carried out the sampling in the recent years were designated. The detailed research on the three witness hills was done for three years between 1999 and 2001. In order to monitor the weed plants of the spring, summer and early autumn periods, I did one sampling at the end of April-beginning of May, one in June-July and one at the end of August-beginning of September.

The results of the samplings were recorded in different tables according to date and site and the tables were completed with the classification of the species according to life form and flora element category. The basic data of the sites were evaluated according to different aspects. After evaluating the results, the derived data were determined regarding each hill, the vine-stock cultivation method, intensity of cultivation, aspects and years. The relative ecological indicator values (water balance of the species; relative ground water and soil moisture indicator values) related to the single species were taken into account at the evaluation of the summarised data of the research.

### 3. RESULTS

After summarising the outcomes it was found that 182 weed species were present in the studied vineyards of the three witness hills and 13 species had a coverage of more than one percent. The highest average weed coverage was found on the Ság Hill (51.31%) but the number of species was the lowest here. *Taraxacum officinale* was present most frequently (35) in the vineyards. *Chenopodium album* was present in almost all plantations (34) but its coverage was only a bit over one percent. The proportion of plants present only on one plantation was relatively high (44 species). It was found that the frequent presence (29) of weed species representative in certain vineyards (e.g. *Lactuca serriola*) does not necessarily entails the large scale propagation of the species (0.26%).

During the study weed infestation of the areas and the number of weeds per site showed a large diversity. The number of weed species and the rate of weed infestation of the sites were very varying on the various sites and they showed significant change on the same site annually and according to the seasons. The average coverage of each weed species in the single years changed significantly and it was significant also in the case of frequently occurring species with a coverage greater than 0.5%.

The coverage of several weed species characteristic in vineyards (*Amaranthus retroflexus*, *Capsella bursa-pastoris*, *Chenopodium album*, *Galinsoga parviflora*, *Stellaria media*, *Taraxacum officinale*, *Senecio vulgaris*) shows a clear decreasing trend. Taking into account the water balance of the species (W-value) and the relative ground water indicator values and soil moisture indicator values (WB-value) it can be stated that these species in most cases prefer temperate fresh, fresh and moderately wet soils. On the basis of the previous we can assume that the reason for their decreasing coverage can be the lack of precipitation during the germination period.

In contradiction with the previous species a tendency for propagation was noticed in case of *Bromus sterilis*, *Bromus tectorum*, *Calamagrostis epigeios*, *Conyza canadensis*, *Erigeron annuus*. These monocotyledon species reflect – according to their W-value – dry conditions. Although *Conyza canadensis* and *Erigeron annuus* are primarily the indicator plants of humid conditions, in this case they managed to be significant due to their increased spreading and aggressiveness. These two weed species are among the most dangerous invasive species in Hungary.

In the single years the number of species with similar coverage was relatively low. *Geranium pusillum*, *Lolium perenne* and *Setaria verticillata* are worth to point out among them. *Geranium pusillum* germinated on the sites mainly after soil cultivation or chemical application, and then gradually suppressed with the occurrence of species with more significant coverage. *Lolium perenne* had a coverage of more than one percent (1.14%) only on the Somló Hill and was present on the other sites only as a less important element. *Setaria verticillata* was mainly present in the vineyards of Badacsony where it had the eighth highest average coverage (1.1%), while according to its coverage on the other two hills it was ranked as a less significant plant.

In total the annual species ( $T_4$ ,  $T_1$ ) are dominating among the life forms and the third highest coverage rate (5.31%) of  $G_3$ -type geophyte perennial species is exclusively due to the significant presence of *Convolvulus arvensis* (4.72%). In the studied vineyards both the coverage and the number of annual species ( $T_4$ ,  $T_2$ ,  $T_1$ ) were high, while the perennials wintering in the soil ( $G_3$ ,  $G_1$ ), and being present with less species had significant coverage. In the studied vineyards the coverage of annual plant species exceeded that of the perennials but during the research period the coverage of annuals showed a gradual decrease, while that of the perennials remained stable.

After summarizing the data it can be stated that with regard to coverage cosmopolitan flora elements clearly dominate in the studied vineyards. The Eurasian group should be pointed out concerning species number, however the coverage of species of this group was only the half of that of the cosmopolitans (10.36%) even if they have higher species number. Considering species number and coverage the importance of the other flora elements is significantly lower.

