POSTER SESSION
PHYTOPATHOLOGICAL GROUP
VERTICILLIUM WILT ON GROUNDNUTS – CAUSAL AGENT AND POSSIBILITIES FOR INTEGRATED DISEASE CONTROL

Mariana Nakova
Agricultural University, Plovdiv, Bulgaria

Verticillium wilt is worldwide spread on a big number of cultivated and wild species (Kranz et al., 1978; Porter, 1984). Most common causal agents are *Verticillium dahliae* and *Verticillium albo-atrum*. They have more than 350 host plants that belong to 160 genera and 60 families. *Verticillium dahliae* is a major pathogen that cause tracheomycosis in tropics and temperate climate zones (Pegg, 1974) and attacks woody and park species, vegetable, forage and arable crops (Bender and Shoemaker, 1984). That fungus is pathogenic to more than 250 plants (Fravel, 1989).

For the first time Verticillium wilt on groundnuts have been reported in Asia in 1937 (cit. Porter et al., 1984). During the second half of 19th century the disease spread quickly and nowadays is found in all groundnuts growing areas (Purss, 1961; Hci, 1967; Frank and Krikun, 1969; Jackson and Durhan, 1969; Issac, 1967; Kranz et al., 1978; Porter et al., 1984). Depending on climate conditions, varieties grown and technologies applied, yield losses vary between 2 and 60% (cit. Porter et al., 1984).

Verticillium wilt is difficult to be controlled with pesticides because pathogens survive for a long time in soil. Results can be obtained only when complex measures are undertaken – technological, chemical, biological and breeding programmes.

Tjamos et al. (1991) and Tjamos and Vellias (1997) reported the possibility for applying antagonistic fungi against *Verticillium dahliae*. Soil colonization with *Talaromyces flavus* can suppress microsclerotia formation and soil infestation of *Verticillium dahliae* especially in root zone.

Research done by Solarska (1997) pointed out that soil incorporation of *Talaromyces flavus* and *Trichoderma viride* before sowing is an useful practice against Verticillium wilt and other soil pathogens. Moreover *Trichoderma viride* has stimulating effect on some crops.

Using *Talaromyces flavus* Kersten (1997) has prepared formulation for Verticillium wilt control and made greenhouse experiments with rape.

Aiming limitation of inoculum some authors (Evans, 1966; Purss, 1961; Morris et al., 1984) recommend well-organized technology practices, including proper irrigation, crop rotation, seed material free from infection, weed control, and introduction of resistant varieties and chemical control.

Soil treatment with metyl bromide and chlorpikrine had been used to control
inoculum (Sinclair, 1967; Krikun and Frank, 1982). Fungicides as benzimidazole, oxichinolinsulphate, methyl tyophanate, Basamid granulate, etc. can also be applied (Nakov et al., 1999).

Most authors pointed out that breeding for resistance was the most prospective method (Morris et al., 1987; Agrios, 1988). Valencia type and Spanish varieties are susceptible to Verticillium wilt (Curtis and Durhan, 1969). Highly resistant forms are found in American type – Georgia bunch (Smith, 1960). Results from resistance breeding programmes are published by Subrahmanyam et al. (1992).

In Bulgaria till present there is no information available about Verticillium wilt on groundnuts and studies on methods for Verticillium control. The aim of present research is to identify causal agents, to test antagonistic fungi against *Verticillium dahliae*, and to study susceptibility of Bulgarian groundnut varieties and lines to the pathogen.

**Materials and Methods**

Research experiments have been done at the Department of Phytopathology, Agricultural University, Plovdiv in the period 1994-2002.

Causal agent have been isolated based on standard phytopathological methods, from cultivars Kalina, Sadovo 2609, Sadovo improved, Orpheus, Rositza, Velikan and lines 3170, and 3078\(^b\). Pathogenicity of the strains have been proved by Koch postules – artificial inoculation of varieties Kalina, Sadovo improved, Orpheus, Rositza, Velikan and line 3170, in growth chamber. Symptoms have been reported after 30-35 days, based on the following scale:

- 0 healthy plants;
- 0.1 roots infected and mild leave chlorosis;
- 1 symptoms at stem base and 0.5-1 cm above (vein necrosis); leaf chlorosis;
- 2 symptoms on root and stem (vein necrosis), chlorotic leaves and beginning of leaf necrosis.

Morphology and cultural characteristics of the colonies and mycelia (conidiophores, conidia) have been studied under microscope from 12-14 days culture on PDA.

Following cultivars have been inoculated with *Verticillium dahliae*: Sadovo 2609. Orpheus 3351, Kalina, Rositza 3092, Velikan, Sadovo 2510, Sadovo improved and lines 3078\(^b\), 3371, 3403, 3301, 3675, 3202\(^b\), 3256, \(3240^a\), 3170, 3190\(^b\), 3301\(^3\) respectively. Experiments have been carried in sterile soil, in growth chamber, two series (10 plants each). Inoculation has been done with spore suspension when young plants appeared and at 2-4 true-leaf stage.
Results have been reported on 30<sup>es</sup> and 50<sup>es</sup> days after inoculation, based on the following grading scale:

1. Resistant – R – No symptoms;
2. Moderately resistant – MR – root tips are infected, mild chlorosis on older leaves;
3. Moderately susceptible – MS – roots and stem-base infected, chlorosis on older leaves;
4. Susceptible – S – roots, stem-base and 1.5-2 cm of the stem infected, beginning of leave necrosis.

Antagonistic activity of <i>Talaromyces flavus</i> and <i>Trichoderma viride</i> has been studied in vitro. Based on diameter of the colonies of pathogen and antagonists, coefficient of competition is calculated:

\[ K = \frac{D_a}{D_f} \]

K – coefficient of competition;
Da – colony diameter of antagonist
Df – colony diameter of pathogen

Strains divide in 3 groups:

5. K < 1 – non competitive
6. 1 < K < 2 – weak competitiveness
7. K > 2 – highly competitive

Other strains divided as follows:

8. Non active – K < 1, no antibiotic activity zone, no hyperparasitic reaction
9. Weak antagonists – 1 < K < 2, sterile zone and/or hyperparasitism
10. Strong antagonists – K > 2, sterile zone and/or hyperparasitism

Results and Discussion

In our experiments 8 strains have been isolated from different varieties: Kalina, Sadovo 2609; Sadovo improved, Orpheus, Rositza, Velikan, lines 3170, 3078<sup>b</sup>. Their pathogenicity have been proved and morphology studied on PDA. Colonies are whitish, fluffy, and rosy at the base. Mycelia are hyaline, with thin walls. Conidiophores formed on horizontal hyphae and vertically branched, short and hyaline. Rarely secondary branches are formed. Conidia are hyaline, single celled, elliptical, rarely ovoid, their size 3.15-7.10 x 1.2-3.4 μm. They are formed at the tip of conidiophores. On nutrient media microsclerotia are also formed. Data correspond with those published by Meloun and Wadsworth (cit. Porter, 1984).
Analysis of data and comparison with literature sources, lead to conclusion that in Bulgaria causal agent of Verticillium wilt on groundnuts is *Verticillium dahliae* Kleb. (Table 1).

Table 1. Conidia size of *Verticillium dahliae* and *Verticillium albo-astrum*, μm

<table>
<thead>
<tr>
<th>Authors</th>
<th><em>Verticillium dahliae</em></th>
<th><em>Verticillium albo-astrum</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Pidoplichko, N.M.</td>
<td>3-3,5 x 1,5-2</td>
<td>3-12 x 2,5-3</td>
</tr>
<tr>
<td>Christov, Al.</td>
<td>3,25-7 x 2-2,75</td>
<td>3,25-7 x 2-2,75</td>
</tr>
<tr>
<td>Chohriakov, M.K.</td>
<td>3-5,5 x 1,5-2</td>
<td>2,8-12 x 1,5-3</td>
</tr>
<tr>
<td>Melouk and Wadsworth</td>
<td>3 x 6,5</td>
<td></td>
</tr>
<tr>
<td>Ibitui, Nakova</td>
<td>3.15 – 7.10 x 1.2-3.4</td>
<td></td>
</tr>
</tbody>
</table>

Results from studies on antagonistic activity of *Talaromyces flavus* and *Trichoderma viride* are present of Table 2.

Table 2. Antagonistic activity of *Talaromyces flavus* and *Trichoderma viride* against different strains of *Verticillium dahliae*

<table>
<thead>
<tr>
<th>Origin of isolate</th>
<th>Pathogen colonia diameter, mm</th>
<th>Antagonist colonia diameter, mm</th>
<th>Coefficient of competition, K</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bulgaria</td>
<td><em>Verticillium dahliae</em> /groundnuts/ 47</td>
<td><em>Trichoderma viride</em> - 69.5</td>
<td>1.47</td>
</tr>
<tr>
<td>Greece</td>
<td><em>Verticillium dahliae</em> /olive/ 10</td>
<td><em>Trichoderma viride</em> - 77.5</td>
<td>7.75 hyperparasitism</td>
</tr>
<tr>
<td>Bulgaria</td>
<td><em>Verticillium dahliae</em> /groundnuts/ 50.5</td>
<td><em>Talaromyces flavus</em> - 67.5</td>
<td>1.33</td>
</tr>
<tr>
<td>Greece</td>
<td><em>Verticillium dahliae</em> /olive/ 20</td>
<td><em>Talaromyces flavus</em> - 50</td>
<td>2.5</td>
</tr>
</tbody>
</table>

*Trichoderma viride* have weak antagonistic activity to *Verticillium dahliae* isolated from groundnuts (K = 1.47) and high competitiveness to the strain from olives (K = 7.75/).
*Talaromyces flavus* also express high antagonistic activity to *Verticillium dahliae*, isolated from olives (K=2.5).

Experiment data concerning cultivar response to *Verticillium dahliae* are present on Table 3.

Table 3. Response of some groundnut varieties and lines to *Verticillium dahliae*

<table>
<thead>
<tr>
<th>Variety/line</th>
<th>30&lt;sup&gt;th&lt;/sup&gt; day</th>
<th>50&lt;sup&gt;th&lt;/sup&gt; day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Line 3675</td>
<td>R</td>
<td>MR</td>
</tr>
<tr>
<td>Line 3170</td>
<td>MR</td>
<td>MS</td>
</tr>
<tr>
<td>Line 3202&lt;sup&gt;b&lt;/sup&gt;</td>
<td>MR</td>
<td>MS</td>
</tr>
<tr>
<td>Kalina</td>
<td>R</td>
<td>MR</td>
</tr>
<tr>
<td>Line 3190&lt;sup&gt;b&lt;/sup&gt;</td>
<td>R</td>
<td>R</td>
</tr>
<tr>
<td>Sadovo 2609</td>
<td>MR</td>
<td>MS</td>
</tr>
<tr>
<td>Line 3256</td>
<td>MR</td>
<td>MS</td>
</tr>
<tr>
<td>Rositza 3092</td>
<td>MS</td>
<td>S</td>
</tr>
<tr>
<td>Line 3240&lt;sup&gt;a&lt;/sup&gt;</td>
<td>MS</td>
<td>S</td>
</tr>
<tr>
<td>Orpheus</td>
<td>MR</td>
<td>MR</td>
</tr>
<tr>
<td>Line 3078&lt;sup&gt;b&lt;/sup&gt;</td>
<td>MS</td>
<td>S</td>
</tr>
<tr>
<td>Sadovo 2510</td>
<td>MS</td>
<td>S</td>
</tr>
<tr>
<td>Velikan</td>
<td>MR</td>
<td>MS</td>
</tr>
<tr>
<td>Sadovo improved</td>
<td>MS</td>
<td>S</td>
</tr>
<tr>
<td>Line 3371</td>
<td>MR</td>
<td>S</td>
</tr>
<tr>
<td>Line 3403</td>
<td>MR</td>
<td>MS</td>
</tr>
<tr>
<td>Line 3301&lt;sup&gt;3&lt;/sup&gt;</td>
<td>MS</td>
<td>S</td>
</tr>
</tbody>
</table>

On the 30<sup>th</sup> day after inoculation resistance is expressed by cultivar Kalina and lines 3675, 3190<sup>b</sup>; moderate resistance – from lines 3170, 3202<sup>b</sup>, 3256, 3371, 3403 and varieties Sadovo 2609, Orpheus, and Velikan.

On the 50<sup>th</sup> day after inoculation resistant response has been observed only on line 3190<sup>b</sup>. Varieties Kalina and Orpheus, and line 3675 showed moderate resistance.

Based on studies and results obtained following conclusions can be made:

- **As a causal agent of Verticillium wilt on groundnuts in Bulgaria *Verticillium dahliae* Klebahn has been isolated and identified.**
- **Trichoderma viride** and *Talaromyces flavus* have weak antagonistic activity to *Verticillium dahliae* isolated from groundnuts and high competitiveness to the strain from olives.
• From cultivars tested for resistance to *Verticillium dahliae* on the 50th day after inoculation only line 3190 showed resistance, and Kalina, Orpheus and line 3675 were moderately resistant.

**References**

Bender, C.G., Shoemaker P.B., 1984, Plant Disease 68, 305-309.
Christov, Al., 1972, Compendium of plant diseases, Zemizdat, Sofia, 482.
Chochriakov, M.K., 1984, Compendium of plant diseases, Kolos, Leningrad
Jackson, C.R. and Durham, K.B., 1969, Diseases of peanut /Groundnut/ caused by fungi
Kranz, J. et al., 1978, Diseases Pest and Weeds in Tropical Crops, John Wiley & Sons
Morris, D.P.et al., 1984, Compendium of Peanut Diseases, APS
Nakov, B. et al., 1999, Special Plant Pathology, ASSP, Sofia, Bulgaria
Pidoplichko, N.M., 1977, Fungi-parasitic to cultivated plants, Compendium, v.2, Naukova dumka, Kiev, 82
Verticillium wilt is a disease of economic importance and can influence the yields in groundnut production. Our goal has been to identify causal agent and study biological means (antagonistic fungi) for control, as well as to test varietal resistance of some groundnut cultivars and lines.

As a causal agent of Verticillium wilt on groundnuts in Bulgaria *Verticillium dahliae* has been isolated and identified. The pathogen has hyaline mycelia and simple conidiophores, vertically branched rarely with secondary branches. Spores formed at the top of conidiophores are single celled, elliptical, hyaline, size 3.15-7.10 x 1.5-2.2 μm. *Talaromyces flavus* and *Trichoderma viridae* have high antagonistic activity to *Verticillium dahliae* isolate from olives, but not to *Verticillium dahliae* from groundnuts.

From cultivars and lines tested for resistance to *Verticillium dahliae* the line 3190 showed resistance, line 3675, varieties Kalina and Orpheus were moderately resistant after the 50 days.
RESISTANCE OF WINTER WHEAT CULTIVARS AGAINST NECROTROPHIC LEAF PATHOGENS
(2001-2003 SZEGED, HUNGARY AND 2003 ASCHERSLEBEN, GERMANY)

Mária Csősz¹ – Doris Kopahnke² – Edit Nagyhaska¹ – Ilona Pusztai¹ – Ákos Mesterházy³

¹Cereal Research Non-profit Company, Szeged, Hungary
²Federal Centre for Breeding Research on Cultivated Plants Institute for Epidemiology and Resistance, Aschersleben, Germany

The infections by *Drechslera tritici-repentis*, *Septoria tritici*, *Stagonospora (Septoria) nodorum* and *Bipolaris sorokiniana* significantly increased due to the poor economic situation, increasing monocultural and minimum tillage practices in Hungary at the late '90s. Medium epidemic was observed in 1996 and 1999 in the Szeged nurseries caused by *S. tritici*. In 1996, Pál Békési recorded in Kecskemét a medium level of epidemic. The two data series often showed significant differences for the same cultivars. *D. tritici-repentis* was described first in Hungary by Aponyi et al. (1988). The available data basis is poor, mostly data about influence on monocultural production were reported (Balogh et al. 1991, Rátai and Peczé 1997).

We have not enough information about the resistance of winter wheat cultivars that is why a new project studying resistance and yield reaction of the varieties has started.

Materials and Methods

1.) Testing of cultivars after winter wheat:
Thirty-two registered cultivars were tested during three years in Szeged. The plot size was 4m², in four replicates, under untreated and treated environments (randomized block design). The previous crop was winter wheat. Applied fungicides in 2001: Folicur Top (1 l/ha, tillering), Sphera (1 l/ha, at flowering); in 2002 and 2003: Juwel (1 l/ha) (at flowering, early spraying was omitted because occurrence only sporadic symptoms).

We scored the leaf spots, powdery mildew (*Blumeria graminis*), leaf rust (*Puccinia triticina*) and yellow rust (*Puccinia striiformis*). Leaf samples were collected from each cultivars. The samples were incubated in Petri dishes on wet filter-paper at 20 °C for 48-72 hours, and then microscopic identification of the necrotrophic fungi was performed (*D. tritici-repentis*, *S.*
tritici, S. nodorum and B. sorokiniana). After harvesting we measured the yield and the results were evaluated by two-way ANOVA.

2.) Testing of cultivars under artificial infection environment in adult and seedling stage

The same thirty-two cultivars were tested in Aschersleben, in 2003. Ten D. tritici-repentis isolates collected from naturally infested wheat grown in Russia, Czech Republic and Germany were used for the field experiments and three from this for the tests in the greenhouse. The two rows of each wheat cultivars were separated from each other by one row of a susceptible cultivar and tested in the field. Infested oat kernels (a mixture of ten isolates) were used as method of inoculating wheat in the field. The oat kernels were dispensed in the field at the end of December. Tan spot was visually assessed on approximately 7-day intervals beginning 20 May 2003 using percentage of leaf attack.

The evaluation of resistance in the greenhouse was performed in 1-leaf seedling stage on detached leaves. Leaf segments were cut from each plant and arranged in trays on cotton soaked with 40 ppm benzimidazole solution (Mikhailova and Kvitko, 1970) and sprayed with conidia suspended in solution of Tween-80 at a concentration 6000 spores/ml. The reaction type was recorded 5-7 days after inoculation using a 0-5 scale (size of necrotic spots and necrotic halos) described by Lamari and Bernier,1989.

Results

Leaf rust epidemic was heavy, powdery mildew epidemic was medium during the last three years. We observed a medium yellow rust epidemic in 2001. Level of leaf spots epidemic was the highest in 2002 years (Table 1).

Table 1. Level of epidemic of the observed diseases

<table>
<thead>
<tr>
<th>Observed diseases</th>
<th>Years</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leaf spots (%)</td>
<td></td>
<td>14.83</td>
<td>38.20</td>
<td>15.77</td>
</tr>
<tr>
<td>Powdery mildew (ACI)*</td>
<td></td>
<td>19.49</td>
<td>11.79</td>
<td>2.84</td>
</tr>
<tr>
<td>Leaf rust (ACI)</td>
<td></td>
<td>37.99</td>
<td>41.50</td>
<td>41.13</td>
</tr>
<tr>
<td>Yellow rust (ACI)</td>
<td></td>
<td>22.98</td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>

* average coefficient of infection (CIMMYT, 1976)
Leaf samples from each cultivar were collected and identified for the following necrotrophic pathogens in the leaf samples (Table 2).

Table 2. Identified necrotrophic pathogens (%)

<table>
<thead>
<tr>
<th>Necrotrophic pathogens</th>
<th>Years</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
</tr>
</thead>
<tbody>
<tr>
<td>D. tritici-repentis</td>
<td></td>
<td>15.91</td>
<td>85.00</td>
<td>29.20</td>
</tr>
<tr>
<td>S. tritici</td>
<td></td>
<td>2.27</td>
<td>23.00</td>
<td>12.50</td>
</tr>
<tr>
<td>S. nodorum</td>
<td></td>
<td>13.64</td>
<td>2.00</td>
<td>12.50</td>
</tr>
<tr>
<td>B. sorokiniana</td>
<td></td>
<td>2.27</td>
<td>17.00</td>
<td>2.90</td>
</tr>
</tbody>
</table>

The occurrence of necrotrophic pathogens differed significantly even in the same location among years.

The mean yield response of the 32 cultivars (2001-2003) differed significantly between the protected and not protected experiments showing the general yield loss that was between 7.11-17.97%. Considering correlation coefficient the biotrophic pathogens influenced more expressed on the yield response of the cultivars (Table 3)

Table 3. Values of correlation coefficient (n=32)

<table>
<thead>
<tr>
<th>Diseases</th>
<th>Years</th>
<th>Yield decrease %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leaf spots</td>
<td>2001</td>
<td>-0.2726</td>
</tr>
<tr>
<td></td>
<td>2002</td>
<td>-0.1999</td>
</tr>
<tr>
<td></td>
<td>2003</td>
<td>0.1715</td>
</tr>
<tr>
<td>Blumeria graminis</td>
<td>2001</td>
<td>-0.6517***</td>
</tr>
<tr>
<td></td>
<td>2002</td>
<td>-0.1545</td>
</tr>
<tr>
<td></td>
<td>2003</td>
<td>-0.3350</td>
</tr>
<tr>
<td>Puccinia triticina</td>
<td>2001</td>
<td>-0.2423</td>
</tr>
<tr>
<td></td>
<td>2002</td>
<td>-0.3730*</td>
</tr>
<tr>
<td></td>
<td>2003</td>
<td>-0.1287</td>
</tr>
<tr>
<td>Puccinia striiformis</td>
<td>2001</td>
<td>-0.1318</td>
</tr>
</tbody>
</table>

On the base of both seedling and adult tests the most resistant cultivars were GK Héja, GK Selyemdur, GK Góbé, GK Holló, GK Margit, GK Bétadur, GK Favorit, and GK Hattyú. These possibly connected with having some resistance gene against D. tritici-repentis. Among these cultivars GK Holló and GK Margit were resistant both in seedling and adult stages. GK
Selyemdur was resistant in adult stage but susceptible in seedling stage. However GK Marcal was resistant in seedling stage and susceptible in adult one. It seems that these cultivars possess specific genes in adult and seedling stages. The clarification of the resistance background needs further investigations (Table 4).

Table 4. Resistance of winter wheat genotypes against *D. tritici-repentis* in adult and seedling stage (Aschersleben, Szeged)

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Location</th>
<th>Leaf spots (%)</th>
<th></th>
<th>Aschersleben</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>field</td>
<td>greenhouse</td>
<td>Aschersleben</td>
<td>seedling stage</td>
<td>Aschersleben</td>
<td>field</td>
<td>Kp1</td>
<td>Kp6</td>
</tr>
<tr>
<td>GK Héja</td>
<td>10.0</td>
<td>R</td>
<td>10.0</td>
<td>R</td>
<td>R</td>
<td>MR</td>
<td>R-MR</td>
<td></td>
</tr>
<tr>
<td>GK Selyemdur</td>
<td>-</td>
<td>S</td>
<td>10.3</td>
<td>S</td>
<td>MS-S</td>
<td>S</td>
<td>MS</td>
<td></td>
</tr>
<tr>
<td>GK Góbé</td>
<td>40.0</td>
<td>S</td>
<td>15.4</td>
<td>S</td>
<td>MS</td>
<td>MS</td>
<td>MS</td>
<td></td>
</tr>
<tr>
<td>GK Holló</td>
<td>3.0</td>
<td>MR</td>
<td>15.7</td>
<td>-</td>
<td>R/MS</td>
<td>R</td>
<td>R</td>
<td></td>
</tr>
<tr>
<td>GK Margit</td>
<td>5.0</td>
<td>R</td>
<td>17.7</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td></td>
</tr>
<tr>
<td>GK Bétadur</td>
<td>5.0</td>
<td>MR</td>
<td>18.3</td>
<td>MR-MS</td>
<td>MR</td>
<td>MR</td>
<td>MR</td>
<td></td>
</tr>
<tr>
<td>GK Favorit</td>
<td>10.0</td>
<td>R</td>
<td>19.6</td>
<td>-</td>
<td>R-MR</td>
<td>R</td>
<td>R</td>
<td></td>
</tr>
<tr>
<td>GK Hattyú</td>
<td>25.0</td>
<td>S</td>
<td>19.6</td>
<td>MR</td>
<td>R</td>
<td>R</td>
<td>R-MR</td>
<td></td>
</tr>
<tr>
<td>GK Marcal</td>
<td>35.0</td>
<td>S</td>
<td>37.5</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td></td>
</tr>
</tbody>
</table>

R- resistant, MR- moderate resistant, MS- moderate susceptible, S- susceptible

References


RESISTANCE OF WINTER WHEAT CULTIVARS AGAINST NECROTROPHIC LEAF PATHOGENS (2001-2003 SZEGED, HUNGARY AND 2003 ASCHERSLEBEN, GERMANY)

M. Csősz\textsuperscript{1}, D. Kopahnke\textsuperscript{2}, E. Nagyhaska\textsuperscript{1}, I. Pusztai\textsuperscript{1} and Á. Mesterházy\textsuperscript{1}
\textsuperscript{1}Cereal Research Non-profit Company, Szeged, Hungary
\textsuperscript{2}Federal Centre for Breeding Research on Cultivated Plants Institute for Epidemiology and Resistance, Aschersleben, Germany

Thirty-two winter wheat cultivars were tested in Szeged after winter wheat in protected and unprotected environment. Among the necrotrophic pathogens, the dominant pathogens were \textit{Drechslera tritici-repentis} (Died.) Shoem. (2001, 2002 and 2003) and \textit{Septoria nodorum} (2001). The resistance differences were significant. The biotrophic (leaf rust, yellow rust and powdery mildew) as well as the mentioned necrotrophic pathogens caused significant yield decrease in three years. According to values of correlation coefficients, the influence of biotrophic pathogens was greater on the yield.