## NEW SCIENTIFIC RESULTS

On the basis of my research done between 1999-2001 on weed plants occurring in the vineyards of the Ság, Somló and Badacsony witness hills, new scientific results are summarized as follows:

1. There has been no detailed survey until now about the weed plants occurring in the vineyards of the three witness hills. During my surveys 182 weed species were recorded in the three witness hills. In addition, I gave an overview on the coverage of the weed plants occurring in the vineyards of Ság, Somló and Badacsony. On the basis of my research it can be stated that the vineyards of the three witness hills have different weed conditions.
2. In the vineyards of the Ság Hill 108 weed species were recorded during the research, among which the coverage of *Stellaria media*, *Portulaca oleracea*, *Taraxacum officinale* and *Convolvulus arvensis* is outstanding. On the basis of the average coverage the vineyards of Ság are mainly characterized by life forms T<sub>4</sub> and T<sub>1</sub>.
3. 112 species occurred in the vineyards of Somló during the 3-year research, among which *Convolvulus arvensis* has the largest coverage. T<sub>2</sub> and G<sub>3</sub> groups were the most significant among the life forms and on the basis of coverage weeds with T<sub>4</sub> life form were only the third.
4. The plantations of Badacsony have the highest species number among the three studied hills. 149 weed plants were recorded in the study period, among which the coverage of *Convolvulus arvensis* and *Stellaria media* is significant. The proportion of life form groups is similar to that of the sites on Ság, the dominance of T<sub>4</sub>, T<sub>1</sub> and G<sub>3</sub> was determined here as well.
5. The weed conditions of the vineyards were influenced by the extreme precipitation patterns experienced during the research. On the basis of coverage perennial species (e.g. *Convolvulus arvensis*) had less sensitive response to the drier circumstances, while the germination and development of annual species (e.g. *Stellaria media*) were hampered due to lack of precipitation.
6. *Convolvulus arvensis* had the highest coverage in all the studied vineyards, while *Taraxacum officinale* was found on the largest number of vineyards.

7. It can be stated that both concerning the species number and the coverage, T<sub>4</sub> life form is the dominant in the studied vineyards. The Eurasian group had the highest species number among the flora elements but on the basis of coverage the cosmopolitan group is the most significant.
8. The decline in the intensity of cultivation creates adequate conditions for certain species spreading aggressively, which may significantly suppress other species. This was noticed in case of *Elymus repens*, *Erigeron annuus* and *Calamagrostis epigeios*.

During my research several aggressively spreading plants, so-called invasive plants (*Ambrosia artemisiifolia*, *Solidago canadensis*, *Solidago gigantea*, *Ailanthus altissima*, *Asclepias syriaca*) appeared in the vineyards. These species mainly dominate in the less cultivated vineyards but it has to be pointed out that they occur – though only in low numbers – in regularly cultivated areas.

#### 4. CONCLUSIONS AND RECOMMENDATIONS

On the basis of my research done between 1999-2001 on weed plants occurring in the vineyards of the Ság, Somló and Badacsony witness hills, the following conclusions can be drawn:

##### 1. Weed flora of the studied vineyards

- 1.1. The basically different conditions of the sites significantly influence the weed composition and the weed coverage of vineyards. Significant changes were observed in the weed flora during the study period even within a site, which usually originates from the combined effect of several environmental factors.
- 1.2. Considering that according to my calculations almost four thousand vineyards having different conditions can be found on the three hills and on the basis of the studied plantations only an overview can be outlined about the weed conditions of the sites.
- 1.3. It can be stated that the significant variability experienced in case of certain species does not change significantly the summarized dominancy of the life form and flora element groups. This corresponds with the earlier statements of UJVÁROSI (1975) and NÉMETH (1986 a, b), according to which the evaluation of the life forms should be emphasized when observing the changes in the weed flora.
- 1.4. During the research there was a significant decrease in precipitation, which was principally considerable in case of the Ság Hill. The change in the amount and timely distribution of precipitation effects the dominance relations of the species and life forms. This finding corresponds with SZŐKE's (2001) statement who also referred to the effects of climate change on weed conditions. The decrease in the coverage of T<sub>4</sub> species can be originated mainly from the unfavourable summer precipitation conditions. The drier conditions did not ensure favourable conditions for the germination of annual species, while perennials – with the decreasing green areas in some cases – survive the drier summer period.
- 1.5. It can be stated that several years of monitoring is needed for the mapping of weed flora characteristic of the sites and for determining the dominancy conditions. The conditions observed at the sampling dates can only be used as signals and general conclusions can not be drawn.
- 1.6. There are certain species (e.g. *Taraxacum officinale*, *Amaranthus retroflexus*), which can be found at each site and have significant coverage. It has to be noted that certain wide-spread

species having their roots in the upper part of the soil (*Stellaria media*) do not compete with grapes, therefore control against them is not justified. Weed control should focus on species causing bigger problem, for example *Conyza canadensis* resistant to triazine, *Bromus* species lying on the surface or *Convolvulus arvensis*, against which there are only restricted protection possibilities.

- 1.7. Invasive plants recorded during my research (*Ambrosia artemisiifolia*, *Solidago canadensis*, *Solidago gigantea*, *Ailanthus altissima*, *Asclepias syriaca*) appeared in the semi-cultivated vineyards. Considering the aggressive spreading capacity of these species their spreading from the vineyards may threaten strictly protected areas of the witness hills due to their ecological risks. In order to reduce risks more attention should be paid in the future to the suppression of invasive species in vineyards.