Same cultivars were tested under artificial inoculated environment (the artificial inoculation was made by \textit{D. tritici-repentis}) in the field and the greenhouse (in seedling stage, three isolates) in 2003, in Aschersleben, Germany.

Among the analyzed cultivars were not completely resistant against \textit{D. tritici-repentis}. The data series often showed significant differences for the same cultivars. According to the above tests, the most resistant cultivars against leaf spots were \textit{GK Héja}, \textit{GK Holló} and \textit{GK Margit}.
STUDY ON NATURAL ALTERNATIVES FOR THE CONTROL OF SUDDEN WILT INFESTING CANTALOUPE UNDER EGYPTIAN CONDITIONS

Mohamed El-Sheshtawi

Plant Pathology Dept., Faculty of Agriculture, Mansoura Univ., Mansoura, Egypt

Pathogenic soilborne fungi i.e. *Fusarium, Rhizoctonia, Pythium, Phoma* spp., etc. cause serious problem of sudden wilt (vine decline) are considered as dangerous organisms threatening vegetable production in the nursery, covered agriculture and open fields, because of the decrease in plants number and quality (Gwynne et al., 1997).

These pathogens of sudden wilt especially in some crops such as cantaloupe and watermelon cause rotting, pre and post-emergence damping off, while the older plants are affected by wilting or bad growth during flowering or fruiting stages reflecting on plant growth and on the yield quantity and quality (Martyn and Miller, 1996). The recommended systemic or contact chemical fungicides for the control of such pathogens are extremely harmful in the short or long terms on the man health and on the environment, causing dangerous diseases i.e. cancer, kidney, liver diseases and others (Mansour, 1992). Because of the importance of this subject we tried to do this applied research program for facing the cantaloupe sudden wilt problem in Egypt through finding safe alternatives for the control of such diseases, by avoiding the use of chemical fungicides or other materials such as methyl bromide for soil treatments in the control of these economic diseases by utilizing other non-chemical and safe means of natural origins such as: antagonistic fungi i.e. *Trichoderma* and *Glicoladium* (Cooney and Lauren, 1998 and Charati et al., 1998), and antagonistic bacteria i.e. *Bacillus, Streptomyces* spp., (Bochow, 1989), plant materials i.e. Cinnamon, Garlic, Fenugreek, Rocket, onion and Camphor (Jiratko 1994 and El-sherbiny 2001), beside some new physical methods such as soil solarization in field trials against such soilborne cantaloupe pathogens (Bell et al., 1991).

Materials and Methods

**Isolation and identification of used pathogenic or antagonistic fungi**:

Two species of different fungal pathogens; *F. solani* and *F. oxysporum* f.sp. *melonis* were tested for its pathogenicity, all were isolated from root diseased seedlings of muskmelon obtained from fields at different locations at Dakahalia Governorate for laboratory tests on PDA. Fungal isolation from soil was done according to (Warcup 1950). Identification of pure...
culture of each fungal pathogen was carried out through Dept.of plant pathology, Faculty of Agriculture and Faculty of Sciences at University of Mansoura, according to Gilman (1957), Barnett and Hunter (1972) stock culture of each fungal pathogen were kept on PDA slant for further studies. Pure culture of antagonistic fungi *Trichoderma viride*, *Coniothyrium minitans* and *Glicoladium virens* were identified by Prof. Dr László Vajna Dept. Plant Pathology, Plant Protection Institute HAS, Budapest, Hungary, and Prof Dr. M. El-Sheshtawi, Dept. of Pant Pathology Faculty of Agriculture, Mansoura University, Egypt.

**Laboratory Experiments**

1 *Inhibitory effect of certain fungal antagonists on radial growth of some soilborne fungal pathogens infesting cantaloupe*

The inhibitory effects of *T. viride, G. virrens* and *C. minitans* on radial growth of *F. solani* and *F. oxysporum f.sp. melonis* were studied. All pure cultures of the above mentioned 3 fungal antagonistic fungi, and the two fungal pathogens were grown on PDA for 5-7 days (25±2°C). The antagonistic effect of the used antagonists on the fungal pathogens was done through using on disc (5 mm in diameter) of the antagonist facing one disc of the pathogen on the PDA surface and relatively closed to the periphery of the plates. The untreated control treatment was done on the same medium in Petri dishes by growing one disc of the pathogenic fungus in the center of medium surface according to (Johanson et al., 1959). The *C. minitans* was grown on PDA for 7 days and was placed in a side of the Petri dish and incubated at (25±2°C) for 3 days then pathogenic fungal discs (5mm in diam.) were put in the other side of the dish in 5 replicates. All plates were incubated at (25±2°C) for 7 days, then incubated for 4 days after inoculation, the diameter average of zones of the pathogenic fungus was recorded.

2 *Effects of some crushed plant materials on radial growth of some soilborne fungal pathogens infesting cantaloupe*

The inhibitory effects of some plant materials; Cinnamon, Garlic, Fenugreek, Rocket and Camphor on *F. solani*, and *F. oxysporum f.sp. melonis* were studied. Plant specimens were washed, dried and crushed by electric miller, treatments were of the doses zero, 2, 3 and 4 g/L of PDA, then autoclaved, 5 replicates were conducted, each replicate consisted of 5 Petri dishes of 9 cm diam., which were inoculated with 5mm diam. 6 days old fungal discs, the concentration zero was free of any crushed plant material but inoculated with the tested fungal pathogens discs. All plates were incubated at (25±2°C) for 7 days and the average radial growth was recorded and compared with control %.
3 Effect of some essential oils on radial growth of some soilborne fungal pathogens infesting cantaloupe

The three essential oils of Nigella, Onion and Camphor of 0.5, 1.0 and 1.5% concentrates were used with the two used fungal pathogens. The used PDA was supplied with 0.5% of tween 80 and with the essential oil concentrates before being solid (Katherine et al., 1998). Control treatment was done by mixing PDA with tween 80 only, and no essential oils were added, while treatments of various concentrates in Petri dishes were inoculated with the tested pathogens by giving on (5 mm diam.) fungal discs per each. Incubation was done for 7 days for *F. solani*, and *F. oxysporum f.sp. melonis* and average radial growth was recorded and compared with the untreated control %.

Greenhouse experiments

1 Phytopathogenicity tests

The test was carried out for studying the pathogenicity of the isolated soilborne fungal pathogens (*F. solani* and *F. oxysporum f.sp. melonis*) on 10 hybrids of Cantaloupe; Regal, Galia, C.8, Vicar, 1022, Caruso, Ideal, Mirella, Primal and Super VIP. Plastic pots of 25 cm diam. were filled with autoclaved sandy loam (50% sand+ 50% clay soil about 2 kg/ pot) then artificially infested with spore suspension of the pathogenic fungus (25 ml / pot) pathogenic fungi were cultured in 250 ml flasks containing 100 ml of potato dextrose broth for 7 days at (25±2°C). The mycelia in each flask were added to 200 ml of sterilized water in a satirized blender for 20 seconds at the low speed. The resulting suspension was used for soil artificial inoculation by 8 days. Irrigation took place immediately after planting, and repeated every 3 days during the duration of experiment. The planted pots were kept under the plastic house conditions during November and December where daily temperature average was (20±2°C), the experiments contained 3 replicates.

Data of disease incidence were recorded after 20 days of sowing for the pre-emergence damping-off and after 40 days for wilting and compared with untreated and chemical controls.

2 Effect of Cantaloupe seed dressing with antagonistic fungi on the development of damping-off disease

Biological control trial in pots against damping-off disease caused by some soilborne fungal pathogens was conducted using fungal antagonists to study the effect of *T. viride, G. virens, C. minitans* in controlling damping-off disease of cantaloupe seedling caused by *Fusarium oxysporum f. sp.*
melonis using seed coating with conidial spores of used antagonists (T. viride, G. virens and C. mimitans).

Plastic pots were filled with autoclaved sandy loam soil (about 2 kg/pot) and artificially inoculated cantaloupe seeds were planted in the artificially infested pots. Planting was carried out 8 days after inoculation, 3 seeds of the hybrids (Vicar, Primal, Ideal) were planted (3 replicates) at 1 cm depth under soil surface of each pot. Prior to planting, seeds were surface sterilized and coated with conidial spores of T. viride, G. virens and C. mimitans (10 days old). Surface sterilization of seeds was carried out by dipping in 10% commercial hypochlorite sodium (Clorox) for 10 min.; washed through distilled water; then dried between sterile filter paper sheets. Seeds coating with fungal spores was performed by wetting them with sterile water containing molasses (as sticker), air dried and then placed on the surface of 6 days-old culture of T. viride, G. virens and C. mimitans in Petri dishes in which conidia were abundant. Control treatment was done by soaking seeds in distilled water, while standard (control) chemical seed treatments were done by Topsin-M 70 1 g/kg and Thiram 2g/kg. Planting was done in all cases in artificially infested and non-infested soils. Data of damping-off and wilting was recorded after 21 and 40 days.

Irrigation took place immediately after planting and repeated after 3 days during the duration of experiment. The planted pots were kept under the plastic house conditions during November and December where daily temperature average range (20±2°C). The experiment contained 3 replicates for each treatment. Data of disease incidence were recorded after 20 days of sowing and after 40 days for and compared with the four controls (mentioned above).

3 Effect of cantaloupe seed soaking in plant materials on the development of damping-off disease

Discs of (5mm diam.) were taken from 7 days old soilborne fungal pathogen cultures (mentioned in abstract) were transferred to PD broth (as mentioned before). Healthy seeds of the cantaloupe hybrids (primal, Ideal, vicar) were soaked for 4 hours in cinnamon and Eucalyptus material at concentration of 75%. Treatments were as follows:

Soaking in Cinnamon and Eucalyptus materials 4 hours, control treatment was done by soaking in distilled water for 4 hour, while chemical seed treatments were done by Topsin 1 g/kg and Thiram 2g/kg. Planting was done in all cases in artificially infested and non-infested soils. Data of damping-off and wilting were recorded after 20 and 40 days.
4 Effect of Cantaloupe seed soaking in essential oils on the development of damping-off disease

After the artificial inoculation, of soil in pots, healthy seeds of Cantaloupe hybrids (Vicar, Primal, Ideal) were soaked separately for 30 min. in each oil of Nigella, Onion and Eucalyptus at concentrate of 0.5%. Control treatments were done.

5 Effect of biofertilizers on the development of damping-off disease:

Trials were carried out to study the effectiveness of biofertilizers (Microbin, phosphorin and Rizobacterin) on the examined two soilborne pathogens (mentioned in the abstract) Biofertilizers were mixed with artificially infested soil in pots in the upper 10 cm, then seeds were planted in infested pots as previously mentioned, taking in consideration that the standard chemical fungicide Topsin-M70 was used as soil drenching with concentration of 1.0 %, while the Thiram concentration was 0.2 %, each 25 cm diameter pot received 25 cm³.

6 Soil solarization and methyl bromide under field condition

Two trails are designed to be done through cooperation with the Agriculture Research center (A.R.C.), Dept. of Covered Agriculture, Vegetable Section of the Institute of Horticulture.

The first trial was done already at Ismailia, (East bank of Suez canal season of 2000/2001) Data is over, while the other trail is done at Aswan (season 2001/2002 ), Data in print.

The trial of 2000-2001 at Ismailia included the following treatments:
1 - Soil Fumigation with methyl bromide at the rate of 35 g/m²
1a - Soil Fumigation with methyl bromide at the rate of 35 g/m² + soil solarization
2 - Soil Fumigation with methyl bromide at the rate of 70 g/m²
3 - Soil solarization alone
4 - Untreated soil (control)

Methyl bromide applications are done before seed sowing with one week, soil solarization was done for nine weeks during June, July, and August 2000. All treatments of this trail were arranged in complete randomized block design with three replicates, each replicate contained 60 plants. Other Agriculture treatments were applied as recommended by A.R.C.- H.R.I Protected Cultivation Department. Mineral fertilizers were applied through drip irrigation system the hybrid primal from Holland was used in this experiment.

The second trial of 2001/2002 conducted at Aswan (1000 km far from Cairo) was done by soil solarization without any chemicals, trail is still repeated till the end of 2003.
Statistical analysis
Statistical analyses of all experimental data of this field trial were done using the statistical software package Costat (1990). All comparisons were first subjected to one way ANOVA and significant differences between treatment means were determinate.

Results and Discussion

Laboratory experiments

Effect of certain antagonistic fungi on radial growth of some soilborne fungal pathogen infesting cantaloupe
Among all tested antagonistic fungi, *T. viride* gave the best inhibitory effect between all tested soilborne pathogenic fungi; this antagonist reduced the radial growth of *F. oxysporum* f.sp. *melonis* by 70.4 % when compared with controls (Table 1). These results agree with some authors who reported that *T. viride* was able to suppress the growth of one or more of these fungi (Zhao- Gouai, et al; 1998; Thiribhuvanamala, et al; 1999; prodeep, et al; 2000 and Mathivaran et al; 2000). They found that *T. viride* eliminated *R. solani*, *F. oxysporum* f.sp. *niveum*, *F. solani* and *A. alternata*. This high antifungal activity of *T. viride* is possibly due to some enzymes and secondary metabolites (Antal, et al; 2000) who reported that the activities of extra cellular chitinase (EC 3.2.-1-30), Beta-glycosidase (EC3-4-21; EC3-4-21-4), which are thought to be involved in the mycoparasitic process. In addition, (Cooney and Lauren, 1998), found that the antifungal *Trichoderma* secondary metabolite 6-n-pentyl-2-H-pyran-2-one level significantly increased in the presence of the pathogen.

In our study, we noticed that *G. virens* gave moderate inhibition to mycelial growth of *F. solani*, and *F. oxysporum* f.sp. *melonis* with radial growth reduction rates of 33.5, and 60% respectively. These results agree with (Aghnoom, et al 1999; Rispoli and Nicoletti1999; Prakash et al 1999; Khan and Akram2000; Singh and Mukhopodhyay2000), they reported that *G. virens* inhibited the mycelial growth of *F. oxysporum*, *S. rolfsii* and *R. solani*, *C. minitans* slightly reduced the mycelial growth of *F. oxysporum* f.sp. *melonis* and *F. solani* with degrees of 47.3 and 26.4 % respectively when compared with control.
Table 1. Effect of some antagonistic fungi on radial growth of some soilborne-fungal pathogens

<table>
<thead>
<tr>
<th>Fungi</th>
<th>Inh%</th>
<th>R.G</th>
<th>Fungi</th>
<th>Inh%</th>
<th>R.G</th>
</tr>
</thead>
<tbody>
<tr>
<td>K. solani</td>
<td>62.4</td>
<td>24.4</td>
<td>K. oxysporum</td>
<td>70.4</td>
<td>26.6</td>
</tr>
<tr>
<td>T. viride</td>
<td>33.5</td>
<td>43.2</td>
<td>G. virens</td>
<td>60.0</td>
<td>36.0</td>
</tr>
<tr>
<td>G. minitans</td>
<td>26.4</td>
<td>47.8</td>
<td>Control</td>
<td>0.0</td>
<td>65.0</td>
</tr>
<tr>
<td>L.S.D 0.05 = 1.00</td>
<td></td>
<td></td>
<td>R.G = Radial Growth</td>
<td>Inh% = inhibition percentage</td>
<td></td>
</tr>
</tbody>
</table>

Effects of some plant materials on radial growth of some soilborne fungal pathogens

Data in Table 2 revealed that, the crushed of Cinnamon material proved to be the most effective on radial growth for the tested fungi, suppressing radial growth of *F. solani* and *F. oxysporum* f.sp. *melonis* by 42.1 and 50% at the concentration of 4 g/l respectively. These results agree with some authors who reported the antifungal activity of cinnamon material against one or more of these fungi (Sinha, et al., 1993; Jiartko, 1994; Michail, et al., 1994 and Scholz 1999). They reported that cinnamon material and its oil inhibited the mycelial growth and spore germination of *Fusarium* spp., *Alternaria* spp., *Cladosporium* sp., *P. italicum*, *A. niger* and *B. cinerea*.

This high antifungal activity of cinnamon is possibly belonging to some aldehydes and acid compounds as many authors reported (El- Maraghy 1995 and Wilson et al. 1997). They reported that cinnamon material contains cinnamaldehyde, cinnamic acid, Beta-myrcene and Alpha-pinene compounds.

The present study revealed that the Garlic material effect came on the second class against the mycelial growth of the tested fungal soilborne pathogens, these results are in agreement with (Gupta and Sharma, 1993; Karade and Sawant, 1999; Sharma and Kapoor, 1999 and Brown, et al., 2000), who reported that garlic material inhibited the mycelial growth of *A. alternata*, *S. sclerotiorum*, *M. phaseolina*, *F. solani*, *R. solani* and *P. italicum*, also inhibited spore germination of *F. solani* and *A. alternata*, they also mention that this material contains ((E,2)-4,4,9-trithiadodeca 1,6 11-triene-9-oxide), a derivative of allicin.
Table 2. Effect of some plant materials and some essential oils on radial growth of *F. oxysporum* f.sp. *melonis* and *F. solani* infesting cantaloupe

<table>
<thead>
<tr>
<th>Conc.</th>
<th>Plant sources</th>
<th>Conc.</th>
<th>Essential oils</th>
</tr>
</thead>
<tbody>
<tr>
<td>2g/L</td>
<td><em>C. zeylanicum</em></td>
<td>0.5%</td>
<td><em>A. cepa</em></td>
</tr>
<tr>
<td>3g/L</td>
<td><em>T. foenum</em></td>
<td>1.0%</td>
<td><em>N. sativa</em></td>
</tr>
<tr>
<td>4g/L</td>
<td><em>E. globulus</em></td>
<td>1.5%</td>
<td><em>E. globulus</em></td>
</tr>
<tr>
<td>2g/L</td>
<td><em>E. sativa</em></td>
<td></td>
<td>Control</td>
</tr>
<tr>
<td>3g/L</td>
<td><em>A. sativum</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4g/L</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F. solani</th>
<th>F. oxysporum f.sp. melonis</th>
<th>Conc.</th>
<th>Plant sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inh%</td>
<td>R.G</td>
<td>Inh%</td>
<td>R.G</td>
</tr>
<tr>
<td>-----------</td>
<td>----------------------------</td>
<td>------</td>
<td>---------------</td>
</tr>
<tr>
<td>18.6</td>
<td>37.2</td>
<td>38.8</td>
<td>55.0</td>
</tr>
<tr>
<td>28.3</td>
<td>64.5</td>
<td>44.1</td>
<td>50.2</td>
</tr>
<tr>
<td>42.1</td>
<td>52.0</td>
<td>50.0</td>
<td>45.0</td>
</tr>
<tr>
<td>9.4</td>
<td>81.4</td>
<td>14.7</td>
<td>76.8</td>
</tr>
<tr>
<td>16.5</td>
<td>75.2</td>
<td>32.1</td>
<td>60.9</td>
</tr>
<tr>
<td>25.2</td>
<td>67.3</td>
<td>33.2</td>
<td>60.1</td>
</tr>
<tr>
<td>12.8</td>
<td>78.4</td>
<td>30.1</td>
<td>62.9</td>
</tr>
<tr>
<td>21.7</td>
<td>70.4</td>
<td>34.1</td>
<td>59.2</td>
</tr>
<tr>
<td>29.2</td>
<td>63.7</td>
<td>41.5</td>
<td>52.6</td>
</tr>
<tr>
<td>5.8</td>
<td>84.7</td>
<td>20.4</td>
<td>71.6</td>
</tr>
<tr>
<td>11.7</td>
<td>81.4</td>
<td>33.2</td>
<td>60.1</td>
</tr>
<tr>
<td>19.3</td>
<td>72.6</td>
<td>38.8</td>
<td>55.0</td>
</tr>
<tr>
<td>13.5</td>
<td>77.8</td>
<td>30.5</td>
<td>62.2</td>
</tr>
<tr>
<td>21.0</td>
<td>71.1</td>
<td>33.8</td>
<td>59.5</td>
</tr>
<tr>
<td>32.8</td>
<td>60.4</td>
<td>43.0</td>
<td>51.3</td>
</tr>
<tr>
<td>2.00</td>
<td>N.S</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.66</td>
<td>N.S</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Conc.** = Concentration, **R.G.** = Radial Growth, **Inh.%** = inhibition percentage

It is noticed also that some plant materials slightly suppressed the fungal growth of the tested pathogens. For example, Eucalyptus on *F. solani* gave (29.2%) mycelial growth reduction.
Inhibitory effect of some essential oils on radial growth of some soilborne fungal pathogens

Among all tested essential oils, onion oil mixed with PDA at concentrate of 1.5% proved to be the most effective growth inhibitor for *F. solani*, *F. oxysporum* f.sp. *melonis*, giving 100% reduction in both cases (Table 2). These results agree with (Favaron, et al., 1993; Zohir, et al., 1995; Wilson, et al., 1997; Fan and Chen, 1998, 1999), who observed antifungal activity of onion oil against the mycelial growth and spore germination of *F. moniliforme*, *B. cinerea*, *S. cepivorum* and *S. sclerotiorum*. Results obtained by (O’Gara et al., 2000) show that onion oil contains some sulfur compounds and he mentioned that oil had antifungal and antibacterial activities.

The present study revealed that oil of *Eucalyptus* gave similar results to Onion against *F. solani*, when it reduced the fungal growth of these fungi by 100%, this oil gave also 78.3% inhibition of the mycelial growth of *F. oxysporum* f.sp. *melonis*, such results agree with (Raghavaiah and Jayaramaiah, 1987; Singh and Dwivedi, 1990; Ansariand Shrivastava, 1991, Singh and Gupta, 1992), who found that *Eucalyptus* oil inhibited the linear growth of *Cercospora* sp., *F. solani*, *F. moniliforme*, *R. solani* and *S. sclerotiorum*.

In our study, *Nigella* oil had moderate inhibitory effect on the radial growth of *F. solani*, *F. oxysporum* f.sp. *melonis* by 37.1 and 34.7% at 1.5%, respectively. These results agree with (Rathee et al., 1983; El-Kayati et al., 1995 and Rahhal 1997), who found that the essential oil of *Nigella* (*N. sativa*) was effective against *R. solani*, *F. solani*, *F. oxysporum*, *S. sclerotiorum*, *Pythium vexans* and *F. moniliforme*.

In general we observed from our tests on the inhibitory effect of various tested plant oils on the 5 tested soilborne fungal pathogens that the best effect came from Onion oil followed by *Eucalyptus* oil and then the *Nigella* oil. About *Eucalyptus* (*E. globulus*) we noticed that when comparing the inhibitory effect of its material and its oil on all tested pathogens that both gave various inhibitory values.

Greenhouse experiments

Effect of antagonistic fungi on the development of the damping-off disease infesting 3 cantaloupe hybrids

Results in (Table 3 and 4) showed that, seed treatment with *T. viride* and *G. virens* gave good inhibitory effects of 88.89% protection against the damping-off caused by *F. oxysporum* f.sp. *melonis* and *F. solani* when living control plants percentage was 44.4%, while seed treatment with fungicides (Thiram and Topsin), gave 88.89% and 100% disease control respectively obtained by (Goundar and Srikant, 1999, Hoda-Ahamed et al.,
2000; Rajapan and Yesuraja, 2000, Dubey, 2000), who reported that *T. viride* gave good result when compared with Captan, Vitavax and Carboxin.

Table 3. Effect of seed dressing with some bioagents on the disease incidence on cantaloupe hybrids caused by *F. oxysporum* f.sp. *melonis*.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Ideal</th>
<th>Primal</th>
<th>Vicar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Survival %</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M%</td>
<td>N0</td>
<td>M%</td>
<td>N0</td>
</tr>
<tr>
<td>100</td>
<td>0.00</td>
<td>3.00</td>
<td>0.00</td>
</tr>
<tr>
<td>44.4</td>
<td>22.22</td>
<td>1.33</td>
<td>33.33</td>
</tr>
<tr>
<td>88.89</td>
<td>11.11</td>
<td>2.66</td>
<td>0.00</td>
</tr>
<tr>
<td>100</td>
<td>0.00</td>
<td>3.00</td>
<td>0.00</td>
</tr>
<tr>
<td>88.89</td>
<td>11.11</td>
<td>2.66</td>
<td>0.00</td>
</tr>
<tr>
<td>88.89</td>
<td>0.00</td>
<td>2.66</td>
<td>11.11</td>
</tr>
<tr>
<td>88.89</td>
<td>0.00</td>
<td>2.66</td>
<td>11.11</td>
</tr>
<tr>
<td>88.89</td>
<td>22.22</td>
<td>1.33</td>
<td>33.33</td>
</tr>
<tr>
<td>88.89</td>
<td>11.11</td>
<td>2.66</td>
<td>0.00</td>
</tr>
<tr>
<td>77.78</td>
<td>11.11</td>
<td>2.66</td>
<td>0.00</td>
</tr>
</tbody>
</table>

L.S.D 0.05 = 0.22 0.66 0.44 0.25 0.36
L.S.D 0.01 = 0.71 0.24 0.43 0.23
L.S.D 0.01 = 0.22 0.42 0.75 0.35

NO= Number of plants  M % = Mortality percentage
A= After 20 days from planting  B = After 40 days from planting

**Effect of some plant materials on the development of the damping-off disease infesting 3 cantaloupe hybrids**

Data in (Tables 3 and 4) show that the effect of plant materials in controlling Cantaloupe damping-off under greenhouse was relatively high giving 88.9 -100 protection in case of Cinnamon (*C. zeylanicum*). *Eucalyptus* (*E. globulus*) material gave 77.8% protection, while chemical treatment with both Topsin-M and Thiram gave 100% and 88.89 % protection respectively when compared with untreated controls gave living plants percentages ranged between 44.4% and 55.5%.

180
Table 4. Effect of seed dressing with some bioagents on the disease incidence on Cantaloupe hybrids caused by *F. solani*

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Ideal</th>
<th></th>
<th></th>
<th>Primal</th>
<th></th>
<th></th>
<th>Vicar</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>A</td>
<td>B</td>
<td>A</td>
<td>B</td>
<td>A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Survival %</td>
<td>M%</td>
<td>NO</td>
<td>M%</td>
<td>NO</td>
<td>M%</td>
<td>NO</td>
<td>M%</td>
<td>NO</td>
<td></td>
</tr>
<tr>
<td>100</td>
<td>0.00</td>
<td>3.00</td>
<td>0.00</td>
<td>3.00</td>
<td>100</td>
<td>0.00</td>
<td>3.00</td>
<td>0.00</td>
<td>3.00</td>
</tr>
<tr>
<td>44.45</td>
<td>22.22</td>
<td>1.33</td>
<td>33.33</td>
<td>2.00</td>
<td>55.56</td>
<td>11.11</td>
<td>1.66</td>
<td>33.33</td>
<td>2.00</td>
</tr>
<tr>
<td>100</td>
<td>0.00</td>
<td>3.00</td>
<td>0.00</td>
<td>3.00</td>
<td>100</td>
<td>0.00</td>
<td>3.00</td>
<td>0.00</td>
<td>3.00</td>
</tr>
<tr>
<td>100</td>
<td>0.00</td>
<td>3.00</td>
<td>0.00</td>
<td>3.00</td>
<td>100</td>
<td>0.00</td>
<td>3.00</td>
<td>0.00</td>
<td>3.00</td>
</tr>
<tr>
<td>100</td>
<td>0.00</td>
<td>3.00</td>
<td>0.00</td>
<td>3.00</td>
<td>100</td>
<td>0.00</td>
<td>3.00</td>
<td>0.00</td>
<td>3.00</td>
</tr>
<tr>
<td>100</td>
<td>0.00</td>
<td>3.00</td>
<td>0.00</td>
<td>3.00</td>
<td>100</td>
<td>0.00</td>
<td>3.00</td>
<td>0.00</td>
<td>3.00</td>
</tr>
<tr>
<td>100</td>
<td>0.00</td>
<td>3.00</td>
<td>0.00</td>
<td>3.00</td>
<td>100</td>
<td>0.00</td>
<td>3.00</td>
<td>0.00</td>
<td>3.00</td>
</tr>
<tr>
<td>100</td>
<td>0.00</td>
<td>3.00</td>
<td>0.00</td>
<td>3.00</td>
<td>100</td>
<td>0.00</td>
<td>3.00</td>
<td>0.00</td>
<td>3.00</td>
</tr>
<tr>
<td>100</td>
<td>0.00</td>
<td>3.00</td>
<td>0.00</td>
<td>3.00</td>
<td>100</td>
<td>0.00</td>
<td>3.00</td>
<td>0.00</td>
<td>3.00</td>
</tr>
<tr>
<td>100</td>
<td>0.00</td>
<td>3.00</td>
<td>0.00</td>
<td>3.00</td>
<td>100</td>
<td>0.00</td>
<td>3.00</td>
<td>0.00</td>
<td>3.00</td>
</tr>
<tr>
<td>100</td>
<td>0.00</td>
<td>3.00</td>
<td>0.00</td>
<td>3.00</td>
<td>100</td>
<td>0.00</td>
<td>3.00</td>
<td>0.00</td>
<td>3.00</td>
</tr>
</tbody>
</table>

L.S.D 0.05 = 0.24  0.43  0.23

NO= Number of plants  M % = Mortality percentage  A= After 20 days from planting  B = After 40 days from planting

(Infested)
Effect of some essential oils as seed disinfectant materials on the development of the damping-off disease infesting 3 Cantaloupe hybrids

Effect of both Eucalyptus (E. globulus) and Onion (A. cepa) essential oils gave the highest level of control to damping-off disease giving of cantaloupe plants (100%) followed by Nigella (N. sativa) which gave 88.89% protection, while control was (44.4%) (Tables 3 and 4). They gave the good results when compared with the chemical fungicides as obtained by (Ansari and Shrivastava, 1991; Purmima, et al., 1999 and Farid, et al., 2000), who reported that utilization of some plant originated essential oils gave better antifungal effect on soilborne pathogens than captan and benomyl.

Effect of biofertilizers on the development of damping-off disease infesting 3 cantaloupe hybrids:

Biofertilizers induced effectiveness on damping-off disease-infesting Cantaloupe (ranged from 66.6 in case of Rhizobacter in to 88.9% in case of phosphorin protection, while untreated control gave 44.4%) (Tables 5 and 6). When they compared with chemical fungicides, they gave lower effects than fungicides which gave100% protection. This result agree with (O’Gara et al., 1996, El Ghany 1996, Koreish et al., 1998, Mahmoud and Mahmoud, 1999) who found that some biofertilizers inhibited some soilborne fungal pathogens; R. solani, A. alternata and F. solani.

Effect of soil solarization in combination with methyl bromide on cantaloupe wilting disease caused by soilborne fungal pathogens under field conditions at Ismailia.

The results obtained reveal that the combination of soil solarization treatment for 10 weeks with the low dose 35 g methyl bromide / m² gave the same effect of methyl bromide at high dose of 70 g/m², it is a good step forward to reduce the chemical fumigation dose with methyl bromide in combination with soil solarization in controlling the causal organisms of cantaloupe wilt disease with 50% (Table 7), such results agree with (Bell et al., 1991), who found that soil solarization in combination with methyl bromide reduced seriously infection with weed seeds and soilborne pathogens including sudden wilt of melon caused by complex of fungi and also reduced tomato decline, they found promising results.
Table 5. Effect of mixing biofertilizers with soil on the disease incidence on cantaloupe hybrids caused by *F. oxysporum* f. sp. *melonis*

<table>
<thead>
<tr>
<th></th>
<th>Ideal</th>
<th>Primal</th>
<th>Vicar</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B A</td>
<td>B A</td>
<td>B A</td>
</tr>
<tr>
<td>Survival %</td>
<td>M% N0</td>
<td>M% N0</td>
<td>M% N0</td>
</tr>
<tr>
<td>100</td>
<td>0.00</td>
<td>3.00</td>
<td>0.00</td>
</tr>
<tr>
<td>44.45</td>
<td>22.22</td>
<td>1.33</td>
<td>33.33</td>
</tr>
<tr>
<td>88.89</td>
<td>11.11</td>
<td>2.66</td>
<td>0.00</td>
</tr>
<tr>
<td>100</td>
<td>0.00</td>
<td>3.00</td>
<td>0.00</td>
</tr>
<tr>
<td>55.56</td>
<td>22.22</td>
<td>1.66</td>
<td>22.22</td>
</tr>
<tr>
<td>66.67</td>
<td>22.22</td>
<td>2.00</td>
<td>11.11</td>
</tr>
<tr>
<td>77.78</td>
<td>11.11</td>
<td>2.33</td>
<td>11.11</td>
</tr>
</tbody>
</table>

LSD 0.05 = 0.33  0.56  0.71

Table 6. Effect of mixing biofertilizers with soil on the disease incidence on cantaloupe hybrids caused by *F. solani*

<table>
<thead>
<tr>
<th></th>
<th>Ideal</th>
<th>Primal</th>
<th>Vicar</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B A</td>
<td>B A</td>
<td>B A</td>
</tr>
<tr>
<td>Survival %</td>
<td>M% N0</td>
<td>M% N0</td>
<td>M% N0</td>
</tr>
<tr>
<td>100</td>
<td>0.00</td>
<td>3.00</td>
<td>0.00</td>
</tr>
<tr>
<td>44.45</td>
<td>22.22</td>
<td>1.33</td>
<td>33.33</td>
</tr>
<tr>
<td>88.89</td>
<td>11.11</td>
<td>2.66</td>
<td>0.00</td>
</tr>
<tr>
<td>100</td>
<td>0.00</td>
<td>3.00</td>
<td>0.00</td>
</tr>
<tr>
<td>55.56</td>
<td>11.11</td>
<td>2.66</td>
<td>0.00</td>
</tr>
<tr>
<td>66.67</td>
<td>11.11</td>
<td>2.00</td>
<td>22.22</td>
</tr>
<tr>
<td>77.78</td>
<td>0.00</td>
<td>2.33</td>
<td>22.22</td>
</tr>
</tbody>
</table>

LSD 0.05 = NS

NO= Number of plants  M % = Mortality percentage  A= After 20 days from planting  B = After 40 days from planting
Table 7. Effect of soil solarization compared with methyl bromide in different doses on cantaloupe sudden wilt

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Germination %</th>
<th>Wilted plant %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methyl bromide 35 gm/m²</td>
<td>91.3</td>
<td>4.86</td>
</tr>
<tr>
<td>Methyl bromide 35 gm/m² + soil solarization</td>
<td>92.7</td>
<td>3.79</td>
</tr>
<tr>
<td>Methyl bromide 70 gm/m²</td>
<td>90.1</td>
<td>4.52</td>
</tr>
<tr>
<td>Soil solarization alone</td>
<td>91.1</td>
<td>17.70</td>
</tr>
<tr>
<td>Control</td>
<td>90</td>
<td>22.63</td>
</tr>
<tr>
<td>L.S.D 0.05 %</td>
<td>N.S</td>
<td>6.50</td>
</tr>
</tbody>
</table>

We hope that the obtained results will provide a starting point for discovering some non-chemical new alternatives of natural origins to avoid or reduce the consumption and harmfulness of chemical fungicides against soilborne fungal pathogens infesting Cantaloupe and other cucurbits.

Acknowledgement
Thanks to prof. Dr. Salah Mohammadin, chairman of Vegetable Production team of the Developing Program of upper and North Egypt and his team specially Dr. G. Gadelrab, Dr. Adel Eltony and Dr Said Kabil. Special thanks to prof. A. Basiony, chairman of the Region Council for Agriculture Research and Extension. Finally, special thanks and respect to the young scientist, Abdallah Mohamed and Maged El-Kahky, Dept. of Plant Pathology, Mansoura University.

References


186


This study is a part of a research project started on 2000/2001 and is still running on under the title of "Utilization of natural (non chemical) sources in controlling soilborne fungi infesting some vegetable crops" which is supported Region council for agricultural Research and Extension. Ministry of Agric., Egypt and managed by M. El-Sheshtawi (as mentioned above)
STRUCTURAL ANALYSES OF DISEASE PROGRESSION OF APPLE SCAB (VENTURIA INAEQUALIS)

Imre Holb

Department of Plant Protection, Centre for Agricultural Sciences, University of Debrecen, Debrecen, Hungary

Apple scab, caused by Venturia inaequalis (Cooke) G. Wint., is the most prevalent disease in apple orchards in most apple growing areas. It causes damage to the leaf and fruit, which negatively affects yield and fruit quality. As environmental considerations have become increasingly significant, most European countries have changed their strategy in the selection of plant protection chemicals. In environmental-friendly horticulture, guidelines have been established, and control methods are applied in integrated and organic production systems (Anonymous, 1989; Dickler, 1992; Bloomers, 1994 and Miklay, 1995).

Many new methods, including microbial preparations, have been evaluated for efficacy against apple scab in vitro and in vivo (Burchill and Cook, 1970; Heye and Andrews 1984; Miedke and Kennel, 1990 and Benyagoub et al., 1998). Despite of these, little practical experience is available about the dynamics of disease progression in environmental-friendly production systems. Moreover, information is needed about cultivars under different ecological conditions and control methods, in order to evaluate the stability of host resistance.

The aim of our study was to analyse disease progression of apple scab on three apple cultivars in organic and integrated production systems.

Materials and Methods

Orchard site and disease assessment

The study was carried out in an experimental apple orchard at Debrecen-Pallag, Hungary, which was divided into two experimental blocks. One of the experimental blocks was treated according to the Hungarian IFP guidelines (Anonymous, 1995); and the other according to Hungarian organic production guidelines (Anonymous, 1997). These guidelines have been applied since 1997, when the orchard was planted. The experimental field consists of 40 apple cultivars. The cultivars were planted in randomised blocks with five replicates in the experimental field. Each block consisted of seven trees, but observations were only made on the middle five trees of each plot. Single trees were used as observation units.
The dwarf trees grafted on M26 rootstock were planted at a distance of 4 x 1.5 m and pruned to a spindle shape. Observations were made on cvs. ‘Egri Piros’, ‘Royal Gala’, and ‘Elstar’. Disease assessments were made on leaves and fruits in 2001 and 2002. For leaves, five sampling units were chosen at random, and for each unit, one-year-old lateral twigs were selected with 50 leaves. Each unit was tagged at the beginning of May, and the total number of healthy and diseased leaves was counted on each observation date. Twenty fruits were chosen at random for each observed tree at each observation date. Incidence of leaf and fruit were calculated. Assessments were made on a weekly basis from the beginning of May until mid-October.

Data analysis
Combined data of both years were used for the data analysis. Disease incidence data (dependent variable, corresponding to ‘y’ axis) was linearised based on transformation functions of Hau and Kranz (1977). The transformation functions were: logarithmic (10 based): \( z = \log(x) \), exponential: \( z = \ln(x) \), Gompertz: \( z = -\ln(-\ln(x)) \), logistic: \( z = \ln \left( \frac{x}{1-x} \right) \), monomolecular \( z = \ln \left( \frac{1}{1/(1-x)} \right) \). Time (independent variable, corresponding to ‘x’ axis) was used without transformation. Linear regression analyses were performed for all linearised dependent variables against non-transformed independent variables. The best regression equations were selected by the following criteria:

- constants and coefficients with reasonably small standard error;
- P-value < 0.1;
- as high \( R^2 \) (coefficient of determination) as possible.

For explaining structure of disease progression, only one transformation function was selected, which generally gave the best result for above selection criteria. Obtained linear regression equations were used to quantify the disease growth rate \( k \). Growth rates were obtained from slopes of linear regressions over time (Berger, 1981).

“Area under the disease progress curve” (AUDPC) was also calculated from the data points based on Naragajan and Muralidharan (1995).
Results

Regression analysis

Generally, the best function was the logistic transformation. Values of intercept, slope, standard errors (SE), coefficient of determination ($R^2$) and mean standard errors (MSE) of obtained linear regression equations can be seen in Table 1. The $R^2$ showed generally high values (0.8), standard errors were reasonably small in the case of leaf incidence. Disease growth rate ($k$), obtained from the slope of linear regression equations, showed the highest values on leaf incidence of cvs. ‘Gala Must’ and ‘Elstar’ in the organic production system. Adequate disease growth rate of leaf incidence was higher in the organic production system than in the integrated one. Disease growth rates of fruit incidences were low and with negative signs on cvs. ‘Elstar’ and ‘Egri Piros’.

Area under the disease progress curve

In all cases, AUDPC were higher in the organic than in the integrated fruit production system. AUDPC showed great differences in leaf incidences among cultivars (Table 2). Differences in leaf incidences were the largest in the organic production system. AUDPC values of leaf incidence for susceptible cultivars were twice to ten times higher compared to old or resistant cultivars. Great difference was found in the AUDPC values of fruit incidence in the organic production system. Cultivar differences in AUDPC values were smaller in the integrated production system.

Discussion

The present study analysed epidemic disease procession of apple scab on three apple cultivars in two environmental-friendly production systems.

Disease growth rate ($k$), obtained from slope values of linear regression equations, was variable depending on production system, cultivars and plant organs (Table 1). Analytis (1973) demonstrated that the rate of disease increase varied from 0.1 to 0.34 in the number and diameter of scab lesion on an individual leaf. Disease growth rate of leaf incidence ranged from 0.018 to 0.044 in this study. There is no scientific information about disease growth rate of apple scab under different fungicide treatments, but results of Plaut and Berger (1981), Gregory et al. (1981) and Rouse et al. (1981) supported our findings on other diseases. They found that if epidemics begun from lower levels of initial disease, then early disease progression was increasingly faster or the disease growth rate was increasingly higher. In this study, disease growth rate for leaf incidence provided permanent disease progression with a high correlation. In contrast,
Table 1. Linear regression analyses of disease progression of apple scab on three apple cultivars in integrated and organic apple production systems, Debrecen - Pallag, 2001-2002

<table>
<thead>
<tr>
<th>Systema</th>
<th>MSEb</th>
<th>R2c</th>
<th>Interceptd</th>
<th>SEi</th>
<th>Slopef</th>
<th>SEsg</th>
<th>F-testh</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gala Must</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ORG fruit</td>
<td>0.013</td>
<td>25.1</td>
<td>-2.11 ± 0.049</td>
<td>0.001 ± 0.001</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ORG leaf</td>
<td>0.111</td>
<td>90.5</td>
<td>-4.12 ± 0.115</td>
<td>0.033 ± 0.002</td>
<td>***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>INT leaf</td>
<td>0.306</td>
<td>78.5</td>
<td>-4.22 ± 0.766</td>
<td>0.014 ± 0.003</td>
<td>**</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Elstar</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ORG fruit</td>
<td>0.032</td>
<td>62.4</td>
<td>-1.26 ± 0.092</td>
<td>-0.004 ± 0.001</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ORG leaf</td>
<td>0.114</td>
<td>91.4</td>
<td>-3.69 ± 0.222</td>
<td>0.025 ± 0.004</td>
<td>**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>INT leaf</td>
<td>0.111</td>
<td>82.7</td>
<td>-5.13 ± 0.673</td>
<td>0.021 ± 0.007</td>
<td>**</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Egri Piros</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ORG fruit</td>
<td>0.027</td>
<td>32.5</td>
<td>-1.59 ± 0.045</td>
<td>-0.003 ± 0.001</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ORG leaf</td>
<td>0.114</td>
<td>91.3</td>
<td>-3.23 ± 0.113</td>
<td>0.019 ± 0.003</td>
<td>***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>INT leaf</td>
<td>0.142</td>
<td>81.3</td>
<td>-3.85 ± 0.387</td>
<td>0.009 ± 0.001</td>
<td>**</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a ORG fruit = fruit incidence data in the organic production system, ORG leaf = leaf incidence data in the organic production system, INT fruit = fruit incidence data in the integrated production system, INT leaf = leaf incidence data in the integrated production system.
b MSE = mean standard error.
c R2 = coefficient of determination.
d Slope value is the coefficient of linear regression analysis and the disease growth rate (k) of disease progress.
e SEi = standard error of intercept.
f Intercept is the constant of linear regression analysis.
g SEs = standard error of slope.
h F-test = *** < 0.01, ** 0.01 - 0.05, * 0.05 - 0.1, ns > 0.1.
<table>
<thead>
<tr>
<th>Cultivars</th>
<th>Integrated</th>
<th></th>
<th>Organic</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>leaf</td>
<td>fruit</td>
<td>leaf</td>
</tr>
<tr>
<td>Gala Must</td>
<td>865.2</td>
<td>0</td>
<td>2,811 a</td>
</tr>
<tr>
<td>Elstar</td>
<td>327.4 b</td>
<td>0</td>
<td>2,134 a</td>
</tr>
<tr>
<td>Egri Piros</td>
<td>243.7 b</td>
<td>0</td>
<td>1,089 b</td>
</tr>
</tbody>
</table>

F-test\(^b\) *** - *** *** ***
SED (df =24)\(^c\) 42.22 - 402.4 121.4
LSD\(_{0.05}\) 89.23 - 821.3 261.5

\(^a\) Values within columns followed by different letters are significantly different.
\(^b\) F-test = *** < 0.01, ** 0.01 - 0.05, * 0.05 - 0.1, ns > 0.1.
\(^c\) SED = standard errors of differences of mean values, df = degrees of freedom.
\(^d\) Because of zero values, no F-test, SED and LSD values were available.

Disease growth rate for fruit incidence support a slow disease increase or, in some cases, slow disease decrease in fruit scab epidemic progression. The reason for this is that some of the early-infested fruits had fallen and the ontogenic resistance of fruits steadily increased during the growing season. Consequently, the percentage of diseased fruits was somewhat lower through the summer and in early autumn, compared to the spring disease level.

Although the disease growth rates were quite similar for both leaf and fruit in both production systems, the “area under the disease progress curve” showed great differences in both production systems. Plank (1963) and Kranz (1974) found close correlation between the disease growth rate and the AUDPC for several diseases. In this study, AUDPC referred to the effectiveness of fungicides and level of epidemic in both production systems. Moreover, AUDPC gave more differences for comparison of disease progression than disease growth rate in both integrated and organic production systems.
Acknowledgements

The study was partly supported by a János Bolyai Research Fellowship and the Hungarian Scientific Research Fund (OTKA F043503).

References


Disease progression of apple scab was analysed in a two-year-study, in two environmental-friendly production systems (organic and integrated) on cvs. ‘Gala Must’, ‘Elstar’ and ‘Egri Piros’. Linear regression analysis of transformed disease incidence data and ‘area under the disease progress curves’ (AUDPC) were used to analyse the epidemic processes on the three apple cultivars. In linear regression analysis, the best function was the logistic transformation. Disease growth rates of leaf incidence were higher in the organic production system than in the integrated one. Disease growth rate of fruit incidences was low and with negative signs on cvs. ‘Elstar’ and ‘Egri Piros’. AUDPC showed great differences in leaf incidences among cultivars and between production systems. AUDPC gave more possibility for comparison of disease progression than disease growth rate in both integrated and organic production systems. Results were compared with similar studies on different pathosystems and biological interpretations of the analyses are discussed.
PHYTOPHTHORA ROOT AND CROWN ROT OF FRUIT TREES IN BULGARIA

Mariana Nakova
Department of Phytopathology, Agricultural University, Plovdiv, Bulgaria

In the literature diseases caused by Phytophthora species are known as “Phytophthora root and crown rot” (Ellis, 1997; Teviotdale and Gubler, 1999); “crown collar rot” (Hickey and Yoder, 2001); “Phytophthora root, crown and collar rots” (Wilcox, 1998). They are spread worldwide and have broad range of host plants – fruit trees, citrus, forest and park species. Recently Phytophthora cause serious damages on apples, cherries, apricots, peaches (Jeffers and Aldwinckle, 1987; Ellis, 1997; Growe, 1997; Teviotdale and Gubler, 1999; Wilcox, 1990, 1998). Pear and plum trees appear relatively resistant.

Tree decline and dying caused by Phytophthora root and crown rots are frequently misdiagnosed as suffering from “wet feet” (root asphyxiation) and sometimes confused with those suffering from winter injury (Ellis, 1997).

Symptoms expression depends upon how much of the root or crown tissues are affected, and how quickly they are destroyed. Crown rots advance rapidly and trees collapse after the first warm weather period in the spring (Teviotdale and Gubler, 1999). Leaves wilt, dry and remain attached to the tree. Phytophthora infections typically kill young trees.

Ellis (1997) states that wet soils that remain saturated for extended periods are required for disease development. Above-ground symptoms vary between tree species but include generally reduced tree vigor and growth, yellowing or chlorosis of leaves, and eventually collapse or death of the tree. Infected trees may decline slowly over one or more years, or they may collapse in spring. Trees may also appear healthy in spring but die suddenly in the latter part of the growing season. Below-ground symptoms include reddish-brown discoloration of the inner bark and wood. A sharp line demarcates the diseased and healthy portion of the crown. Similar symptoms can be found on the roots (Ellis, 1997; Hickey and Yoder, 2001).

Periods of 24 hrs or more saturated soil favourable for Phytophthora infections. Conversely, good soil drainage and more frequent but shorter irrigations reduce the risk of root and crown rot (Teviotdale and Gubler, 1999). Disease is more often observed in low areas of the orchard on heavy, poorly drained soils / Hickey, Yoder, 2001; Wilcox, 1998/.