## **2. Effect of cultivation and weed control of plantations on the weed flora of vineyards**

- 2.1. In the past period the changes in ownership status had negative impact on the non-cultivated vineyards and infested by weeds is significant. Moreover, there are hardly any new vineyards.
- 2.2. The number of species occurring is influenced by both cultivation and the lack of cultivation. The highest species number (158 species) was found on the regularly cultivated sites, while the lowest number of weed species was found on the non-cultivated sites (74 species). The reason for the previous statement is succession happening on non-cultivated areas, while in case of plantations younger than 4 years continuous weed control creates favourable life conditions for several weed species.
- 2.3. Different cultivation method resulted in different weed conditions on the studied vineyards. This difference is evident mainly in case of the ratio of the different life forms. It can be stated that concerning weed conditions the situation is worse in areas with cordon cultivation. The fundamental difference between the weed conditions of vineyards with cordon cultivation and traditional stake vine-stock cultivation is that weed management is based on chemical weed control in cordon vineyards where cultivation is more intensive and mechanized, while stake cultivation is based on hoeing.
- 2.4. Weed control can only be effective if weed survey is done prior to the intervention. In this way weed species that pose the greatest risk on our vineyards can be assessed and the mechanical and chemical (active ingredient and product) weed control methods, which adapt the most to the site conditions, can be selected.

- 2.5. The proportion of chemical weed control is increasing on the studied vineyards, which mainly means the use of free-trade products having total effect and mostly containing glyphosate. Thick and dry plant material (as mulch) remaining due to chemical weed control reduced the number of species in many cases.
- 2.6. Grapes in the studied vineyards were mainly planted parallel to the slopes. Significant erosion needs to be considered on these sites. As a consequence of the previous, we must maintain such weed coverage, which ensures protection against erosion caused by large amount of sudden precipitation and meanwhile provides habitat for the organisms living there. We can herewith meet the expectations of integrated weed control as well (5% unmanaged compensation area).
- 2.7. The results of the surveyed soil cover method done with a sedge-reed-golden rod mixture underlines the assumption that we can keep the area free of weeds without continuous chemical use and excessive mechanical cultivation as well. In case of viticulture on protected natural areas this weed control method should have a greater importance in the future because besides reducing the load of chemicals it can have a role in preventing erosion.

## 8. IMPORTANT PUBLICATIONS RELATED TO THE SUBJECT OF THE THESIS

### Articles in scientific journals:

- MIHÁLY, B. – NÉMETH, I. (2004): **Gyommonitoring nyugat-dunántúli vulkáni tanúhegyek szőlőiben.** *Magyar Gyomkutatás és Technológia.* 5 (1): 42-54. p.
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- TÖRÖK, K. – BOTTA-DUKÁT, Z. – DANCZA, I. – NÉMETH, I. – KISS, J. – MIHÁLY, B. – MAGYAR, D. (2003): **Invasion gateways and corridors in the Carpathian Basin: biological invasions in Hungary.** *Biological Invasions.* Kluwer Academic Publishers. 5: 349–356. p.
- NÉMETH, I. – MIHÁLY, B. (2001): **Present situation of *Convolvulus arvensis*. Distribution, importance in vineyards and strategy for control.** *International Journal of Horticultural Sciences.* AGROINFORM Publishing House. 1-4. p.
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### Presentations:

- MIHÁLY, B. – NÉMETH, I. (2000): **Adatok a Sághegyi Tájvédelmi Körzet szőlőinek gyomflórájához.** In: Összefoglalók. Növényvédelmi Tudományos Napok, Budapest, 147. p.
- MIHÁLY, B. – NÉMETH, I. (2000): **Védett vulkáni tanúhegyeken lévő szőlők gyomflórájának vizsgálata.** In: Összefoglalók. Növényvédelmi Tudományos Napok, Budapest, 148. p.
- MIHÁLY, B. – NÉMETH, I. (2000): **Szőlők gyomflórájának vizsgálata a Sághegyi Tájvédelmi Körzetben - Weed Plants in Vineyards of Ság-Hill Landscape Protection Reserve.** Második Nemzetközi Növényvédelmi Konferencia - 2<sup>nd</sup> International Plant Protection Symposium at Debrecen University. Abstracts. 36-37. p.
- MIHÁLY, B. – NÉMETH, I. (2000): **Védett területek gazdálkodásának gyomszabályozási problémái, különös tekintettel a szőlőkre - Weed Control Problems in the management of Vineyards in Protected Sites.** Második Nemzetközi Növényvédelmi Konferencia - 2<sup>nd</sup> International Plant Protection Symposium at Debrecen University. Abstracts. 112-114. p.
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