Phytophthora root and crown rots are caused by several Phytophthora species. All of them require extremely wet soils in order to infect and cause significant damage but they differ in destructiveness depending on plant
species (Ellis, 1997). Rootstocks vary in susceptibility to different *Phytophthora* species. Among apple rootstocks, seedlings are relatively resistant. Among dwarfing-apple rootstocks M-9, M-2 and M-4 are relatively resistant. The Canadian rootstock Ottawa-3 has M-9 type resistance. M-7 and MM-111 are moderately susceptible, M-26 and MM-106 are susceptible, MM-104 is highly susceptible (Ellis, 1997; Wilcox, 1998). Teviotdale and Gubler (1999) wrote that MM-104 and MM-106 are more susceptible than M-9 and M-26. M-111 is susceptible to moderately resistant, M-7 a susceptible (Yoder and Biggs, personal observations). Among stone fruits, plums are relatively resistant. Mahaleb is the most susceptible cherry rootstock, whereas Mazzard, Morrello, and Colt are more resistant and recommended on heavier soils (Ellis, 1997). Fungus infection is favoured also by cool soils (10-16 °C) (Hickey and Yoder, 2001) for some *Phytophthora* species. For other soil temperature in the range of 15 to 25°C is appropriate (Wilcox, 1998).

*Phytophthora* fungi in fruit trees are difficult to control. Teviotdale and Gubler (1999) recommend foliar application of Aliette (fosetil-Al) and soil application of Ridomil Gold (mefenoxam) in early spring and fall. Soil fumigation is considered ineffective because it never completely eradicates the fungus, and *Phytophthora* are easily reintroduced into soils (Ellis, 1997; Wilcox, 1998). Fungicides can be effective when used preventively but not in infected trees showing moderate symptoms. Wilcox (1998) also recommends fungicide treatments in the early stages of decline, in advanced stages is cheaper to remove the tree and replant.

In general fungicides are most effective when used in combination with cultural practices, including comparatively resistant rootstock and drained soils.

**Materials and Methods**

In the period 1999-2002 plant materials from the following regions have been analyzed:

- Bjaga /Peschera, Plovdiv/ - apple trees
- Katunitza /Plovdiv/ - cherry rootstocks
- Trilistnik /Plovdiv/ - apple and cherry trees
- Brestnik /Plovdiv/ - cherry trees

The causal agents have been isolated on specific culture media and applying “baiting bioassay” method. Culture media are based on corn meal agar plus pimaricin, ampicillin, rifampicin, PCNB and hymexazol (PARP). Both methods are standard ones for isolating *Phytophthora* fungi from infected wood and soils. Wood showing symptoms (from the root or crown zones) have been thoroughly washed with running water. Afterwards it has
been surface sterilized with alcohol, and cut into small pieces. They have been plated into Petri dishes on PARP media.
Sterilized woody tissues have been used in baiting bioassays also. Green apples serve as “trap culture”. They have been surface sterilized, afterwards sterile cone shape cuts have been done. In holes on the fruit diseased pieces from wood have been placed, 4-5 ml sterile water have been added, wax and parafilm as a cover. Infected fruits have been incubated in growth chamber (25°C, RH 75% and 12 hrs photoperiod) for 7-10 days, till symptoms appeared. Fruit tissues from the edge of rotten zone have been transferred on V-8 or PDA media.
PDA has been used for studying morphological and cultural characteristics of mycelia and conidia, as well as formation of chlamydospores, antheridia, oogonia and oospores.
Strains isolated from apple trees (Bjaga, Plovdiv) and cherry rootstocks (Katunitza, Plovdiv) have been identified based on morphology and studied on culture media (PDA, V-8).

Results and Discussion

In Bulgaria first symptoms have been found during 1998-99 on 2-3 years old apple trees in the region of Peschera (Bjaga) and on 2-year-old cherry rootstocks (Katunitza, Plovdiv). Latter in the period 2000-2002 the same type of symptoms, caused by *Phytophthora*, have been observed on fruit trees in two more locations close to Plovdiv – Trilistnik (2-year-old cherries) and Brestitnik (cherries).
Symptoms of Phytophthora root rot type disease appear in early spring. Infected trees suffer bud break delay, their leaves are small and chlorotic, branches dye all of a sudden or whole tree dry out. That type of symptoms are not enough for diagnosis, but point out that root system or crown of the tree can be affected. Reddish-brown lesions with wet, necrotic appearance have been found on the crown and roots of infected trees (Fig 1). There is distinct margin between diseased and healthy wood tissues. Latter infected wood becomes dark brown. Lesions can spread as a ring and also upwards on the trunk of the tree.
Diagnostic symptoms are found also bellow-grafting zone as large dark spots clearly defined from healthy tissues. When bark is removed orange to reddish discoloration has been seen and a dark line marks the border with healthy tissues. Roots show similar symptoms when infected.
Trees with healthy appearance in spring can all of a sudden wilt and dry out later in the season (mainly in August-September). When trees are infected leaves drop down early and have reddish discoloration at the end of August. Studies point out that disease spread is favoured by wet and heavy not well-drained soils. Heavy rains also provoke disease symptoms.
Causal agents have been isolated from infected wood on PARP media and applying “baiting bioassays”. Identification has been done on PDA based on fungal morphology and cultural characteristics.

“Apple” strains isolated from apple trees differ in appearance. First group on PDA develops whitish, slightly smoky, featherlike colonies with radial growth (star-like) (Fig. 2). Sporangiophores are simple or branched, zoosporangia are oval, fusiform or irregular in shape (38-40 x 31-33 µm²).

Figure 1. Symptoms of Phytophthora root and crown rot on apple trees (Bjaga region)
Terminal chlamydomospheres are rarely formed, especially when NH$_4$NO$_3$ has been added to media. Oospores have been developed. Second group has whitish, smoky, fluffy mycelia (Fig. 3).

Figure 2. Colony of *Phytophthora citrophthora* isolated from apples (Bjaga region)

Figure 3. Colony of *Phytophthora cactorum* isolated from cherries (region Katunitza)
Mycelia are long, branched, normal or slightly swollen at the point of branching. Conidiophores are simple or sympodially branched. Zoosporangia are oval to elongated (lemon shaped), average size 33-34 x 26-28 µm on a media. After long period of culturing (more than 7 days) terminally or intercalary chlamydospores developed. Antheridia and oogonia, as well ooosores are formed in large numbers on strains with fluffy mycelia. They are sparse in strains with radial growth of the colonies.

“Cherry strains” isolated from cherry trees have whitish, slightly smoky colonies in appearance, with fluffy aerial mycelia. On mycelia oval or lemon shaped (elongated) zoosporangia (conidia) are formed, as well as abundant chlamydospores and oospores.

Data analysis and their comparison with results published by other authors (Smith, 1937, 1953, 1955, 1956; Novotelnova, 1974; Ellis, 1997; Hickey and Yoder, 2001; Smith and Smith, 1906, 1925, etc.) let us to conclude that strains isolated from apples belong to the species: *Phytophthora cactorum* (Leb. & Cohn) Schröt and *Phytophthora citrophthora* (R.E. Smith & E.H. Smith) Leonian.

Pathogen isolated from cherries belongs to *Phytophthora cactorum* (Leb. & Cohn) Schröt.

**Conclusions**

Analyses of results received from the studies on morphological and cultural characteristics of the strains isolated give us evidence to conclude that two *Phytophthora* species have been found on fruit trees in Bulgaria: *Phytophthora cactorum* (Leb. & Cohn) Schröt – on apples and cherries and *Phytophthora citrophthora* (R.E. Smith & E.H. Smith) Leonian – on apples.

**References**

Ellis, M.A., 1997, Phytophthora root and crown rot of fruit trees. The Ohio State University Extension Factsheet HYG-3029-95

Grove, G.G., 1997, Collar Rot of Apple, Washington State University, Tree Fruit Research and Extension Center

Hickey, K.D., K.S. Yoder, 2001, Crown or Collar Rot, *Phytophthora cactorum*. Kearneysville The Fruit Research and Education Center, West Virginia University


Ribeiro, K.O., R.G. Linderman, Chemical and biological control of
Phytophthora species in woody plants. 1991, in Phytophthora. (eds.)
Lucas, J.A. et al., Cambridge University Press, Cambridge

Smith, C.O., 1937, Inoculation on some economic plants with Phytophthora
cactorum and Ph. citrophthora, Phytopathology, 27:11 1106-1109.


Smith, H.C., 1955, Collar rot and crown rot of apple trees, Orchard., New
Zealand, 28:10 16-17, 19, 21.

Smith, H.C., 1956, Collar rot of apricots, peaches and cherries, Orchard.,
New Zealand, 29: 22-23.

Smith, R.E. and E.H. Smith, 1906, A new fungus of economic importance,

Smith, R.E. and E.H. Smith, 1925, Further studies on Pythiacystic infection
of deciduous fruit trees in California, Phytopathology 15:7 389-404.

Teviotdale, B.L. and W.D. Gubler, 1999, UC Pest management guidelines,
Apple-Phytophthora root and crown rot, UC DANR Publication
3339.

Tsao, P.H., 1983, Factors affecting isolation and quantitation of
Phytophthora from soil, In: Phytophthora – its biology, taxonomy,
ecology, pathology, Erwin, D.C. et al., APS Press.

Aldwinckle, (eds.), Compendium of Apple and Pear Diseases, APS
Press, St. Paul, MN.

Wilcox, W.F., 1998, Phytophthora Root, Crown and Collar Rots,
Phytophthora spp., Fruit Focus, USA.
Summary

PHYTOPHTHORA ROOT AND CROWN ROT OF FRUIT TREES IN BULGARIA

M. Nakova
Department of Phytopathology, Agricultural University, Plovdiv, Bulgaria

In Bulgaria disease first have been recognized during the autumn of 1998-1999 on young apple trees in Plovdiv region (Bjaga, Peschera) and on 2-year-old cherry root-stocks (Plovdiv, Katunitza). Later in the period 2000-2002 symptoms have been found on 2-year-old cherries (Trilistnik, Plovdiv), cherry trees (Brestnik, Plovdiv) and on young apples (Kjustendil).

In the literature diseases caused by Phytophthora fungi are known as Phytophthora root and crown rot; crown collar rots; Phytophthora root, crown and collar rots respectively. Phytophthora species are world-wide spread on large number of host plants. Recently they cause considerable damages on apples, cherries, apricots and peaches.

Disease symptoms have been studied with the aim of diagnostic and in connection with conditions favouring its spread and appearance. Phytophthora species have been isolated on specific artificial media containing antibiotics (PARP) and also by applying “baiting bioassays” on green apples. Cultures isolated from apples have been identified as Phytophthora cactorum and Phytophthora citrophthora. From cherries only Phytophthora cactorum have been isolated.

Morphological and cultural characteristics (morphology of mycelia, conidia, their shape and size, presence of chlamydospores, antheridia, oogonia, oospores) have been studied on different nutrient media.
INCIDENCE OF THIELAVIOPSIS POPULI ON HYBRID POPLARS IN HUNGARY

Ilona Szabó – Szabolcs Varga

University of West-Hungary, Institute of Forest and Wood Protection,
Sopron, Hungary

Unusual root disease of *Populus x euramericana* “Pannónia” was observed in summer 2002 in Hungary, near Bábolna. Beside the *Fusarium* species, *Thielaviopsis populi* (Veldeman ex Kiffer et Delon) Paulin, Harrington et McNew was isolated from the roots and collar of decaying trees. This is the first record of *T. populi* in Hungary.

*Thielaviopsis populi* (=*Chalara populi* Veldeman ex Kiffer et Delon) is a conidial fungus pathogen on poplars. It was described first in Belgium as causing bark lesions killing the cambium of the stem (Veldeman, 1971). The fungus shows some similarities with the conidial state of *Ceratocystis fimbriata* Ellis and Halsted, ubiquitous ascomycete reported also from *Populus tremuloides* in North America and from poplar hybrids in Poland (Gremmen and Kam, 1977). Nevertheless some differences were detected both in the morphology (Gremmen and Kam 1977) and in the ITS sequences of the nuclear rDNA (Paulin-Mahady et al., 2002) of the two fungus.

The field investigations were effected in August and September 2002 in two 3- and 4-year-old stands, respectively. The observed symptoms were: swollen and cracked collar usually wounded by xylophagous insects, the bark of the roots turned dark coloured, soft and rot, then the attacked trees died.

Pathological materials and soil samples were collected from the collar and roots of decaying trees in different state of decay. The material was washed, superficially disinfected with chlorine, cut into pieces and incubated in wet chamber. After a few days the grown fungal colonies were examined and identified. The isolations were performed on PDA media with plant tissues from the limit of necrosis and from the colonies developing in wet chamber. Simultaneously special isolation essays were made from soil and roots for detection of *Phytophthora* species, their presence being presupposed on the ground of similar disease symptoms.

Mostly different *Fusarium* species were identified on the samples with advanced symptoms. Bacteria and nematodes were also abundantly detected. On the wood and bark pieces with initial symptoms *Thielaviopsis populi* was identified and isolated. On the wood, perithecia of *Ceratocystis*
The morphological characters of *T. populi* isolate (culture, endoconidia and conidiophores as well as chlamydospores) were identical to the descriptions of the species in the literature cited. The molecular identification was performed by T. C. Harrington. Our isolate proved to be identical in ITS sequences of the nuclear rDNA to other isolates of *T. populi* in his collection.

The pathogenicity probe was conducted by inoculation under the bark of hybrid poplar cuttings. In average 25.12 x 12.75 mm large necroses were produced in the bark at 5 weeks after inoculation. For comparison, under the same conditions the *Fusarium* isolates caused far larger necrosis extending to the full surface of the cuttings of 45 cm. This fact indicates that *Fusarium* species had an important role in the decay of the trees. *T. populi* could be isolated more rarely and from the initial symptoms only, and produced smaller necrosis by artificial inoculation.

Regarding the ethiology of the decay the presence and mass attack of the xylophagous insects as poplar hornet clearwing, (*Aegeria apiformis*), large poplar longhorn (*Anaerea carcharias*) and poplar borer (*Agrilus populneus*) at the collar of trees should be considered as inciting factor, which opened infection portals for the pathogens (*Fusarium* species, *T. populi*) causing bark necrosis of the root system.

**Acknowledgement**

I. Szabó is grateful to T. C. Harrington for the molecular identification of *T. populi* and to the Hungarian Scientific Research Found (T 037352) for the support of the research.

**References**


Summary

INCIDENCE OF THIELAVIOPSIS POPULI ON HYBRID POPLAR IN HUNGARY

I. Szabó and Sz. Varga
University of West-Hungary, Institute of Forest and Wood Protection, Sopron, Hungary

Unusual root disease of Populus x euramericana “Pannónia” was observed in summer 2002. Thielaviopsis populí was isolated from the roots and collar of decaying trees. The artificial inoculations proved the pathogenicity of the isolate. This is the first record of T. populí in Hungary.
TISSUE DEFORMATIONS OF SUNSCALD INJURY ON THE SURFACE OF APPLE FRUIT (*MALUS DOMESTICA BORKH.*) AND ITS METEOROLOGICAL CAUSES

Miklós Piskolczi

University of Debrecen Centre of Agricultural Sciences, Agri-meteorological Observatory, Debrecen, Hungary

Sunburn of apple fruit is a surface injury caused by solar radiation, that in the initial phase results in a light corky layer, golden or bronze discoloration and injuries of the epidermal tissue on the surface exposed to radiation. According to the definition of Retig and Kedar (1967) "sunsclad" is the physiological injury of the fruit that significantly affects its quality. Meteorological elements, the physiological condition of the plant, its variety may all contribute to the formation of the injury. The change mainly occurs in the surface layers or those close to the surface. Later, plant pathogens such as *Alternaria tenuis*, *Physalospora obstusa*, *Monilia fruticola*, *Monilia laxa*, *Monilia fructigena*, *Glomerella cingulata*, *Venturia inaequalis* can infect the apple fruit through the injured epidermal tissue making the fruit unmarketable (Gurnsey and Lawes, 1999; Holb, 2002; Leeuwen *et al*. 2000, 2002). Therefore, this phenomenon causes serious economic losses in apple plantations (Brooks and Fisher, 1926; Ware, 1932; Meyer, 1932; Whittaker and McDonald, 1941; Moore and Rogers, 1942; Barber and Sharpe, 1971; Bergh *et al*., 1980; Simpson *et al*., 1988; Warner, 1997; Schrader *et al*., 2001).

Barber and Sharpe (1971) studied the injuries on pepper and pumpkin fruits and separated three sunscald types: heat injury sunscald -HIS, ultra-violet radiation sunscald -UVS and photo-dynamic sunscald of heated tissues - PSHT. Besides the above-mentioned grouping, American apple growers divide the phenomenon called sunscald into three groups. They distinguish "sunburn", "sunsclad" and "delayed sunscald". Previously, Walker (1952, 1957) used the phrase of "sunsclad" for all injuries caused by solar radiation. On the basis of the triggering reasons Schrader *et al*. (2001) determined two main types of "sunburn" injuries. The so-called "sunburn necrosis" is caused by the effect of heat and necrosis of the epidermal and sub-epidermal cells. This phenomenon causes spottiness on the sunlit side of the apple fruit. The second type is called "sunburn browning" and causes yellowish or brownish patches on the sun exposed side of the apple fruit. Schrader *et al*. (2001) also determined the physiological reasons of the two phenomena. Sunburn necrosis already happens when the overheating of the surface of the fruit reaches 52±1°C, meanwhile the permeability of cell
membranes is damaged. Sunburn browning forms at 46-49°C surface temperature, but sunlight has a decisive role in its formation as well. In this case the membranes of the surface cells of the apple fruit are injured in a lesser extent (Schrader et al., 2001, 2003). The phrases of "sunburn" and "sunscald" are often mixed in the common knowledge. The American Phytopathological Society defines sunburn as a fruit injury caused by solar radiation, while sunscald as injuries occurring on the surface or in sub-surface layers caused by freeze (Jones and Aldwinckle, 1990). In Hungary and Slovakia, Vanek and Szőke (1988) detected serious sunburn on apple and grape fruits caused by solar radiation. They predicted an increasing sunburn damage for the following years because of increasing UV-light radiation and global warming. Due to the injury, the amount and quality of yield significantly decrease many times. According to Arndt (1992) in the case of the Jonagold variety this can cause a 50% loss in yield, but this variety is sensitive to sunburn. Even in the beginning of ripening on the surface of the fruit discoloration caused by solar radiation, i.e. surface scars may appear, that have influence on the further coloration as well as taste, then marketability and storability of the fruit. Gurnsey and Lawes (1999) determine that under American market conditions the excellently coloured apple is worth even 3-4 dollars more per hamper. Schrader et al. (2001) report on several-million-dollar loss in the apple plantations in America. More detailed knowledge of the process of sunburn can contribute to the estimation of the risks caused by climatic factors, even to each variety. The obtained information can help to decrease the further losses, when planning fruit plantations (e.g. direction and distance of rows, irrigation, shaping of the structure of canopy). With proper agri-technical methods the frequency of the occurrence of sunburn can be decreased in apple plantations (Meheriuk et al., 1994).

**Description of symptoms of injuries caused by solar radiation**

"Sunburn" causes golden-bronze discoloration on the sunlit side of the apple fruit. Thus, it detracts from its appearance, but in most of the cases it would not cause serious damages in the epidermal tissue. Even the sub-epidermal tissues show no serious change. The sunlit area of the fruit is firmer, but it tends to soften quickly during storage (Gurnsey and Lawes, 1999). True "sunscald" occurs when the fruit growing in shade is suddenly exposed to strong sunlight. Due to sunlight, light or yellowish-brown patches appear on the apple fruit's surface and in its appearance more serious damages can happen in the surface tissues than in the other case. This damage is most common on fruits on the southern, west-southern sides of the tree. These
symptoms can be observed on apple fruits fallen from the tree and those ones in hampers as well, if they were exposed to strong radiation for long periods. During storage or sometimes even already on the tree brown, hard, sagging patches with bright surface appear, which have spongy structure inside. These are called "delayed sunscalds", that mean entrance points for fungi (e.g. Alternaria rot) (Barber and Sharpe, 1971; Bergh et al., 1980; Simpson et al., 1988).

The more severe form of this damage indicates serious changes in the cuticle, in the epidermal and the sub-epidermal tissues. The cell walls thicken. The volume of phenols increases in the intercellular space and the structure of plastids and thylakoids alters (Barber and Scharpe, 1971; Andrews and Johnson, 1996, 1997).

**Reasons of sunburn, conditions of its formation**

Besides the basic role of solar radiation, other factors play a role as well in the formation of sunburn. According to Barber and Sharpe, (1970) basically the following factors influence the formation of sunscald: solar absorptivity, interception of solar energy, temperature tolerance, "specific photostability", tolerance to ultra-violet radiation and degree of adaptation or sensitisation to the environment. It occurs mainly in such areas where the air temperature is high and during the ripening period the number of sunny hours is high as well. These damages also occur in great number when cool or mild weather situations are followed through a short transition by a hot, sunny period. If the change does not occur immediately, the plant can acclimatise to the changed climatic conditions, therefore, the risk of sunscald decreases as well. The damage is intensive, if it is accompanied by water stress as well in this period (Brooks and Fisher, 1926; Ware, 1932; Meyer, 1932; Whittaker and McDonald, 1941; Moore and Rogers, 1942; Barber and Sharpe, 1971).

**Biotic reasons of sunscald formation**

The main key factors during the formation of sunscald are primarily the variety of the apple, its physiological state and the structure of the planting. Apple varieties are sensitive to solar radiation and temperature to a different extent. This originates from the differences in environmental needs, but the tissue structure of the fruit, thickness of cuticle and wax as well as the pigmentation characteristic to the variety has important roles too. During each stage of ripening, sensitivity to solar radiation and temperature can change. This can be explained by the tissue development of the flesh of the fruit.

Some varieties – for example the Granny Smith – are sensitive to light since their epidermal tissue is thin, therefore, this can be damaged more easily.
The lack of calcium (soils with calcium deficiency) increases sensitivity to light since it has an effect to the thickness of the epidermal tissue. Under physiological state of the plant, we mean water- and nutrient supplies. Transpiration heat loss can decrease the overheating of the fruit, the effectiveness of which lessens in dry periods (draught) or when there is small accessible water supply (sandy soils). Then, the risk of sunscald increases. Due to the effect of the not properly distributed nutrients, the plant tissues become more sensitive to injuries. Nitrogen stimulates the production of new shoots that is disadvantageous for reaching the optimal colour because of shadowing (Meheriuk et al., 1994).

Brooks and Fisher (1926) and Meyer (1932) established that apple varieties having red-colour fruits are more resistant to sunscald.

For formation of the intensive apple colours 20-25°C daytime- and about 18°C evening/night temperature are needed in the pre-harvest weeks. For formation of the proper colour 50-70% of the light that reaches the soil surface (full sunlight) is needed (Gurnsey and Lawes, 1999). In order to achieve this, the canopy of the tree is trained, a part of the new shoots is pruned during summertime (e.g. the variety of Royal Gala needs this pruning). The aim is to prevent the leaves from shading the ripening fruits. But the plantings and tree structure optimal for colour formation can increase the risk of sunscald (Gurnsey and Lawes, 1999). One of the protective mechanisms of the plant against light is that on the sunlit side the amount of the pigments (flavonoids, carotinoids, anthocyanins) increases in the fruit skin. This process means a natural protection against solar radiation. These materials are also responsible for the taste and pattern of the apple fruit (Reay and Lancaster, 2001; Merzlyak et al., 2002).

**Abiotic reasons of sunscald formation**

According to the establishment of Smart and Sinclair (1976) in the case of grape the formation of sunscald depends on the direction of the wind, the velocity of the wind and the intensity of turbulence. The injury can particularly occur when the sunlit side of the fruit overheats (particularly in the case of fruits on the southern or south-western quadrant of the tree) and due to tissue injury, scars develop. From the environmental parameters, radiation flux density and the velocity of the wind can primarily determine the temperature of the fruit, but the size of the fruit, its albedo, the transpiration of the fruit and the heat change by long-wave rays play a role as well. This connection is based on the energy formula of the surface and estimates the maximum and minimum heat increase of the surface of the fruit exposed to sunlight. The variables that form the connection are the following: the absorbed radiation flux density, the size of the fruit, its heat conduction and the convective heat change coefficient (Smart and Sinclair,
1976). This latter can be calculated from the velocity of the wind on the basis of the formula of Nobel (1975).

The formation of sunscald can be determined by the weather conditions of several days, if the changes occur in a sensitive stage of the development of the fruit. Besides the elements of solar radiation, the other important change is that the temperature of the surface of the sunlit side of the fruit can be as much as 18ºC above air temperature and 8-9ºC warmer than that of the shaded side (Meheriuk et al., 1994). When the cool night is followed by a too hot daytime the anthocyanin synthesis strongly decreases. According to Arndt (1992), if the temperature in July, August and September surpasses the 28-32ºC, the formation of sunscald is more frequent as well. Barber and Sharpe (1971) and Schroeder (1961) studied the further effects of air temperature in the case of different fruits. Brooks and Fisher (1926) reported that if the surface temperature of an apple exposed to sunlight is as much as 14ºC above the air temperature, the injury already appears. It occurs due to heat, not because of solar radiation. On the contrary Rabinowitch et al. (1974) established that in the case of tomato the phenomenon of sunburn occurs due to heat and visible light.

On the surface and in the flesh of the fruit the uneven distribution of light and temperature triggers a series of biochemical processes, while it changes the water management of the juicy fruit as well.

Smart and Sinclair (1976) studied the above-mentioned statements in the case of grape. Determining the energy of the absorbed solar radiation the following values were taken into consideration: convective energy loss, net energy loss because of long-wave radiation, energy loss of transpirational cooling and the energy loss led into the fruit. This was applied to a fruit having a small surface (grape). In the case of the applied connection two limitations have been mentioned. On the one hand, their model supposes homogeneous conditions in the fruit's flesh that cannot be considered as a mistake in the case of a fruit having high heat conductivity (e.g. grape). However, in the case of fruits with bigger diameter or having small heat conductivity this can be a problem. The other disputable part of the model used by Smart and Sinclair (1976) is that it takes the heat transformation coefficient uniform above the fruit surface (Thorpe, 1974).

Schrader et al. (2001) established in their trials conducted between 1996-1997, that UV-B radiation is not required for sunburn and cannot cause sunburn-like symptoms alone.

**Decreasing of occurrence of sunburn by agri-technical methods**

Applying these methods we should strive to decrease the exposure of fruits to heat and radiation, meanwhile the development of intensive colours characteristic to the species would not be hindered as well.
Summer pruning must be performed in such a way that the fruits' extensive exposure to radiation is avoided. Besides, overhead sprinkling can be applied in the canopy level to cool the surface of the fruits, but this can increase the possibility of spreading other infections (e.g. apple scab and fire blight).

In cool-houses during storage the development of delayed sunscald cannot be influenced. According to the studies washing with diphenylamine did not help much. In this case, the regular sorting can be a solution, since applying this we can decrease the possible infection spots of *Alternaria* rot (Meheriuk et al., 1994).

**References**


PROPOSAL FOR THE EXPLOITATION OF RESISTANCE GENES IN PROTECTION OF THE HUNGARIAN WHEAT CULTIVARS AGAINST RUSTS

(Summary)

K. Manninger

Plant Protection Institute, Hungarian Academy of Sciences, Budapest, Hungary

Leaf rust (*Puccinia triticina*), yellow rust (*P. striiformis*) and stem rust (*P. graminis*) are important pathogens in wheat growing areas in Hungary. The best method of the protection of wheat against rusts is to increase the resistance of cultivars.

The role of resistance genes in protection of wheat against rusts depends on virulence changes of pathogens. According to our data of seedling and field tests conducted in the past years (2000-2002) a lot of resistance genes (e.g. Sr31, Sr36, Lr9, Lr19, Lr24, Lr28, Lr29, Yr18) were effective against wheat rusts, which could give protection in wheat specifically in Hungary. Although our experiences proved that Hungarian cultivars carry only some of the effective resistance genes. This is the reason why nowadays rust epidemic can occur (e.g. yellow rust epidemic in 2000) in our country. We have to increase the opportunity of protection of wheat against rusts by means of resistance genes in the future.

Supported by the National Research Development Program (Project No.NKFP-4-0020/2002)
EFFECT OF N-PHENIL-PHTALANIC ACID (NEVIROL 60 WP) ON QUANTITATIVE AND QUALITATIVE PARAMETERS OF SOME HORTICULTURAL PLANTS

József Racskó¹ – László Lakatos²

¹Institute for Extension and Development, Centre of Agricultural Sciences, University of Debrecen, Debrecen, Hungary
²Department of Fruit Growing, Centre of Agricultural Sciences, University of Debrecen, Debrecen, Hungary

Ensuring yield-balance - although the applied technologies give a good possibility for this - in the large-scale farming is a difficult and complicated task. Pollination of certain horticultural species - because of climatic or genetic influences - is not possible in many cases. For sufficient yield amount and required yield quality we have to interfere in pollination. With the help of the N-phenyl-phthalanic acid, which is an agent of NEVIROL 60 WP, we can achieve this goal (Búza, 1986).

The N-phenyl-phthalanic acid as a regulator increases the working life of stigma, helps the better pollination, which results in a higher yield. The acid is not auxin, but it has synergistic effect with auxin in biological tests (Nyéki, 1980). Applying NEVIROL 60 WP, the possible unfavourable effects of the objective (agronomics, agrotechnics, species, weather, etc.) and subjective conditions of production can be reduced, yield fluctuation can be levelled, thus crop safety can be considerably increased. The product, like other regulators and all synthetic pesticides, is not approved in the organic production system (Holb and Heijne, 2001; Holb et al., 2003).

Its application is recommended at the flowering period in greenhouses, foilhouses as well as in field cultivation for some crops (tomato, paprika, peas, beans, cucumber, grape, apple, sour cherry, lupin, soya etc.) (Eõri, 1984; Teleky, 1985; Teleky and Bésán, 1986; Teleky and Eõri, 1984; Teleky and Horváth, 1986; Teleky and Veress, 1986). Its spray application at full bloom does not influence each crop parameter such as taste, colour, germinative ability, oil content etc. (Nyéki, 1980). The formulation with recommended rate irrespectively of culture and application conditions has not caused any phytotoxicity or partenocarpia. The product may be mixed with insecticides, fungicides and foliar fertilizers except for alkaline products. Attention has to be paid to phytotoxic effect of some scab fungicides at full bloom period, which should be avoided (Holb, 2002). The preparation of the spray liquid does not need any special measures as the preparation contains the necessary constituents to ensure quick and thorough
wetting. At applications with ground machine use 400-1000 l/ha, at aerial applications 60-80 l/ha.
It is important to note that while a higher yield is aimed at through the better fruit setting, a higher level of basic nutrition should be provided (Szirtes, 1984).

**Materials and Methods**

Field conditions of research and different characteristics of plant species are presented in Table 1. and Table 2. We have chosen four plant species, two of them were fruits and the other two were vegetables. The fruit species were apple and grape and the vegetables were tomato and cucumber. From each species we have chosen two varieties, one was fertilized and the other was without fertilization. The conditions of fertilization can be seen in Table 3.

Table 1. Field conditions of research

<table>
<thead>
<tr>
<th>Genus</th>
<th>Variety</th>
<th>Place of experiment</th>
<th>Size of area (ha)</th>
<th>Size of parcel (m²)</th>
<th>In-row spacing (cm)</th>
<th>Harvest first date</th>
<th>Harvest last date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apple</td>
<td>Idared</td>
<td>Nagylapos</td>
<td>9,5</td>
<td>400</td>
<td>300*100</td>
<td>29.09.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Jonathán</td>
<td>Nagylapos</td>
<td>4,5</td>
<td>400</td>
<td>300*100</td>
<td>20.09.</td>
<td></td>
</tr>
<tr>
<td>Grape</td>
<td>Muscat Ott.</td>
<td>Mád</td>
<td>2,7</td>
<td>220</td>
<td>180*60</td>
<td>21.09.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Olasz rizling</td>
<td>Mád</td>
<td>8,0</td>
<td>220</td>
<td>180*60</td>
<td>09.10.</td>
<td></td>
</tr>
<tr>
<td>Tomato</td>
<td>Robot</td>
<td>Kálmánháza</td>
<td>1,2</td>
<td>18</td>
<td>60*30</td>
<td>16.08.</td>
<td>21.09.</td>
</tr>
<tr>
<td></td>
<td>Delta</td>
<td>Kálmánháza</td>
<td>3,4</td>
<td>18</td>
<td>60*30</td>
<td>14.08.</td>
<td>21.09.</td>
</tr>
<tr>
<td>Cucumber</td>
<td>Barbara F1</td>
<td>Nagylapos</td>
<td>1,0</td>
<td>20</td>
<td>200*20</td>
<td>11.07.</td>
<td>02.09.</td>
</tr>
<tr>
<td></td>
<td>Profi F1</td>
<td>Nagylapos</td>
<td>1,5</td>
<td>20</td>
<td>200*20</td>
<td>11.07.</td>
<td>02.09.</td>
</tr>
</tbody>
</table>
Table 2. Experimental conditions of NEVIROL 60 WP

<table>
<thead>
<tr>
<th>Date of treatments</th>
<th>Treatments (x times)</th>
<th>Treatments (% of flowering)</th>
<th>Mode of delivery</th>
</tr>
</thead>
<tbody>
<tr>
<td>04. 30.</td>
<td>1</td>
<td>50%</td>
<td>Kertitox NA-10</td>
</tr>
<tr>
<td>26. 04.</td>
<td>1</td>
<td>55%</td>
<td>Kertitox NA-10</td>
</tr>
<tr>
<td>04. 06.</td>
<td>1</td>
<td>10%</td>
<td>Novatur 1507</td>
</tr>
<tr>
<td>09. 06.</td>
<td>1</td>
<td>10%</td>
<td>Novatur 1507</td>
</tr>
<tr>
<td>24. 07. and 09., 20. 08.</td>
<td>3</td>
<td>60-90%</td>
<td>Novor 1005</td>
</tr>
<tr>
<td>24. 07. and 09., 20. 08.</td>
<td>3</td>
<td>60-90%</td>
<td>Novor 1005</td>
</tr>
<tr>
<td>03., 19. 07. and 11. 08.</td>
<td>3</td>
<td>60-90%</td>
<td>Arumic</td>
</tr>
<tr>
<td>02., 17. 07. and 10. 08.</td>
<td>3</td>
<td>60-90%</td>
<td>Arumic</td>
</tr>
</tbody>
</table>

Table 3. Conditions of fertilization in research

<table>
<thead>
<tr>
<th>Genus</th>
<th>Varieties</th>
<th>Fertilization</th>
<th>Date of fertilization</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>N  P₂O₅  K₂O</td>
<td>base</td>
<td>head</td>
</tr>
<tr>
<td>Apple</td>
<td>Idared/MM 106</td>
<td>72  25  25</td>
<td>27 January</td>
<td>2 May</td>
</tr>
<tr>
<td></td>
<td>Jonathán/MM106</td>
<td>72  25  25</td>
<td>26 January</td>
<td>2 May</td>
</tr>
<tr>
<td>Grape</td>
<td>Muscat Ottonel</td>
<td>112 18  52</td>
<td>21 December</td>
<td>22 March</td>
</tr>
<tr>
<td></td>
<td>Olasz rizling</td>
<td>112 18  52</td>
<td>21 December</td>
<td>22 March</td>
</tr>
<tr>
<td>Tomato</td>
<td>Robot</td>
<td>159 58  58</td>
<td>12 January</td>
<td>15 August</td>
</tr>
<tr>
<td></td>
<td>Delta</td>
<td>159 58  58</td>
<td>12 January</td>
<td>17 August</td>
</tr>
<tr>
<td>Cucumber</td>
<td>Barbara F1</td>
<td>12  4  12</td>
<td>15 January</td>
<td>*every week</td>
</tr>
<tr>
<td></td>
<td>Profi F1</td>
<td>12  4  12</td>
<td>15 January</td>
<td>*every week</td>
</tr>
</tbody>
</table>

*In the growing period (from 2 June to 1 September)

Results and Discussion

The detailed results of NEVIROL application can be seen in Tables 4-7. The research results can prove, that there is quite a big difference between the pollination rates of different varieties. These differences can be increased by N-phenyl-phthalanic acid, which is the agent of NEVIROL 60 WP.
**Apple**

The research results show that the pollination rate increased by 22.9% without any fertilization, due to the effect of fertilization, the pollination rate can reach 28.8%. As a result of the usage of NEVIROL 60 WP, both the mass and diameter of fruit can be changed. When we did not fertilize the soil, the usage of NEVIROL decreased the fruit mass (it could reach 99.4%) and the fruit diameter (on 98.3%). In the case of fertilization, the NEVIROL usage improved the fruit mass and diameter, but it was not significant. However, the yield amount (in both kg/tree and kg/ha) has increased remarkably. Due to fertilization the yield amount increased by 21.5% at Idared. For the other variety (Jonathan) the rate of yield increase was only 15.6%.

Table 4. Effects of NEVIROL 60 WP application on the pollination and fruit quality at two apple varieties, Idared and Jonathan

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Treatments</th>
<th>Varieties</th>
<th>Pollination (%)</th>
<th>Fruit mass (g)</th>
<th>Fruit diameter (mm)</th>
<th>Yield amount (kg/tree)</th>
<th>Yield amount (t/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Controll</td>
<td>Without</td>
<td>Idared</td>
<td>11.8</td>
<td>176</td>
<td>76.1</td>
<td>28.5</td>
<td>94.9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Jonathán</td>
<td>10.2</td>
<td>140</td>
<td>70.5</td>
<td>25.2</td>
<td>84.2</td>
</tr>
<tr>
<td></td>
<td>Fertilized</td>
<td>Idared</td>
<td>12.1</td>
<td>179</td>
<td>76.9</td>
<td>31.2</td>
<td>103.9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Jonathán</td>
<td>10.9</td>
<td>143</td>
<td>71.3</td>
<td>26.8</td>
<td>89.3</td>
</tr>
<tr>
<td>Nevirol 60 WP</td>
<td>Without</td>
<td>Idared</td>
<td>14.5</td>
<td>175</td>
<td>74.8</td>
<td>30.9</td>
<td>103.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Jonathán</td>
<td>11.5</td>
<td>138</td>
<td>68.4</td>
<td>26.8</td>
<td>89.3</td>
</tr>
<tr>
<td></td>
<td>Fertilized</td>
<td>Idared</td>
<td>15.2</td>
<td>179</td>
<td>77.2</td>
<td>34.6</td>
<td>115.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Jonathán</td>
<td>13.4</td>
<td>144</td>
<td>71.5</td>
<td>29.2</td>
<td>97.3</td>
</tr>
</tbody>
</table>

**Grape**

The other examined fruit species was the grape. We have chosen two traditional varieties for the NEVIROL usage. One was Muscat Ottonel and the other was Olasz rizling. The results can be seen in Table 5.
Table 5. Effects of NEVIROL 60 WP application on the pollination of two grape varieties, Muscat Ottone and Olaszrizling

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Treatments</th>
<th>Varieties</th>
<th>Number of flowers (number/bunch)</th>
<th>Number of set berries (number/bunch)</th>
<th>Average set fruit (%)</th>
<th>Yield amount (t/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>Without</td>
<td>Muscat Ottone</td>
<td>298.5</td>
<td>118.6</td>
<td>39.7</td>
<td>12.9</td>
</tr>
<tr>
<td></td>
<td>Olaszrizling</td>
<td></td>
<td>216.7</td>
<td>96.7</td>
<td>44.6</td>
<td>9.43</td>
</tr>
<tr>
<td>Fertilized</td>
<td>Muscat Ottone</td>
<td></td>
<td>299.1</td>
<td>128.4</td>
<td>42.9</td>
<td>13.1</td>
</tr>
<tr>
<td></td>
<td>Olaszrizling</td>
<td></td>
<td>212.6</td>
<td>97.4</td>
<td>45.8</td>
<td>9.65</td>
</tr>
<tr>
<td>Nevirol 60 WP</td>
<td>Without</td>
<td>Muscat Ottone</td>
<td>305.4</td>
<td>176.8</td>
<td>57.9</td>
<td>13.9</td>
</tr>
<tr>
<td></td>
<td>Olaszrizling</td>
<td></td>
<td>214.3</td>
<td>112.3</td>
<td>52.4</td>
<td>10.3</td>
</tr>
<tr>
<td>Fertilized</td>
<td>Muscat Ottone</td>
<td></td>
<td>307.6</td>
<td>191.2</td>
<td>62.2</td>
<td>15.7</td>
</tr>
<tr>
<td></td>
<td>Olaszrizling</td>
<td></td>
<td>211.5</td>
<td>118.6</td>
<td>56.1</td>
<td>11.9</td>
</tr>
</tbody>
</table>

In Table 5 it is demonstrated that there is not a big difference between the two grape varieties under normal circumstances, i.e. if we do not use NEVIROL. As a result of NEVIROL usage – without any fertilization – the number of set berry (average fruit set) has changed significantly. The rate of increase for variety Muscat Ottone reached 29.2% (18.2%), while for Olaszrizling it was 16.1% (7.5%). When further fertilization was applied, the NEVIROL 60 WP had a great effect on yield amount and the number of set fruit. In the case of Muscat Ottone the increase in the number of set fruits reached 49.3% and the rate of increase for yield amount was 19.8%. The reason of the differences is that many set berries do not develop into a matured berry till the harvesting date. We can get a similar result for Olaszrizling.
Cucumber

The third studied plant was cucumber. The NEVIROL usage results are shown in Table 6. The N-phenyl-phthalamic acid has the greatest influence on the size of the cucumber. The cucumber’s price mainly depends on its size. There is an inverse relationship between prize and size. The NEVIROL can help to reach small-sized cucumbers. In the case of variety Barbara F1, it increased the rate of 3-6 cm sized cucumbers by 11% and the rate of 6-9 cm sized cucumbers reached 13.1%, while the lower priced, big-sized (9-12 cm) cucumbers’ rate decreased by 20.1%. The reason for the phenomena is the increased number of cucumbers. Not only the small-sized cucumbers’ number was higher in the fertilized treatment, but also that of the normal-sized ones. For variety Profi F1, we have to take into consideration the intensive growing rate of yield amount, which could reach 26.8% under fertilized circumstances.

Table 6. Effects of NEVIROL 60 WP application on yield quality and pollination at two cucumber varieties, Barbara F1 and Profi F1.

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Treatment</th>
<th>Varieties</th>
<th>Quality distribution in the percent of mass production</th>
<th>Percent of standard yield (%)</th>
<th>Yield amount (t/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>3-6 cm</td>
<td>6-9 cm</td>
<td>9-12 cm</td>
</tr>
<tr>
<td>Control</td>
<td>Without</td>
<td>Barbara F1</td>
<td>7.4</td>
<td>42.7</td>
<td>45.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Profi F1</td>
<td>8</td>
<td>41.6</td>
<td>48.1</td>
</tr>
<tr>
<td>Fertilized</td>
<td></td>
<td>Barbara F1</td>
<td>7.3</td>
<td>42.7</td>
<td>46.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Profi F1</td>
<td>8</td>
<td>43.5</td>
<td>46.3</td>
</tr>
<tr>
<td>Nevirol 60</td>
<td>Without</td>
<td>Barbara F1</td>
<td>7.6</td>
<td>44.6</td>
<td>43.5</td>
</tr>
<tr>
<td>WP</td>
<td></td>
<td>Profi F1</td>
<td>8.1</td>
<td>45.3</td>
<td>44.4</td>
</tr>
<tr>
<td></td>
<td>Fertilized</td>
<td>Barbara F1</td>
<td>8.1</td>
<td>48.3</td>
<td>41.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Profi F1</td>
<td>8.4</td>
<td>46.6</td>
<td>43.1</td>
</tr>
</tbody>
</table>
Tomato
The research results in tomato by using NEVIROL can be seen in Table 7. For both varieties, the rate of set fruit and standard-sized yield have increased. We found a decreasing tendency in average fruit mass when we did not fertilize, although the yield amount slightly increased in this case. The fruit remained small-sized, the rate of saleable fruits decreased. In the fertilized case, when the standard yield amount was high, the yield amount increased in both cases. The rate of increase by NEVIROL usage could reach 7.6% for Delta F1 and 12.2% for Robot.

Table 7. Effects of NEVIROL 60 WP application on yield quality and pollination at the two tomato varieties, Delta F1 and Robot

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Treatments</th>
<th>Varieties</th>
<th>Average set fruit (db/bunch)</th>
<th>Standard yield (%)</th>
<th>Average mass of fruit (g)</th>
<th>Yield amount (t/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Controll</td>
<td>Without</td>
<td>Delta F1</td>
<td>5.2</td>
<td>98.8</td>
<td>80</td>
<td>22.9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Robot</td>
<td>7.8</td>
<td>98.2</td>
<td>64</td>
<td>50.1</td>
</tr>
<tr>
<td></td>
<td>Fertilized</td>
<td>Delta F1</td>
<td>5.2</td>
<td>99.1</td>
<td>83</td>
<td>25.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Robot</td>
<td>7.9</td>
<td>99.1</td>
<td>68</td>
<td>53.4</td>
</tr>
<tr>
<td>Nevirol 60 WP</td>
<td>Without</td>
<td>Delta F1</td>
<td>5.4</td>
<td>97.3</td>
<td>78</td>
<td>25.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Robot</td>
<td>8.5</td>
<td>98.1</td>
<td>62</td>
<td>55.2</td>
</tr>
<tr>
<td></td>
<td>Fertilized</td>
<td>Delta F1</td>
<td>6.5</td>
<td>99.1</td>
<td>84</td>
<td>27.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Robot</td>
<td>9.1</td>
<td>99.3</td>
<td>68</td>
<td>59.9</td>
</tr>
</tbody>
</table>

It can be proved that with the N-phenyl-phthalanic acid, the agent of NEVIROL 60 WP, we can improve the number of pollination and yield amount. The different species and varieties have different reactions to the usage of NEVIROL. After the usage, the level of fertilization has to be taken into consideration. Under low nutrient supply, the mass or diameter of the fruit will decrease, the yield will be broken up into little bits. The N-phenyl-phthalanic acid as a regulator is not a substitute for the main elements of fruit and vegetable production and plant protection, if these are available for the production the favourable effect of the usage can be experienced.
References


Summary

EFFECT OF N-PHENIL-PHTALANIC ACID (NEVIROL 60 WP) ON QUANTITATIVE AND QUALITATIVE PARAMETERS OF SOME HORTICULTURAL PLANTS

J. Racskó¹ – L. Lakatos²

¹Institute for Extension and Development, Centre of Agricultural Sciences, University of Debrecen, Debrecen, Hungary
²Department of Fruit Growing, Centre of Agricultural Sciences, University of Debrecen, Debrecen, Hungary

At four plant species (apple, grape, cucumber, tomato), the influence of N-phenyl-phthalanic acid (NEVIROL 60 WP) has been studied on yield formation and yield quality by the authors.

The research results show that by using NEVIROL 60 WP we can improve the number of fruits, and the number of berries in a bunch. As a result of this process, the yield amount will increase.

NEVIROL has a great effect on the improvement of yield amount, especially under good nutrient supply. There is quite a big difference between the reactions of different species (for example, at those grape varieties, which have a loose bunch structure, the effect of NEVIROL is more favourable than at others). Before using NEVIROL, we have to take into consideration that the increased yield needs higher nutrient supply, otherwise, fruit mass and diameter will decrease, the yield will be broken up into little bits. In the study, the most favourable effect of NEVIROL 60 WP was detected under additionally fertilized conditions by the authors.
POSTER SESSION
ENTOMOLOGICAL & ECOLOGICAL GROUP
NEW SPIDER MITE PEST IN THE VINEYARDS OF NORTH HUNGARY: GARDEN SPIDER MITE
[EOTETRANYCHUS PRUNI (OUDEMANS, 1931)]

Adrienne Garai¹ – Péter Gyulai¹ – Géza Ripka² – Zoltán Loboda¹

¹Plant Protection and Soil Conservation Service of Borsod-Abaúj-Zemplén county, Miskolc, Hungary
²Central Service for Plant Protection and Soil Conservation, Budapest, Hungary

The common pests among the mites of the vineyards in BAZ county are the grape erineum mite [Colomerus vitis (Pagenstecher)] and the grape rust mite [Calepitrimerus vitis (Nalepa)] from the Eriophyidae family; the two-spotted spider mite (Tetranychus urticae Koch) and the European red mite [Panonychus ulmi (Koch)] from the Tetranychidae family. Their damage can be detected generally every year, but its measure is different, up to the species and locality of the vineyard.

The garden spider mite (Eotetranychus pruni) was found in Hungary for the first time in the vineyards of BAZ county in 2000. Recently, the frequency of symptoms and the measure of infestation are more and more characteristics to the vineyards here. This spider mite species occurs almost on all of the cultivated vine varieties in the entire historical grape growing regions of BAZ county, especially in Hegyalja and Bükkalja.

Distribution and host-plants of the garden spider mite in the world:
Hungary – It is known from plum and apple trees of cultivated and abandoned fruit gardens as well (Bozai, 1971) and from purple crab and sloe (Ripka, 1998).
Bulgaria – in several regions, on vine (Balevski, 1980 cit. Schruft, 1985);
Greece – on apple, cherry, plum and peach (Papaioannou-Souliotis et al., 1994);
Georgia – on ash-tree (Zajceva et al., 1983);
The United States, England, Germany – on maple, horse chestnut, plum and grape (Jeppson et al. 1975, Baker & Tuttle, 1994);
The former Soviet Union – on plum, vine, apple, hazel and horse chestnut (Mitrofanov et al., 1987).

Description of the developmental stages:
Egg: Nearly spherical, width 0.01 mm diameter, surface plain, colouration yellowish-green
Female: Body oval, colouration yellowish-green, length of the body 0.32 mm, width of it 0.15 mm. Female has two lance-shaped eyes. Dorsal bristles with fine setae; four palpal segments
Male: Body oval, elongated, the same colouration as the female. Length 0.22 -, width 0.12 mm
Life cycle: The fertile female overwinters in the split of the vine stock or under the bark.
The egg laying begins after 3-4 days long matural feeding in spring, to the underneath of the lower leaves, close to the midrib or to the veins. The eggs are covered with fine strands of webbing.
Embryonic period is 15.4 days on 23 °C (Sepasgosarian, 1956).
The female lives from 38 to 53 days and average egg production is 37 (Sepasgosarian, 1956).
Depending on the ecological factors, 4-5 generations develop until the end of the vegetation period.
Hibernation starts at the end of August or the beginning of September.
Noticeable mortality can be observed only below minus 16.8°C (Sepasgosarian, 1956)

Observations

Detection of garden spider mite is possible only with a microscope, at least with 25x magnification, respecting the small size of this species. Developmental stages can be observed on the underneath of the leaves, closely to the midrib and veins.

Symptoms

The first symptoms appear on the leaves of the lower leaf floor, close to the ground and to the vine-stock, with a pale yellowish spot near to the midrib or to the veins, on the upper surface too. Feeding of the mites results reddish spots on red wine grape varieties. After this initial symptoms, the extension of these patches increase. Frequently, necrotic spots as a result of sun-ray are produced. Finally, the whole surface of the lower leaves wither, turn to yellowish-brown and the damage spread to higher floors of the vine-stock. If the population density is high, the deformation of the leaves can be observed. Complete defoliation of the lower leaf floor may follow when the mites are absolutely not, or not well controlled.
Economic importance

Garden spider mite is considered to be one of the most economically important spider mite in vineyards of BAZ county. Due to the warming up of climate, shortcoming of the applied pest management and to the false determination of symptoms (are known as beginning of some fungal infection or lack of nutritional elements (e.g. magnesia) by the most of the vineyard owners), the intensity of the infestation and the extension of the infested area is increasing more and more.

Control

Out of the inspected acaricides, good result was given by pyridaben and amitraz active ingredients, especially when these were used at the beginning of the infestation. It is necessary to start the control of this species in early season, at the appearing of the first symptoms (at the middle or end of May). When higher established population was observed (second part of June), only a very slight biological effectivity was provided by all of the inspected acaricides. The spray should cover the underneath of the lower leaf floor and rather small spray drops should use in order to respect the size of the mite.

References


The ornamental water plants are worldwide going to be more and more popular. This statement can be verified also by a plenty of special works and international expositions.

On the hilly countries of Hungary, the settlements developed a lot of dams across the valleys and made use of some abandoned mine outflows. Local leisure centres, fish ponds and recreational areas came into existence by the co-operation of inhabitants.

After changing regime, the social polarization resulted in prosperity of new type as the garden ponds became symbols of the upstaring. On a lower level, the aquaria appeared as flat ornaments. The equipments of these “mini-biotopes” are the ornamental plants and animals (fishes and turtles).

On the new biotopes, some new elements of flora and fauna appeared. These water-ecosystems must not be left alone. By means of implanting some attractive wild, semi-wild or cultivated water-plants, the new plant community could be regulated by the man.

**Literature**

Some species of the reed, sedge, rush and bulrush are gradually but independently appearing in the cold-watered lakes, creeks and backwaters (Fischl et al., 1998). The plant community can be accelerated and coloured by the human interventions. The *Lythrum* spp., *Potamogetan* spp., *Trapa natans* etc. are semi-wild water plants attractive and wantless which would settle down and multiply independently sooner or later (Botta, 1987; Krizsán, 1997). Some species of them will be presented briefly as follow.

The water marrow (*Nuphar lutea*) is denominated of its yellow flowers and characteristic fruits. It can be found in the standing waters and slow canals everywhere in the country. An ornamental water plant of the Kis-Balaton and the backwaters of Danube and Tisza.

Among the *Lotus* species, the perennial *Nymphaea alba* can also winter in the deep or shallow marshes of the flat areas of Hungary. It blooms from June to September continually. The petals of the opened flowers (10-15 cm in diameter) are white as snow, genital leaves yellowish. It can easily be
settled on sunny parts of some garden ponds. It grows rapidly and blooms abundantly when supplied with peat nutrition (Tuba – Bíró, 1987, Simon, 1992).

The ornamental water-plants which are Mediterranean by origin require a level of warmth above 20°C. The beautiful queens of the warm biotopes are the big-flowered *Nymphaea* species. These plants are the main ornaments of our warm ponds or pools because of their big round leaves, pretty flowers and perennial manner of life. The red water-lily (*N. rubra*) has from Félixfürdő been settled into the lake of Hévíz by Lovassy Sándor in 1898. Since that time, a plenty of species and variants of several colours (yellow, blue, pink) are there in the lake and outflows.

The popularity of the water-lily in Hévíz is shown above all by the fact that this ornamental water-plant has an excellent place on the town-shield. Within cultural programmes, water-lily festivals have also been organized in Hévíz recently every year.

The Indian lotus (*Nelumbo nucifera*) is a holy plant of India. It was one of the main adornments of the ponds of Pharaohs in the ancient Egypt. It is a horticultural secrecy till now, how the individual plants of diverse colours and appearances to be selected (Botta, 1987). Some exotic specimens of these plants are to be seen in the botanic garden of Szeged. Their leaves and flowers as well as fruits are adornments of the gardens.

Some later, after having the ornamental plants been settled, the pest also appear. As Linné’s eternal truth says: “Every being has its own enemy hunting it forever”.

The damaging pests of water-plants have by the researchers been neglected up today. There are only few exceptions: the damages on the reed were investigated by Vásárhegyi (1995), Fischl et al., (1998) and Bürgész et al., (1998) minutely. The damaging pests of water-lilies were noticed abroad by Sorauer (1954), Balachowsky (1963), Pape and Hemer (1964). The manner of life of the pests of the warm and cold watered biotopes in Hungary as well as the control possibilities are mentioned in the works of Bürgész – Horváth (1998a,b), Bürgész et al., (2000).

**Materials and Methods**

The investigations began 8 years ago. Our surveying have continually been done in warm ponds and outflows (Hévíz, Zalakaros, Kehida, Kincsesbánya, Félixfürdő, Püspökfürdő) as well as in cold-watered creeks, rivers and backflows (Mártély), mine inflows (Pötrete) and the Kis-Balaton.

Our main method is, by diagnosing the damages and diseases, the “plant individual survey”. The grass net is an useful instrument for collecting. The less frequent pests will be brought up in hygrostats under laboratorial and free-field conditions. The observations on manner of life are done by tent
isolators and running instrument.

Results

By our investigations, 12 damaging pests of the ornamental water plants mentioned above were observed. From among the seven herbivore pests of the water-lilies, the *Galerucella nymphaea* and the *Rhopalosiphon nymphaeae* are the most important ones. The individual density and the number of generations of these species in the warm-watered spa make the regular control necessary. For this reason, the species mentioned above have to be presented more minutely.

*Galerucella nymphaea* L.

Description:
- **Imago**: 6-8 mm, elongated oval yellow-brown sleek-haired body, flat wingtips. Mottles on wingtips. Feet and feelers darker.
- **Eggs**: Spherical, opal-white, surface reticulated. Bunches of 10-15 pieces on the plant part emerging out of water surface.
- **Larvae**: Young larvae black-green, after sloughing light brown. Larva after developing 8-10 mm, 3 foot-pairs, head capsule chestnut-brown, body elongated.
- **Pupa**: Orange-yellow free pupa adhering to the surface of the leaf.

Spreading:
Spread but one of the less frequent species in Hungary. To be found on lake shores, marshes, rivers, canals or on water plants. Surveyed by us in warm-watered lakes and outflows as well as in the peat-mine waters of Pótréte, the river Marcal, the backflows of Tisza (Gyirmót, Tiszáug, Csépa) or on the water-plants of the Kis-Balaton. The species is also well-known by the gardeners caring for water-plants (Kincsesbánya, Tata, Háromfa, Balatonfüred) because of its damages.

The species has numerous host plants. It occurs primarily on water-plants which are floating on water surface, on (secondarily) on the wet land-plants. It shows a preference for the water-lily and the water-marrow, but also damages the *Potomogeton natus*, *Sagittoria sagittifolia*, *Rumex hydrolahum*, *Polygonum amphibium*, *Comarum palvistre*. Our surveys show that it damages also *Nymphaea rubra*, *N. marliacea* var. *chromatella* and *N. coerulea*. The last species is the least infected one within the stock of Hévíz and this fact could be considered as a phenomenon of somewhat resistency.

Damage: The adults and the larvae are chewing at the surface of leaves.
The adults mostly pell circular polyeder surfaces on the leaves floating upon the water while the larvae gnaw shorter or longer canals on them. Having the epidermis got damaged, the leaves begin to become rotten and brown after a couple of days, losing decorative value. Some new leaves grow on the plants by intensive sprouting but these will be smaller and less attractive. Developing cycle: In a cold-watered biotope the species has two generations. The adults winter on the shores among the fallen leaves. Our surveys show that the species has 3-4 generations in the warm lake of Hévíz every year. Elsewhere no investigations were done. The adults settle from the fallen leaves near to the water in early April. At first, they are only on the shores to be found. Later, as the air gets warmer, they mostly fly to the plants growing in the lake. After a couple days’ feeding the adults copulate, then the females lay the groups of eggs on the surface of leaves. Our surveys by isolators show that a single female lays 80-120 eggs for a lifetime. She does it not at once but putting in some days’ pauses. The embryonic developing lasts 5-10 days. The larvae hatched out of the same group begin to feed scattering on the surface of leaves. During their development period four scales were observed thus they slough three times. The ripen larva, when finished feeding, becomes a pupa on the leaf. After a week, the new adults appear and soon begin to feed. The damages caused by them are by far not so serious than those of the larvae. The adults live long thus the generations fuse together. Control: From among the preparations, Bacillus thuringiensis var. tenebrionis (Novodor FC) is allowed.

Rhopalosiphon nymphaeae L.

Its form, colour and size are mostly similar to those of Aphis pisi. Host-plant circle is still unknown. Damage: When the colony is populous, the leaves wind themselves up emerging out of the water, become withered and faded losing their ornament. Developing cycle: It has 6-8 generations, the eggs winter on shrubby plants. The manner of life of the species is to be continued. Control: The Vektafid-A containing paraffine oil is separately allowed. The spa of Hévíz and the natural water surfaces are protected to a greater extent, thus the control measures mostly encounter difficulties. The plant parts over the water surface were cut down when infected strongly. After placed on the shore, the biomass infected was covered with black plastics. The pests were killed by the heat becoming close under the plastics. It is to be noted that the water-lily species have an excellent capacity for sprouting. They produce natural leaf-changes 4-5 times a year.
References


Linné C. (1786): Systema nature.


Summary

ORNAMENTAL WATER-PLANTS AND THEIR PESTS IN HUNGARY

Gy. Bürgés¹ and V. Csiszár²
¹University of Veszprém, Georgikon Faculty of Agriculture, Institute for Plant Protection, Keszthely, Hungary
²Szent András Kórház, Hévíz, Hungary

The ornamental water-plants are worldwide as well as everywhere in the country going to spread. There are several pests and enemies of these plants which are practically unknown. Some of these are dealt with in this study.

Two important leaf-damaging pest species of the water-lilies (Nymphaeae spp.) and the water-marrow (Nuphar lutea) will be treated of as follows namely (Galerucella nymphaea L.) and (Rhopalosiphon nymphaeae L.). Because of high individual density and number of their generations in the warm-watered spa of Hévíz and its outfalls, a regular control is necessary.
In special literature light-trap effectiveness is interpreted differently by a number of authors.

**The number of individual insects collected**

In this sense effectiveness can be modified by the following factors:

- The physiological states age and sex of insects.
- The construction of trap, the wavelength and intensity of light applied placement of trap in a given environment (composition of flora in the surroundings, its phenological state, disturbing lights, altitude over sea level, etc.).
- Meteorological and cosmic factors (weather elements, macrosynoptic weather situations, atmospheric electricity, solar activity, ionospheric disturbances, environmental illumination, interplanetary magnetic field, moonlight as well as in close connection with it distance of insect attraction, and gravitational potential caused by celestial bodies, etc.).

Several authors have dealt with the above issues. As it is now not our duty to survey literature in more depth, we only refer to our monograph (Nowinszky, [ed.], 1994) which deals with the modification effects of meteorological and cosmic factors in details.

**Collection area of light-trap**

It signifies that distance, from which the insect species with varying vagility fly to the light-trap. In this sense a number of researchers have approached the concept of effectiveness.

**The ratio of individual insects caught from those attracted by the light-trap**

Only a smaller quantity of insects getting into the vicinity of light-trap, are actually caught by the trap, about 20 % (McGeachie, 1988). With this kind of interpretation of effectiveness only few researchers have dealt with, although the thorough examination of the topic would be extremely important for plant protection forecasting.
The ratio of individuals caught from the species present in the vicinity of light-trap

In literature we have not found the interpretation of light-trap effectiveness that we are going to present in the followings, neither in Hungarian nor in international literature. As a matter of fact it is not easy to determine this ratio, as one has first define what is understood under species "present". It is well known that mobile and vagile species can fly into the light-trap that do not live in the given area, but are coming from a longer distance. Consequently the individual insects caught are made up from the individuals that have developed on plants in the vicinity of the trap and individuals arriving from a longer distance, e.g. migrants. The local insect population can anytime added by immigrant individuals, which cannot be unambiguously separated from the locally developed ones. (Mészáros, 1987-88). The vigilance of the various species is different thus they can get into the vicinity of the light-trap from various distances, even in case of identical environment illumination. In the daily entrapped material there appear individuals of such species on one hand that do not belong to the population living in the direct surrounding, but arrive from longer distances. On the other hand, similarly to the trapping procedure based on other luring methods. Those individuals of local insect populations do not appear in them that do not react to the trap stimulus for whatever reason. Consequently we understand under species "present" those individuals which stay at a given time at such a distance from the light-trap so that they can react to trap stimulus, irrespective of whether the do it actually or do not effected by any inhibitions. Thus the term "present" means in our opinion an actual distance that is differing species by species.

We have set the following objectives for our study:

- Elaboration of a method based on light trap collection data for the calculation of number of species present in the vicinity for any day of the year, and based on this determination of number of aspects, their appearance in time and the time duration of their existence, as well as the effectiveness of the trap,
- Elaboration of a method to understand the relationship between trap effectiveness and weather situations,
- Comparison of Péczely's and Hess-Brezowsky's macrosynoptic typologies for determining which one of them is more reasonable to be used in case of agrometeorological processing of light-trap data.
Materials and Methods

Data were collected and obtained from the material of forestry light-trap in Szombathely, one of the uniformly equipped national Jermy-type light-trap network. The Jermy-type light-trap is a modified version of the Minnesota-type from which the gatherer sheets are missing. Its light source is a normal bulb displayed at 2-m height, with colour temperature of 2900 °K, the killing substance is chloroform. The traps are operated by the research institutes and plant protection sites from April 1st to October 31st, the forestry traps are operated the whole year round, irrespective of weather, sunset or sunrise conditions all day from 18 PM to 4 AM. The traps do not operate on days when temperature does not rise over 0 °C, or if the area is covered with snow. Insects get the whole night into a single collecting glass. The results of collection per night mean one data.

The light-trap chosen for our investigation was operated in Szombathely between 1961-1970 within the premises of the Kámon Arboretum. The complete Macrolepidoptera material of this observation site was used to examine light-trap effectiveness. Collection period species collected and number of swarming are displayed in Table 1.

Table 1. Light-trap collection periods as well as the number of caught species and swarmings

<table>
<thead>
<tr>
<th>Years</th>
<th>Collection periods</th>
<th>Number of species</th>
<th>Number of swarmings</th>
</tr>
</thead>
<tbody>
<tr>
<td>1962</td>
<td>March 05 – November 21</td>
<td>343</td>
<td>435</td>
</tr>
<tr>
<td>1963</td>
<td>March 08 – December 03</td>
<td>349</td>
<td>472</td>
</tr>
<tr>
<td>1964</td>
<td>March 23 – December 19</td>
<td>354</td>
<td>463</td>
</tr>
<tr>
<td>1965</td>
<td>March 14 - December 21</td>
<td>205</td>
<td>242</td>
</tr>
<tr>
<td>1966</td>
<td>February 02 - December 02</td>
<td>153</td>
<td>191</td>
</tr>
<tr>
<td>1967</td>
<td>February 03 - November 19</td>
<td>261</td>
<td>312</td>
</tr>
<tr>
<td>1968</td>
<td>February 20 - November 26</td>
<td>296</td>
<td>418</td>
</tr>
<tr>
<td>1969</td>
<td>March 13 - November 27</td>
<td>316</td>
<td>427</td>
</tr>
<tr>
<td>1970</td>
<td>February 03 - November 30</td>
<td>323</td>
<td>437</td>
</tr>
</tbody>
</table>

Data related to macroscopic typology and the detailed description of the situations can be found in the papers of Károssy et al. (1994) and Nowinszky et al. (1994).

Trap effectiveness was calculated on every day of the 9-year period from the Macrolepidoptera material of the light-trap Szombathely. The numbers of individuals of the respective species were not considered on a daily basis, it was only examined whether certain species was present on a
particular day. Data on more-generation species were processed separately, according to generations. On the other hand if between the swarming time of two generation’s vagile or migrating individuals between the swarming period of two generations could be easily observed, these were considered as independent generation. If the two generations were not to be separated unambiguously from each other, the procedure used with one-generation species was followed.

The trapping data of the first sample of a given generation is called appearance, and the day following trapping data of the last individual is called disappearance. The frequency of appearance and disappearance of all generations of species were summarised day by day, then it was cumulated and illustrated. The difference between the cumulated appearance and the disappearance was calculated. This way we obtained the number of species present in the surrounding of the trap as a function of time. The number of species trapped daily was determined from the light-trap record and displayed with the species present.

The individual species of course appear and disappear continuously, thus the aspects following each other cannot be sharply distinguished. We have determined the division lines of aspects through the following procedure: the total amount of appearing (A) and disappearing (D) species was calculated day by day and illustrated and the most periods of most dynamic changes identified. These were compared with the rising curves of (A) and (D) as well as with present (P) curves and the approximate time data of aspect changes could be read. Finally ratio of entrapped individuals compared with those present in the vicinity was calculated in percentages. This result is what we considered to be the effectiveness of the trap (E). In the followings the daily effectiveness data for the 9 years were jointly handled, but sorted according to aspects and correlated according to the Péczely’s and Hess-Brezowsky’s macrosynoptic type codes numbers for the days in question and averaged. Then we controlled the significant deviation of averages from the average value of the aspect.

Results

The effectiveness of the light-trap in Szombathely is correlated with the Péczely’s and Hess-Brezowsky’s macrosynoptic weather situations, according to the aspects and illustrated in Table 2 and Table 3.
Table 2 The effectiveness of the light-trap in connection with the Péczely's macrosynoptic weather situations

<table>
<thead>
<tr>
<th>Péczely's situations</th>
<th>Spring aspect</th>
<th>Early summer aspect</th>
<th>Late summer aspect</th>
<th>Autumn aspect</th>
<th>Winter aspect</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>E %</td>
<td>N</td>
<td>E %</td>
<td>N</td>
<td>E %</td>
</tr>
<tr>
<td>mCc (1)</td>
<td>20.3</td>
<td>53</td>
<td>18.9</td>
<td>56</td>
<td>26.0</td>
</tr>
<tr>
<td>AB (2)</td>
<td>12.7</td>
<td>31</td>
<td>21.5</td>
<td>34</td>
<td>26.7</td>
</tr>
<tr>
<td>CMc (3)</td>
<td>17.4</td>
<td>36</td>
<td>23.9</td>
<td>24</td>
<td>21.6</td>
</tr>
<tr>
<td>mCw (4)</td>
<td>33.7</td>
<td>98</td>
<td>28.0</td>
<td>71</td>
<td>29.0</td>
</tr>
<tr>
<td>Ae (5)</td>
<td>34.2</td>
<td>74</td>
<td>30.3</td>
<td>34</td>
<td>34.7</td>
</tr>
<tr>
<td>CMw (6)</td>
<td>19.2</td>
<td>60</td>
<td>15.7</td>
<td>33</td>
<td>23.9</td>
</tr>
<tr>
<td>zC (7)</td>
<td>35.5</td>
<td>52</td>
<td>25.4</td>
<td>18</td>
<td>26.4</td>
</tr>
<tr>
<td>Aw (8)</td>
<td>21.3</td>
<td>107</td>
<td>27.6</td>
<td>131</td>
<td>26.0</td>
</tr>
<tr>
<td>As (9)</td>
<td>35.9</td>
<td>27</td>
<td>20.4</td>
<td>20</td>
<td>29.0</td>
</tr>
<tr>
<td>An (10)</td>
<td>19.1</td>
<td>69</td>
<td>26.0</td>
<td>74</td>
<td>32.5</td>
</tr>
<tr>
<td>AF (11)</td>
<td>16.8</td>
<td>15</td>
<td>30.1</td>
<td>24</td>
<td>32.8</td>
</tr>
<tr>
<td>A (12)</td>
<td>38.3</td>
<td>27</td>
<td>34.9</td>
<td>47</td>
<td>32.9</td>
</tr>
<tr>
<td>C (13)</td>
<td>23.3</td>
<td>13</td>
<td>26.5</td>
<td>7</td>
<td>25.9</td>
</tr>
<tr>
<td>Averages:</td>
<td>25.8</td>
<td>25.9</td>
<td>29.4</td>
<td>29.4</td>
<td>29.4</td>
</tr>
</tbody>
</table>

Notes: E = efficiency of light-trap (%). Bold numbers sign if the significance levels of average effectiveness values are higher than 95 % as well as the deviation characteristic for a given aspect.

Discussion

The almost up-to-date Péczely typology and the regular publishing of codes allow both the continuity of the related entomological research and the processing of the latest observation data. Based on the former examinations exploring the effect of weather factors as well as trapping results correlated with the individual Péczely-type situations one can determine those weather situations that are favourable or unfavourable from light trapping of insects. If we compare the typology considering the surface baric field as well as the Hess-Brezowsky's typology based on 500 bar atmospheric levels, it seems proved that light trapping effectiveness in Hungary can be more closely related to Péczely's typology relating to the lower levels of planetary border stratum.

Péczely's macrosynoptic weather situations are not only valid from the point of view of climatologic typology but they are also apt for agrometeorologic research purposes as well. Elaboration of similar typologies for other geographic regions seems also reasonable.
Table 3. The effectiveness of the light-trap in connection with the Hess-Brezowsky's macrosynoptic weather situations

<table>
<thead>
<tr>
<th>Hess-Brezowsky's situations</th>
<th>Spring</th>
<th>Early summer</th>
<th>Late summer</th>
<th>Autumn</th>
<th>Winter</th>
</tr>
</thead>
<tbody>
<tr>
<td>E %</td>
<td>N</td>
<td>E %</td>
<td>N</td>
<td>E %</td>
<td>N</td>
</tr>
<tr>
<td>Na (11)</td>
<td>17.1</td>
<td>10</td>
<td>31.4</td>
<td>4</td>
<td>29.3</td>
</tr>
<tr>
<td>Nz (12)</td>
<td>13.2</td>
<td>20</td>
<td>33.9</td>
<td>15</td>
<td>29.2</td>
</tr>
<tr>
<td>HNa (19)</td>
<td>18.3</td>
<td>15</td>
<td>31.9</td>
<td>21</td>
<td>31.3</td>
</tr>
<tr>
<td>HNZ (20)</td>
<td>26.2</td>
<td>10</td>
<td>24.5</td>
<td>14</td>
<td>31.9</td>
</tr>
<tr>
<td>HB (18)</td>
<td>8.3</td>
<td>13</td>
<td>15.0</td>
<td>12</td>
<td>16.9</td>
</tr>
<tr>
<td>NWa (13)</td>
<td>26.6</td>
<td>7</td>
<td>36.8</td>
<td>11</td>
<td>17.0</td>
</tr>
<tr>
<td>NWZ (14)</td>
<td>19.2</td>
<td>56</td>
<td>32.8</td>
<td>13</td>
<td>25.7</td>
</tr>
<tr>
<td>TRM (27)</td>
<td>9.1</td>
<td>28</td>
<td>19.1</td>
<td>26</td>
<td>24.0</td>
</tr>
<tr>
<td>Wa (1)</td>
<td>37.7</td>
<td>13</td>
<td>29.1</td>
<td>42</td>
<td>30.0</td>
</tr>
<tr>
<td>Wz (2)</td>
<td>35.5</td>
<td>119</td>
<td>24.8</td>
<td>66</td>
<td>29.3</td>
</tr>
<tr>
<td>WS (3)</td>
<td>43.1</td>
<td>22</td>
<td>22.8</td>
<td>9</td>
<td>30.1</td>
</tr>
<tr>
<td>Swa (7)</td>
<td>36.7</td>
<td>20</td>
<td>36.0</td>
<td>15</td>
<td>32.5</td>
</tr>
<tr>
<td>SWZ (8)</td>
<td>35.4</td>
<td>43</td>
<td>32.8</td>
<td>13</td>
<td>31.5</td>
</tr>
<tr>
<td>TRW (28)</td>
<td>31.0</td>
<td>31</td>
<td>22.5</td>
<td>28</td>
<td>30.7</td>
</tr>
<tr>
<td>WW (4)</td>
<td>15.1</td>
<td>28</td>
<td>26.0</td>
<td>24</td>
<td>29.6</td>
</tr>
<tr>
<td>SA (5)</td>
<td>38.6</td>
<td>13</td>
<td>16.7</td>
<td>1</td>
<td>31.8</td>
</tr>
<tr>
<td>Sz (6)</td>
<td>35.7</td>
<td>8</td>
<td>-</td>
<td>-</td>
<td>40.8</td>
</tr>
<tr>
<td>TB (26)</td>
<td>26.8</td>
<td>11</td>
<td>21.1</td>
<td>17</td>
<td>38.5</td>
</tr>
<tr>
<td>SEa (9)</td>
<td>14.6</td>
<td>12</td>
<td>32.2</td>
<td>6</td>
<td>17.2</td>
</tr>
<tr>
<td>SEZ (10)</td>
<td>40.0</td>
<td>2</td>
<td>32.8</td>
<td>3</td>
<td>25.0</td>
</tr>
<tr>
<td>HFz (22)</td>
<td>27.8</td>
<td>19</td>
<td>25.1</td>
<td>23</td>
<td>28.7</td>
</tr>
<tr>
<td>HNFa (23)</td>
<td>29.9</td>
<td>35</td>
<td>21.1</td>
<td>11</td>
<td>26.5</td>
</tr>
<tr>
<td>HNFZ (24)</td>
<td>-</td>
<td>-</td>
<td>26.5</td>
<td>14</td>
<td>31.1</td>
</tr>
<tr>
<td>Nea (15)</td>
<td>16.3</td>
<td>9</td>
<td>21.3</td>
<td>22</td>
<td>18.9</td>
</tr>
<tr>
<td>Nez (16)</td>
<td>22.6</td>
<td>7</td>
<td>22.5</td>
<td>21</td>
<td>25.3</td>
</tr>
<tr>
<td>HM (17)</td>
<td>19.7</td>
<td>36</td>
<td>31.5</td>
<td>31</td>
<td>30.4</td>
</tr>
<tr>
<td>BM (30)</td>
<td>30.2</td>
<td>30</td>
<td>27.8</td>
<td>19</td>
<td>31.9</td>
</tr>
<tr>
<td>TM (25)</td>
<td>8.3</td>
<td>33</td>
<td>21.1</td>
<td>17</td>
<td>24.8</td>
</tr>
</tbody>
</table>

Averages | 25.8 | 25.9 | 29.4 | 29.4 | 9.4 |

Notes: E = efficiency of light-trap (%). Bold numbers sign if the significance levels of average effectiveness values are higher than 95 % as well as the deviation characteristic for a given aspect.

There are more examinations required to explore the effect of the Hess-Brezowsky's macrosynoptic weather situations (valid for whole Europe) in Hungary as well. Irrespective of this their utilisation seems to be promising.
for forecasting in plant protection. The Péczely-type macrosynoptic weather situations are probably easier to interpret and give a less ambiguous picture of weather conditions. Thus we recommend their application in researches that focus on insect ecology, serving the purposes of forecasting in plant protection in Hungary. Hess-Brezowsky's macrosynoptic types can in our opinion be utilised first of all in international research efforts, for example in controlling migrating insect populations.

The better understanding of the role of whether allows making better forecasts for plant protection. Thus the results of our work can contribute to the application of environment-friendly, effective and at the same efficient plant protection procedures. The application of our method allows to research the relation of life phenomena of insects with weather even in those cases, when measuring the individuals factors hits against difficulties. The collection data of the national light trap network are of invaluable scientific importance and can also be utilised in research of insect ecology and etology. The results of our method to determine effectiveness of light trap can be utilised in ecology, cenology and faunistic research.

Even from the data continually collected at an observation site over a period of year can serve for drawing conclusions as related to various taxons, supposing naturally that the research is not restricted to reporting the collection data of only a few insect species:

- The number of species present in the surroundings can be determined for any day of the year.
- The number of aspects, their appearance in time and the period of their existence can be determined.
- The periods of rapid changes and relatively steady periods are recognisable.
- Trap effectiveness can be calculated indicating the percentage of species entrapped by the trap in a given period.
- The alteration of effectiveness is comparable by aspects, by taxons and by sexes can indicate their different demands against the abiotic factors.

The data obtained at the same observation site in different years, as well as the data gained at various observation sites for the same years can also be evaluated on the basis of the categories listed above. The differences manifested in the number of aspects, the time of their appearance and disappearance, the period of their existence, species diversity as well in trap effectiveness can be compared with data on climatic and weather conditions. Observation covering a number of years can indicated unfavourable changes occurring in the environment, for example the continuous decrease of species as a consequence of environment pollution. Thus the method
presented here can play a major part in research related to environment protection.

As a matter of fact, the method presented has the shortcomings that are connected with the peculiar features of light trapping. In addition one has to consider that the involvement of those species that are only detected for one or two days in trap material can lead to overestimation of trap effectiveness. Their swarming lasts obviously for longer time, but the method is not able to show the decrease of effectiveness on other days. On the other hand effectiveness is under-estimated if the swarming time of two subsequent generations is inaccurately divided from each other or if we consider the whole period of collecting a given species as one swarming because of the individual arriving from longer distances. Most of these potential failures can be avoided if one has been adequately prepared professionally, if phenology of the various species at the given observation site is studied in a thorough way, and if in case of processing fresh insect material, migrating individuals are singled out.

References

Summary

LIGHT-TRAP EFFECTIVENESS DEPENDING ON THE PÉCZELY’S AND HESS-BREZOWSKY’S MACROSYNOPTIC WEATHER SITUATIONS

L. Nowinszky and J. Puskás
Berzsenyi Dániel College, Szombathely

The authors developed a method for calculating the number of species present in the vicinity of the trap for any given day of the year. Using this, we determined the number of aspects, the time and duration of their appearance, as well as the effectiveness of the trap. We studied the daily effectiveness with regard to the Hess-Brezowsky’s and Péczely's macrosynoptic weather situations using the data of Jermy-type light-trap operated at Arboretum in Szombathely. We took the code numbers from the Péczely’s (1983) and Hess-Brezowsky’s (1977) catalogues. According to the days of the calendar we summed up and then cumulated the frequency with which each generation of each species appeared and disappeared. The difference between the cumulated appearance and disappearance gives the number of species present in the vicinity of the trap. We plotted this, then determined when the changes of aspects occurred. Next we determined the number of species trapped daily. Finally we calculated the percentage of insects trapped in comparison to those present. This result is what we considered to be the effectiveness of the trap. The daily effectiveness data for the nine years sorted according to aspects and correlated according to the Péczely’s and Hess-Brezowsky’s macrosynoptic type code numbers for the days in question was averaged. We were able to determine the macrosynoptic situations favourable and unfavourable for collecting.
Quantifying biodiversity in ecosystems by green lacewing assemblages

I. A valuable method to do (Insecta: Neuroptera: Chrysopidae)

(Summary)

Thierry, D.1, Deutsch, B.1, Paulian, M.2, Villenave, J.3, and Canard, M.4

1 Université Catholique de l’Ouest Angers, France
2 Institutul de Cercetari pentru Protectia Plantelor, Bucuresti, România
3 Institut National d’Horticulture, Protection des Plantes, Angers, France
4 47 chemin Flou de Rious, Toulouse, France

Green lacewing samplings coming from eleven various significant biotopes were chosen to characterize the biodiversity they display. They point out different types of landscapes: Mediterranean and montane forest biotopes, two wet meadow-lands and a vegetable field in plain, one subspontaneous and three managed Mediterranean olive groves, a submediterranean calcareous slopes and an oro-mediterranean moorland. Three parameters were used to quantify biodiversity. They betoken: (1) the rough faunistical richness (Margalef’s index), (2) the diversity as the relative importance of each collected species and the ratio between the total numbers of species and individuals (Shannon’s index), and (3) the equitability or relative heterogeneity featuring the distribution of the species specimens and giving an idea of their dominance (Hulbert’s index). To ascertain the values recorded on single samplings, we operated by the method of Bootstrap. We calculated a confidence interval (Box Plot) coming from 10,000 virtual samplings, simulated by randomly picked up pullings within a infinite population showing the same distribution of species than the original assemblage. A classifying process (Cluster Scatterplot) was then established in order to appraise the proximity of the different habitats.

The Shannon and the Hulbert’s indices bear out the high sensivity of these parameters to the structure of studied assemblages. They evidence a conspicuous difference of the montane forest biotope: the number of rare species was fairly high, seven species were abundant mainly *Cunctochrysa albolineata* (48.1 %) and *Chrysopa pallens* (26.9 %). Reversely, in the scanty agroecosystem and also at a lower level in the sites strongly altered either by agricultural farming practices or by climatic cues (inundation), the faunistical richness and the diversity were low whilst a strong dominance of the common green lacewings appeared. Mediterranean biotopes together with the wet meadow are characterized by an equitability always higher than...
0.48, unless the number of collected species. The wild Mediterranean biotopes constituted by the maquis moorland, the typical Aleppo-pine forest and the calcareous slopes look like both rich and well-balanced biotopes, however better than the two insecticide-free olive groves. The analysis results in a diagrammatic typological approach of the biotopes. Establishing average diversity indices together with their confidence intervals allows unambiguous comparisons between various chrysopid assemblages. By the way, one may characterize their plight relative to the more or less abundant and diversified occurrence of these polyvalent predators which are a valuable signal of a good ecological functioning within ecosystems. In farming advising, such an approach of checking, forecast and management is promiseful for all responsible and advisors of future agriculture which must become and remain sustainable and respectful of the planet resources.
The ability of an agroecosystem to enter sustainable development needs control and maintenance in time of its good health, failing which they fall into disrepair. Owing to the availability of quantifying accurately biodiversity indices, we demonstrate here by an example the possibility of detecting biodiversity chronological changes during a short period by means of green lacewing samplings. Light-trap data of green lacewings captured from 1985 to 1994 in the vicinity of Bucharest (Romania) suggests that there have been alterations in the species assemblages. The main occurring species were those constituting the common green lacewings, i.e. the *Chrysoperla carnea* complex, plus *Chrysopa formosa* Brauer, *Chrysopa pallens* (Rambur) and *Chrysopa perla* (Linnaeus). They are present every year whilst several other casual species did not. Among the latters, *Chrysopa abbreviata* Curtis, *Chrysopa nigricostata* Brauer and *Cunctochrysa albolineata* (Killington) disappeared along time contrarily to eurytopic and more generalist species. *Chrysoperla carnea* (Stephens) *sensu lato* was almost double in its relative frequency when measured during a similar (summer) period, increasing from 38 to 72%.

Three parameters were used to quantify biodiversity. They betoken: (1) the rough faunal richness (Margalef’s index), (2) the diversity as the relative importance of each collected species and the ratio between the total numbers of species and individuals (Shannon’s index), and (3) the equitability or relative heterogeneity of populations, featuring the distribution of the species specimens occurring in an assemblage and giving an idea of the dominance of the more abundant species (Hurlbert’s index). To ascertain the values recorded on a single sampling in each case, we operated by the method of Bootstrap. We calculated a confidence interval (Box Plot) coming from 10,000 virtual samplings, simulated by randomly picked up
pullings within an infinite population showing the same distribution of species than the original collection. A classifying process (Cluster scatterplot) was then established in order to appraise the proximity of annual values.

The present study did not show any significant decrease in the basic biomass of lacewings. The faunal global richness seemed not very perturbed, only lessening of about 9% of its initial value. The diversity and equitability indices relative to each year manifested a rather high level of biodiversity for an agricultural environment. Nevertheless, they decreased significantly with time (parametric and non-parametric tests). They left about 45%, meaning both together a loss in diversity. The progressive dominance of the ubiquist common green lacewings is attested by a logistic regression showing a good adequation. It constitutes a strong cue of alteration in the crop fields and a preliminary upsetting statement.

Key words: green lacewing, biodiversity, biodiversity indices, agroecosystem, light trapping, Romania.
DISCOVERY OF A LONG-RANGE CHEMICAL ATTRACTANT FOR LACEWINGS (*CHrysoperla* SPP.)

(Summary)

Miklós Tóth¹ – Ferenc Szentkirályi¹ – Maria Rosaria Tabilio² – Daniela Cesare² – Agostino Letardi³

¹Plant Protection Institute, HAS, Budapest, Hungary
²Istituto Sperimentale per la Frutticoltura di Roma, Ciampino Aeroporto (RM), Italy
³ENEA – C.R. Casaccia, Biotec-SIC, S. Maria de Galeria, Roma, Italy

In the course of field trapping tests in Hungary originally aimed at capturing female noctuids, regular catches of green lacewings were observed in traps baited with phenylacetaldehyde, a well known attractant for several Lepidoptera. In subsequent trapping tests at several sites in Hungary and Italy, traps baited with one (lower dose) or three (higher dose) polyethylene bag bait dispensers loaded with this compound caught significantly higher numbers of green lacewings than unbaited traps, confirming beyond doubt the long-range attractivity of this compound. There was no significant difference between catches of traps with one or three dispensers. Both sticky delta and funnel traps baited with phenylacetaldehyde were capable of catching green lacewings and there was no difference between the performance of the two trap types. Funnel traps baited with three dispensers were used for monitoring the occurrence pattern of green lacewings throughout all the season with success. Captured specimens belonged mainly to the *C. carnea* species complex.

Until now, only a few substances were described as attractants for green lacewings. Some of these were tested by other groups to increase common green lacewings (*Chrysoperla carnea* s.l.) in arable crops with different results, which may in part be due to the difficulty to distinguish the effect of confounding factors (such as any competing odours from the crop, influence of naturally-occurring prey populations, weather conditions, and so on) under field conditions.

*Chrysoperla carnea* s.l. is a key-species in several crops for the control of a wide range of pest aphids, caterpillars, and other soft-bodied arthropods. The attractant discovered in this study showed approximately the same level of attraction towards female and male specimens of the common green lacewing whereas a wide range of plant volatiles tested by Dodds and McEwen (1998) showed a stronger intensity of attraction towards male specimens of *C. carnea*.
Fig. 1. Catches of green lacewings in sticky delta or funnel traps baited with phenylacetaldehyde vs. unbaited traps at Halásztelek, Hungary, May 9 - June 10, 2003. All specimens captured belonged to the *C. carnea* species group (establishment of species identity of single specimens captured is underway). Significance: columns with same letter within one diagram not significantly different at *P*=5% by ANOVA, Games-Howell.

Further research would focus on the possibility of application of the new attractant on its own or in combination with previously known attractants for the study of lacewings in different crops.

**Reference**

RESPONSE OF THE ANTIOXIDATIVE DEFENCE TO FLAVONOID QUERCETIN IN TWO POPULATIONS OF
LYMANTRIA DISPAR L.


Institute for Biological Research "Sinisa Stankovic", Belgrade, Serbia-Montenegro

Lymantria dispar L. a polyphagous herbivore is the most dangerous insect pest of forest and fruit trees. Its host range is estimated at more than 500 plant species from 73 families (Lance, 1983, Liebhold et al., 1995). The locust tree Robinia pseudoacaccia is a plant that the gypsy moth avoids as a food (Barbosa and Krischik, 1987). Locust tree leaves contain large quantities of alkaloids and flavonoids (Bagrbosa & Krischik 1987). Some of them may have toxic and prooxidant effects (Hodnick et al., 1986). Gypsy moth populations in locust tree forest are rare (Jankovic 1958). The ingestion of oxidizable flavonoids can exacerbate oxidative stress in herbivorous insects (Ahmad, 1992; Felton and Summers, 1995; Pardini, 1995). The flavonoid quercetin used in this experiment was chosen as test prooxidant plant allelochemical. Upon insect ingestion quercetin is metabolically activated by one-electron oxidation to a free radical (o-semiquinone) which in turn reacts with O_2 (oxygen) to generate O_2^- (superoxide anion radical) and consequently H_2O_2 (hydrogen peroxide) and OH (hydroxyl radical) resulting in numerous destructive reactions in insect cell (Hodnick et al.,1986; Hodnick et al.,1989).

The cellular antioxidative defense of herbivorous insects includes the enzymes (superoxide dismutase-SOD, catalase-CAT, glutathione-S-transferase-GST, glutathione reductase GR, ascorbat peroxidase and dehydroascorbate reductase) and antioxidants (e.g. ascorbic acid, glutathione and α-tocopherol) that protect cells from oxidative stress (Ahmad 1992; Felton and Summers 1995; Pardini 1995). Considering that the gypsy moth population is present in the Bagremara (our experimental population) for more than 50 years (Sidor & Jodal, 1983), it is to a certain extent adapted to a locust-tree leaves diet (Peric-Mataruga et al., 1997; Lazarevic et al., 2002). Our previous results have shown that locust tree leaf diet lead to on increase in GST and SOD activities and GSH content as well as to a decrease in CAT activity in the midgut tissue. Fifty-year adaptation of the gypsy moth population to the unfavourable host plant in the locust tree forest have resulted in the changes of antioxidative defence (Peric-Mataruga et al., 1997). The adaptive changes of the constitutive expression
of the activities of antioxidative enzymes of the pest insects are very important component of their susceptibility to insecticides (Gordon 1961). The aim of this research was investigating the effects of artificial diet supplemented with the flavonoid quercetin (1.5% w/w) on the level of midgut tissue antioxidative defence: the activity of superoxide dismutase (SOD), catalase (CAT), glutathione-S-transferase (GST), glutathione reductase (GR) and glutathione content (GSH) in the 4th instar of the gypsy moth originating from oak and locust tree forest.

**Materials and Methods**

Egg masses of *Lymantria dispar* L. were collected from two localities (oak forest – “Bogovadja”, locust-tree forest – “Bagrema ra”). During the winter the egg masses were kept at 4°C until May when they were transferred to a constant temperature of 23°C to hatch. After hatching the gypsy moth caterpillars were divided into the following four experimental groups:

- OC- caterpillars from the oak forest fed artificial diet without quercetin
- OQ- caterpillars from the oak forest fed artificial diet supplemented with quercetin (1.5% w/w).
- LC- caterpillars from the locust-tree forest fed artificial diet without quercetin
- LQ- caterpillars from the locust-tree forest fed artificial diet supplemented with quercetin (1.5% w/w).

The caterpillars (4th instar) were reared in plastic containers (2dl) at 23°C and fed standard artificial diet for gypsy moth (O’Dell et al., 1985) with or without quercetin (3,3',4',5,7-pentahydroxyflavone, Sigma Chemicals Co., St. Louis, Missouri). After the caterpillars were sacrificed the midguts were dissected on ice, washed several times with ice-cold physiological saline solution (0.9% NaCl), midgut peritrophic membrane with content was removed and midgut were rinsed again with ice-cold physiological saline solution again. Midguts of 7-10 larvae were pooled by weight and homogenized in 0.25 M sucrose, 0.05 M Tris-HCl, 1mM EDTA pH=7.4 buffer (1:10 w/v) according to Rossi et al. (1983), and sonicated according to Takeda et al. (1982). For determination of the total amount of glutathione, part of the sonicated homogenate used to precipitate proteins with 5% sulpho-saliclyc acid and the total amount of glutathione was measured after centrifugation at 5000 rpm for 10 min. The rest of the sonicated homogenate was centrifuged at 10500g for 90 min and the activities of SOD, CAT, GST and GR were determined in the supernatant.
SOD activity was determined according to Misra and Fridovich (1972). The method includes monitoring the degree of inhibition of adrenaline autooxidation in an alkaline medium in the presence of SOD. The enzyme unit was defined as the amount of enzyme inhibiting 50% of the control reaction and was expressed per mg protein.

CAT activity was determined by monitoring spectrophotometrically the degradation of a standard concentration of hydrogen-peroxide (Beutler, 1982) and was expressed as nmol H$_2$O$_2$/min/mg protein.

Habig’s method (Habig et al., 1974) was used for determining GST activity. The unit is defined as nmol GSH/min/mg protein.

GR activity was measured according to Glatzle et al., 1974, by monitoring spectrophotometrically changes of the amount of NADPH consumed for the reduction of a standard amount of oxidized glutathione (GSSG). The activity was expressed as nmol NADPH/min/mg protein. All enzyme assays were performed at 30°C. The total amount of glutathione both oxidized and reduced was measured according to Griffith 1980 and was expressed per g wet midgut mass.

The statistical significance of the results was estimated by analysis of variance (Sokal and Rohlf, 1981).

Results

Activity of the superoxide dismutase in the midgut tissue of the larvae fed artificial diet supplemented with quercetin (OQ and LQ) was higher than in the control groups (OC and LC) (Table 1). Two way ANOVA confirmed significant effect of quercetin in a diet for the SOD activity (Table 2). This difference was more expressed in a oak population which were more sensitive to nutritional stress. SOD activity was higher in a control group from locust tree (LC) than in a control group from oak population (CO) (Table 1).

An artificial diet with quercetin was associated with a decrease of the glutathione-S-transferase activity regardless of the population origine (Table 1.). Two-way ANOVA revealed significant population and significant host-plant effects of the diet supplemented with quercetin on the GST activity in the midgut tissue of the gypsy moth caterpillars (Table 2.). The effect is more pronounced in oak adapted than in locust tree adapted population. Both populations showed the trend of elevated total amount of glutathione in the midgut tissue as a response to quercetin supplemented arteficial diet (but with no significance) (Table 1.).

Quercetin in the artificial diet did not change activity of the catalase and glutathione reductase in the midgut tissue of the larvae of both populations.
Table 1. Activity of antioxidative defence enzymes and amount of glutathione in the midgut tissue of 4th instar gypsy moth larvae originating from different populations and fed artificial diet supplemented with quercetin (1.5% w/w quercetin)

OC- caterpillars from the oak forest fed arteficial diet without quercetin
OQ- caterpillars from the oak forest fed arteficial diet supplemented with quercetin (1.5% w/w)
LC- caterpillars from the locust-tree forest fed arteficial diet without quercetin
LQ- caterpillars from the locust-tree forest fed arteficial diet supplemented with quercetin (1.5% w/w)

<table>
<thead>
<tr>
<th></th>
<th>OC</th>
<th>OQ</th>
<th>LC</th>
<th>LQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOD</td>
<td>10.77 ± 1.46</td>
<td>21.39 ± 1.78</td>
<td>16.01 ± 1.21</td>
<td>21.37 ± 1.49</td>
</tr>
<tr>
<td>CAT</td>
<td>88.9 ± 25.8</td>
<td>120.17 ± 20.0</td>
<td>± 99.91 ± 13.3</td>
<td>84.67 ± 1.65</td>
</tr>
<tr>
<td>GST</td>
<td>29.77 ± 2.17</td>
<td>17.62 ± 4.26</td>
<td>13.17 ± 3.65</td>
<td>10.46 ± 0.6</td>
</tr>
<tr>
<td>GR</td>
<td>1.35 ± 0.275</td>
<td>1.79 ± 0.29</td>
<td>1.73 ± 0.625</td>
<td>1.45 ± 0.425</td>
</tr>
<tr>
<td>GSH</td>
<td>0.83 ± 0.08</td>
<td>0.93 ± 0.12</td>
<td>0.73 ± 0.068</td>
<td>0.95 ± 0.065</td>
</tr>
</tbody>
</table>

Discussion

Due to its poliphagous nature, the gypsy moth is exposed to a variety of allelochemicals, some of which has prooxidant effect. The preference of gypsy moth caterpillars for host plants correlates negatively with the presence of flavonoids and alkaloids (Barbosa and Krischik 1987).

Upon insect ingestion quercetin can be metabolically activated by one-electron reduction to generate free radical species, which can further react with molecular oxygen to form the oxygen radical, superoxide (Hodnick et al., 1989).

Our results show that both oak and locust tree caterpillars fed on diet supplemented with quercetin have higher SOD activity than control groups (Table 1.). SOD is an antioxidative enzyme that catalyzes the dismutation of superoxide radical to hydrogen peroxide (Fridovich 1978). It is interesting that SOD activity in the midgut tissue was higher in a control group from locust tree population than in a control group from oak forest (Table 1). Superoxide dismutase is one of the most important components of the antioxidative defence against prooxidant effects of quercetin (Pritsos et al., 1988). This high constitutive SOD activity explains a potential of the gypsy
Table 2. The two-way analysis of variance (ANOVA) for the impact of population origin
– P and types of diet (artificial diet and artificial diet supplemented with quercetin)
– D on the levels of components of antioxidative defence in the midgut tissue of 4th instar gypsy moth

<table>
<thead>
<tr>
<th>Component</th>
<th>P df</th>
<th>D df</th>
<th>P x H df</th>
<th>Error df</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOD</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>17</td>
</tr>
<tr>
<td>MS</td>
<td>0.027</td>
<td>0.29</td>
<td>0.026</td>
<td>0.0093</td>
</tr>
<tr>
<td>F</td>
<td>2.9</td>
<td>31.06***</td>
<td>2.84</td>
<td></td>
</tr>
<tr>
<td>CAT</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>14</td>
</tr>
<tr>
<td>MS</td>
<td>0.0017</td>
<td>0.0091</td>
<td>0.0855</td>
<td>0.043</td>
</tr>
<tr>
<td>F</td>
<td>0.038</td>
<td>0.21</td>
<td>1.96</td>
<td></td>
</tr>
<tr>
<td>GST</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>14</td>
</tr>
<tr>
<td>MS</td>
<td>0.17</td>
<td>0.24</td>
<td>0.02</td>
<td>0.0111</td>
</tr>
<tr>
<td>F</td>
<td>15.69***</td>
<td>21.37***</td>
<td>1.84</td>
<td></td>
</tr>
<tr>
<td>GR</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>17</td>
</tr>
<tr>
<td>MS</td>
<td>0.017</td>
<td>0.00027</td>
<td>0.0126</td>
<td>0.042</td>
</tr>
<tr>
<td>F</td>
<td>0.401</td>
<td>0.0064</td>
<td>0.3</td>
<td></td>
</tr>
<tr>
<td>GSH</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>17</td>
</tr>
<tr>
<td>MS</td>
<td>0.0011</td>
<td>0.029</td>
<td>0.0083</td>
<td>0.0108</td>
</tr>
<tr>
<td>F</td>
<td>0.105</td>
<td>2.712</td>
<td>0.767</td>
<td></td>
</tr>
</tbody>
</table>

*P<0.05; **P<0.01; ***P<0.001;

Moth population from the locust forest to survive at higher quercetin concentration in the artificial diet than oak population (Peric-Mataruga et al., 2001). As the gypsy moth had inhabited the locust tree forest for more than fifty years it is likely that a trophic process occurred which is also manifested in the rise in SOD activity. The dismutation reaction catalysed by SOD results in the production of toxic H$_2$O$_2$ (Fridovich 1978). H$_2$O$_2$ is scavenged by another antioxidant enzyme catalase (Ahmad et al., 1987). Since there was no changes in CAT activity in the midgut of the treated groups of the gypsy moth, toxic effect of quercetin can be attributed to H$_2$O$_2$ mediated effect.

Our results showed that glutathion-S-transferase activity decrease if caterpillars from both populations fed diet supplemented with quercetin (Table 1). In insects GST is important in metabolic detoxification of
insecticides (Yu 1996), of allelochemicals from host plants (Yu 1993) in protect insects from the toxic effects of active oxygen species (Parkes et al., 1993, Zaman et al. 1994, Hodnick et al., 1996) and for the turning on the detoxifying enzymes enhancing the defense machinery, speeding the development of resistance to insecticides (Hinkle et al, 1995, Carlini et al., 1995). The natural flavonoids such as quercetin and gossypol are capable of inhibiting GST (Wood et al., 1990). That is one more fact that can explain toxic effect of quercetin on the gypsy moth larvae.

Our results show the trend of increasing in the amount of GSH in the midgut tissue of the caterpillars which were fed diet supplemented with quercetin (Table 1). Reduced glutathione can also react passively as an antioxidant and can reconstitute enzymes by reduction of oxidized SH groups (Jocelson, 1962).

It is well known that feeding on certain host plants can alter the susceptibility of the herbivore to insecticides (Berry et al., 1980). The herbivorous insects metabolize and detoxify insecticides using the same enzymes that are involved in the metabolism of ingested plant allelochemicals (Brattsten 1979). Induction of a detoxification and antioxidative enzyme system as a result of feeding on particular host plants can alter to susceptibility to insecticides (Berry et al., 1980).

References


**Summary**

**RESPONSE OF THE ANTIOXIDATIVE DEFENCE TO FLAVONOID QUERCETIN IN TWO POPULATIONS OF *LYMANTRIA DISPAR* L.**

V. Peric-Mataruga, J. Lazarevic, D. Blagojevic, and S. Pavlovic

Institute for Biological Research “Sinisa Stankovic”, Belgrade, Serbia - Montenegro

The gypsy moth caterpillars used in this experiment were originating from two populations (oak and locust tree forest) which were differently adapted to toxic effects of quercetin supplemented in artificial diet. The responses of 4th instar *Lymantria dispar* L. to artificial diet with quercetin (1.5% w/w) were monitored at the level of antioxidative defence in the midgut tissue: the activities of superoxide dismutase (SOD), catalase (CAT), glutathione-S-transferase (GST), glutathione reductase (GR) and glutathione content (GSH). Regardless of population origin activity of SOD was higher in the caterpillars if fed diet with quercetin than in a control group. In average SOD and CAT activities were higher in the population from locust tree forest than oak forest population. An artificial diet with quercetin led to a decrease of GST activity in both populations. The diet with quercetin did not affect activity of CAT and GR.
CHRYSOLENA FASTUOSA (COLEOPTERA: CHRYSMELIDAE) AN AGENT FOR BIOLOGICAL CONTROL OR A PEST?

András Bozsik

University of Debrecen, Department of Plant Protection, Debrecen, Hungary

The species diversity of our planet is one of the most important maintaining resources of life and thus, it represents an integrated element of the sustainable agricultural production. There are innumerable hardly visible living organisms contributing almost invisibly to the welfare of mankind. Regarding the species richness, the Insecta class of the phylum Uniramia (formerly Arthropoda) contains the most species living on the Earth. Insular and selfish human activity called production of goods or free market economy managed to put the life sustaining mechanism of our ecosystem with ill-considered destruction of living beings in danger. The following study on a barely known insect might direct our attention to our common responsibility and interest for a better appreciation of the services of the insects.

*Chrysolina fastuosa* (Scopoli, 1763) is a chrysomelid beetle with 5-6 mm body length. Head, thorax, elytra are shining greenish golden. It is widely distributed in continental Europe, but of very local occurrence in Britain. In Europe recent sources reported its occurrence in Belgium (Varlez, 1988), Hungary (Víg, 2001), Transylvania (Rozner, 1998) and Bohemia (Rehounek, 2002). In Hungary adult beetles can be found from April to August or September on hemp-nettle (*Galeopsis pubescens*), black horehound (*Ballota nigra*) and surely on other labiatae plants. Since *Ch. fastuosa* can be seen very often in strikingly great number on black horehound, this fact urged us to have a closer look at it.

The aim of this short study was to assess the controlling capacity of *Ch. fastuosa* on *B. nigra* an on roadsides and along walls commonly occurring soft caulescent European plant which can be called minor weed.

**Materials and Methods**

A with black horehound densely grown area to be found on a roadside in Gödöllő (small university town in the north of Hungary) has been chosen for the observation in the spring of 2003. Forty *B. nigra* plants with adult *Ch. fastuosa* have been randomly selected and labelled. The height, the number of leaves of the plants as well as the number of beetles feeding on their leaves and the caused surface damage have been measured and counted.
on 24\textsuperscript{th} May and a week later. The plants have been selected according to their height into three groups (plants to about 20, 30 and 50 cm height) in order to see the possible preference of \textit{Ch. fastuosa}. The progress of damage and the change of the beetles’ number were calculated and compared. For considering remarkable differences two-tailed t-test was used (Sváb, 1981).

**Results and discussion**

Results are presented in Table 1 and 2.

**Table 1. Number of \textit{Chrysolina fastuosa} adults on \textit{Ballota nigra}**

<table>
<thead>
<tr>
<th>Date of evaluation</th>
<th>Plants of 20 cm</th>
<th>Plants of 30 cm</th>
<th>Plants of 50 cm</th>
</tr>
</thead>
<tbody>
<tr>
<td>0524</td>
<td>1.46\textsuperscript{a} (0.660)</td>
<td>4.93\textsuperscript{a} (4.714)</td>
<td>4.61\textsuperscript{a} (6.158)</td>
</tr>
<tr>
<td>0530</td>
<td>1.73\textsuperscript{a} (1.555)</td>
<td>3.12\textsuperscript{a} (3.638)</td>
<td>10.71\textsuperscript{a} (8.789)</td>
</tr>
</tbody>
</table>

Standard deviation is in brackets. Means followed by the same letter within a column are not significantly different at P = 0.05 by two tailed t-test.

**Table 2. Surface damage caused by \textit{Chrysolina fastuosa} adults on \textit{Ballota nigra}**

<table>
<thead>
<tr>
<th>Date of evaluation</th>
<th>Plants of 20 cm</th>
<th>Plants of 30 cm</th>
<th>Plants of 50 cm</th>
</tr>
</thead>
<tbody>
<tr>
<td>0524</td>
<td>25.08\textsuperscript{a} (18.518)</td>
<td>40.71\textsuperscript{a} (28.280)</td>
<td>23.57\textsuperscript{a} (17.568)</td>
</tr>
<tr>
<td>0530</td>
<td>56.09\textsuperscript{b} (19.852)</td>
<td>68.47\textsuperscript{b} (15.910)</td>
<td>44.00\textsuperscript{a} (25.538)</td>
</tr>
</tbody>
</table>

Standard deviation is in brackets. Means followed by the same letter within a column are not significantly different at P = 0.05 by two tailed t-test.
Although, in two height groups regarding the number of individuals feeding on *B. nigra* some progress could have been observed, no significant difference was revealed between the two evaluations (table 1). In contrast to that, results in table 2 show that in two height groups significant differences have been found and also in the third group a remarkable not significant damage progress could be perceived which means that the control of *Ch. fastuosa* on *B. nigra* can be considerable. Hence, theoretically this shining beetle seems to contribute to the control of a minor weed for that reason it is worthy of further research.

However, taking into consideration the growing importance of the production of medicinal plants among which Lamiaceae species are numerous, *Ch. fastuosa* can cause a damage not known yet in more detail.

**References**


A poorly known chrysomelid beetle, *Chrysolina fastuosa* (Scopoli, 1763) has been found in strikingly great number on black horehound (*Ballota nigra*), a soft caulescent plant belonging to Lamiaceae family. *B. nigra* can be found from April to August commonly on roadsides, along walls or at the border of gardens and orchards in Hungary and continental Europe, thus it can be called a minor weed. The glistering tiny adults feeding voraciously on its leaves caused apparently important damage. The subsequent investigation focusing on the number of feeding individuals and the loss of plant tissue showed 1-24 beetles a plant and the consumed leaf surface amounted 8-94 %. The repeated damage assessment a week later pointed out a significantly unimportant increase in the number of individuals but a significantly considerable, 20-31 % increase of the plant loss. According to the literature *Ch. fastuosa* has been found in association with other labiate plants such as *Galeopsis pubescens*, *Lamium alba* and *Urtica* spp. (Urticaceae) thus regarding its efficiency presented above it could be used augmenting and maintaining its populations as biological control agent of these weeds. However, taking into consideration the growing importance of the production of medicinal plants among which Lamiaceae species are numerous, *Ch. fastuosa* can cause a damage not known yet in more detail.
ACUTE EFFECT OF CADMIUM ON PHOSPHATASE ACTIVITY IN THE MIDGUT OF GYPSY MOTH LARVAE

(Summary)

Milena Vlahovic – Jelica Lazarevic – Larisa Ilijin and Vesna Peric and Mataruga

Institute for Biological Research “Sinisa Stankovic”, Belgrade, Serbia and Montenegro

The effects of two cadmium concentrations (10 and 30 gCd/g dry food) on larval mass and midgut phosphatase activity (total acid, lysosomal and alkaline) as well as their plasticities were investigated in the 4th instar larvae of the gypsy moth (Lymantria dispar L.) under acute three day exposure to cadmium. The analysis was performed on 20 egg masses (5 larvae/egg mass/treatment). It was found that acute exposure to lower cadmium concentration had inhibitory effect only on lysosomal phosphatase. Activity of alkaline, total acid phosphatase and larval mass remain at the control value. Cadmium concentration of 30 µgCd/g significantly decreased larval mass, and activity of alkaline and lysosomal phosphatases. Activity of alkaline phosphatase had greater plasticity at 30 than 10 µgCd/g while other traits did not show significant difference in phenotypic plasticity and its variability between the two cadmium concentrations. Acute exposure to both cadmium concentrations increased the variance for larval mass while variability of phosphatase activities were not affected. Significant correlations between control group and treatments were not observed while correlations between the environments with different cadmium concentrations were significant only for alkaline phosphatase activity. As midgut homogenates were pulled within each egg mass (full-sib family), the change in a trait variance represents the change in genetic diversity. Additionally, the absence of significant correlations among environments point to an independent genetic determination of a trait in different environments.
FATE OF IMIDACLOPRID IN SOIL AND PLANT AFTER APPLICATION TO COTTON SEEDS

(Summary)

S. E. El-Hamady¹ and R. Kubiak²

¹Plant Protection Dept., Fac. of Agric., Tanta Univ., Kafr El-Sheikh, Egypt
²Ecology Dept., SLFA, Neustadt / Germany

The study aimed to investigate the persistence of imidacloprid in soil after seed dressing of cotton and to obtain a complete picture on the mass balance of this compound in soil and cotton plants. The study was carried out as a pot experiment under laboratory conditions using a Gaucho formation containing ¹⁴C-labelled imidacloprid. Three treatments of treated cotton seeds were made in sandy loamy soil: fertile seeds grown in autoclaved soil, dead seeds put in fertile soil and fertile seeds grown in fertile soil. Results showed that total ¹⁴C recoveries decreased by time from 93.8 – 96.2, 77.1 – 88.4, 53.5 – 62.4 and 60.0 – 64.5% of the applied radioactivity at days 7, 14, 21 and 28 after application, respectively. Extracted ¹⁴C from soil decreased in all treatments by time up to three weeks following application and this coincided with fluctuated increase of non-extracted ¹⁴C (bound ¹⁴C). Bound ¹⁴C level was always less in autoclaved soil than in fertile ones. Results revealed also that only 1.8 – 6.8% of the applied ¹⁴C was taken up by the plants and fluctuated within the test period. ¹⁴C levels were higher in plants grown in autoclaved soil than those in fertile ones. Radioactivity tended to accumulate on the edges of cotton leaves. Most of the radioactivity in the soil extracts was identified as unchanged ¹⁴C-imidacloprid. The residues of this compound in soil declined with time with half life periods ranging from 12.6 to 14.3 days at 24 ºC. This decline was due to a rapid degradation process of imidacloprid forming metabolites, which were quickly mineralized or fast bound to the soil matrix since higher concentrations of ¹⁴C-metabolites were not detected. The degradation products were changed to ¹⁴CO₂ or might also be associated with the non-extracted residues that were analyzed quantitatively.
POSTER SESSION
WEED SCIENCES &
INTEGRATED PEST
MANAGEMENT (IPM) GROUP
Adaptive ability of weed species during individual development on herbicide action is ontogenetic adaptation, gradual and hardly noticeable. It occurs as the consequence of long lasting action of the particular herbicide during several years lasting application. Weed resistance occurrence has great practical significance in current situation when herbicides are applied in high in almost all countries of the world. Resistance causes inability of previously successful herbicide control of certain weed species, i.e. their lower systematic categories that are more variable and unstable than the species itself. Therefore, mass occurrence of resistance within a weed species can be major limiting factor of further herbicide application. Resistance phenomenon cannot be distinguished by visual assessments until 1-10% of resistant individuals of one population in the field do not occur, i.e. less than 0.1% in laboratory conditions. If only one weed species is spread, it can be considered that there occurred resistance (Konstantinovic, 1999).

Literature

In 1970 weed herbicide resistance was for the first time established in Washington forest nursery, where Senecio vulgaris resistance on triazines was determined (Holt, 1992, cit. Konstantinovic and Meseldzija, 2002). Following several repeated treatments found some weeds such as Solanum nigrum, Amaranthus retroflexus and Chenopodium album, with anatomic modifications on the membrane level became unsusceptible to this herbicide type. Evolution of resistant weed species was caused by frequent use of the herbicides belonging to the herbicide group with the same mechanism action in over five years period. Crossed resistance was also determined in cases in which a weed biotype is resistant to two or more herbicides due to the presence of one resistance mechanism, as well as multiple resistance i.e. occurrence of resistant plants to herbicides that have two or more resistance mechanisms. All of them make choice of alternative herbicide as mean of control in the case of resistance more complicated. Therefore, rotation of various herbicides with
various mechanisms of action is necessary. *Lolium rigidum* in Australia and *Alopecurus myosuroides* in Great Britain are examples of the occurrence of crossed, i.e. multiple resistance (Le Baron, 1991).

Up to day, HRAC group (Herbicide Resistance Action Committee), founded in 1989 by industry with support of Federation for global crop protection registered 272 resistant weed species on over 210,000 fields, of which even 79 species developed resistance on ALS inhibitor herbicides (HRAC, 2003). In 1988 herbicide resistance in our country was for the first time determined in *Amaranthus retroflexus* L. (Janjic et al., 1994). In 1991, as the result of more years lasting use of triazine herbicides on Yugoslav railroad tracks, Arsenovic et al. also determined resistance in various weed species, such as *Amaranthus retroflexus* L., *Convolvulus arvensis* L., *Sorghum halepense* (L.) Beauv., *Cynodon dactylon* (L.), Pers etc. In 2001, in studies performed by Konstantinovic and Meseldzija in certain localities of Vojvodina, resistance of biotypes of *Amaranthus retroflexus* and *Setaria viridis* was determined. This was confirmed by Herbicide Resistance Action Committee (HRAC, 2003).

We considered studies of resistance occurrence of the weed species *Amaranthus retroflexus* L. on ALS inhibitors, group of herbicides that include sulfonilureas and imidazolinones, of which imazethapyr was applied the most frequently in our country last years, of great importance. Primary site of ALS inhibitor action is enzyme acetolactate synthase that has key role in biosynthesis of amino acid leucine, isoleucine and valine in weed plants. Inhibition of these amino acids synthesis causes reduction of protein quantity in younger parts of the plant, and reduced protein synthesis inevitably leads to inhibition of cell division. Species *Amaranthus retroflexus* L. is the first weed in Israel that developed resistance to ALS inhibitors (Sibony & Rubin, 1996). Studies of weed species *Echinochloa crus-galli* L. resistance on ALS inhibitors are the first studies of weed resistance occurrence toward herbicides with this action mechanism in our country. Up to now, resistance of the species *Amaranthus retroflexus* L. has been determined in Israel, Canada and four USA states (HRAC, 2003).

**Materials and Methods**

Seeds were collected from the different sites of locality Becej, which had a long history of imidazolinone and sulfonilurea herbicides use (ten years backwards). A susceptible population collected from an area where no herbicides had been used was used as a reference population. Imazethapyr was used since it was one of the most frequently applied ALS inhibitors in the localities studied.

The most important individual factor for the initial determination of resistance, is the level of non-susceptibility in the field. Consequently, we
have used a method of visual assessment of imazethapyr efficiency to detect possible resistance. There are several factors that can indicate possibility of resistance occurrence in field, such as: level of control of other susceptible species, presence of live plants alongside dead ones, past experiences, i.e. previously successful control by the same treatment, herbicide history, i.e. repetition of the same herbicide treatment, or herbicide with the same mode of action, resistance occurrence in the region, harvest, cultural history, i.e. monoculture and minimum tillage (Moss, 1995).

Studies were made on whole plants (Thurwachter, 1998) and Petri dishes bioassays (Clay & Underwood, 1990). Assays were performed in four replications and plants were treated with various doses of imazethapyr, representing 40, 80, 100, 150 and 200 g a.i. ha⁻¹.

In whole plant studies, plants were grown in controlled conditions in pots from seed which was suspected to be imazethapyr resistant. There were ten seeds per plots and the trial was set on chernozem with 3.5% of humus in four replications, and assessments were done 50 days after treatment (pre-emergence herbicide application). In whole plant studies, efficacy was evaluated by measuring height steam, as well as by counting emerged plants and assessing their vigour.

In the Petri dish assays, twenty seeds per dish were spread evenly over the paper and 5ml of imazethapyr solution added to saturate, but not flood, the filter paper (pre-emergence herbicide application). There were four replications of each treatment. Dishes were kept in thermostat on 22⁰C. Germination and seedling condition were recorded at intervals up to 25 days from the start, with visual assessment of number of healthy and damaged seedlings in each dish. In Petri dishes bioassays, the lengths of epicotyls and hypocotyls of shoots were measured.

Results

In Figure 1 mean epicotyls lengths of the *Amaranthus retroflexus* samples from Becej locality are presented, table T-7, T-26 and T-72, as well as of the sample from non-agricultural land that served as standard.

In Figure 2 mean hypocotyls length values of *Amaranthus retroflexus* L. samples from locality Becej are presented, table T-7, T-26 and T-72 and susceptible standard.
During resistance studies in Petri dish assays, seed germination of the species *Amaranthus retroflexus* L. in different imazethapyr quantities was also measured (Figure 3).
In whole plant studies, 50 days after emergence stem height was measured, and calculated mean values in range of imazethapyr rates are given in Table 1.

Table 1. Mean stem height of *A. retroflexus* L. at different imazethapyr quantities

<table>
<thead>
<tr>
<th>Imazethapyr quantity (g ha⁻¹)</th>
<th>Mean stem height of <em>A. retroflexus</em> L. (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Becej T-7</td>
</tr>
<tr>
<td>40</td>
<td>8.36</td>
</tr>
<tr>
<td>80</td>
<td>7.79</td>
</tr>
<tr>
<td>100</td>
<td>7.47</td>
</tr>
<tr>
<td>150</td>
<td>6.05</td>
</tr>
<tr>
<td>200</td>
<td>6.01</td>
</tr>
</tbody>
</table>

**Discussion**

At Petri dish assays 20 seeds in four replications were germinated in thermostat at temperature of 22 °C. Three days upon setting of the assay, 65% of germinated seeds were recorded. On the fifth day maximal seed germination was recorded. It was 60% for seeds from locality Becej T-7,
30% for seeds from locality Becej T-26, 50% for seeds from locality Becej T-72 and from non-agricultural land it was 35%.

Ten days upon setting of the assay the best seed germination was determined for samples from localities Becej T-72 and Becej T-7. Later on, in these samples were measured significantly lower values for epicotyls and hypocotyls lengths as regards to the first locality. Seed from locality Becej T-72 had the highest values of the studied parameters. The lowest germination was recorded for seeds from locality Becej T-26, which was lower even from one recorded for seeds collected from non-agricultural land.

During second week, gradual decay arose on shoots of samples from non-agricultural land at higher imazethapyr quantities. Shoots epycotils and hypocotyls lengths from localities Becej T-7, 26 and 72 were significantly lower at imazethapyr quantities of 1.5 and 2.0 ppm. This was especially typical of samples from locality Becej T-7, where no shoot decay occurred.

Based upon values for the mean epicotyls and hypocotyls lengths, from Figures 1 and 2, it is obvious that samples from non-agricultural land and from locality Becej T-7 showed the highest susceptibility at imazethapyr quantity of 2.0 ppm. This was also the case with imazethapyr quantity of 1.0 ppm.

At samples from all three studied localities (Becej T-7, Becej T-26 and Becej T-72), increase of imazethapyr quantity led to gradual decrease of epicotyls and hypocotyls relative length, and higher quantities above 0.4 ppm of imazethapyr led to decay of shoots from non-agricultural land.

In whole plant studies, a month after shooting up of A. retroflexus L, the first occurrence of chlorosis at higher imazethapyr quantities on samples from non-agricultural land and locality Becej T-7 was determined. From Table 1, it is obvious that samples from non-agricultural land and locality Becej T-7 had the highest susceptibility at imazethapyr quantity of 100 and 200 g ha\(^{-1}\). Increase of imazethapyr quantity led to gradual reduction of mean stem height values of samples from all studied localities, excluding samples from non-agricultural land. Seed of A. retroflexus L. from all localities did not germinate at imazethapyr quantities of 100, 150 and 200 g. a.i. ha\(^{-1}\).

According to the obtained results, samples from locality Becej T-72 showed the highest resistance, even at imazethapyr quantities of 150 and 200 g. a.i. ha\(^{-1}\).

References


**Summary**

**DETERMINATION OF RESISTANT BIOTYPES OF *AMARANTHUS RETROFLEXUS* L. ON ALS INHIBITORS**

B.Konstantinovic, M.Meseldzija, D.Sunjka and Bo. Konstantinovic

Faculty of Agriculture, Department for Environmental and Plant Protection, Novi Sad, Serbia - Montenegro

The aim of the study was determination of resistance occurrence of the species *Amaranthus retroflexus* L. on ALS inhibitors. Weed resistance toward herbicides represents phenomenon of these plant species adaptation toward changed environmental conditions and occurs as the consequence of use of herbicides with the same mode of action during several years lasting period. Studies with the aim of resistance determination were performed during 2002, and material for the studies was collected from various sites at Becej locality (Vojvodina). Long lasting use of the herbicides belonging to the group of ALS inhibitors, which are very successfully applied for control of dicotyledonous and monocotyledonous weeds in certain areas lead to occurrence of resistance of the weed species *Amaranthus retroflexus* L. Results of the study obtained by biological assays, field experiments and Petri dish assays confirmed presence of resistant biotype *Amaranthus retroflexus* L.
Harmful effect of the neighbouring plants on each other is called interference, which consist of competition and allelopathy. Allelopathy is considered as one of the stress factors, which influence the development of an individual plant, a species or plant community. It plays an important role in plant succession and is a well known phenomenon in natural ecosystems. In agriculture, it has been frequently studied in crop monocultures. The two fundamental approaches to the use of allelochemicals for weed management are: 1. as a herbicide or a lead for a synthetic herbicide and 2. use of allelopathic plants in plant production (Kazinczi 1999, Béres 2000, Duke et al. 2002).

Literature

Perennials cause serious problems in Hungary. Asclepias syriaca L. originated from North-America is an adventive weed in Hungary. According to the first Hungarian Weed Survey (1947-1953), it did not exist in Hungary, while on the basis of the IV. National Weed Survey (1996-1997) it occupied the 76th positions (Tóth and Spilák 1998). Cirsium arvense (L.) Scop., a native plant of Europe is a weed of 27 crops in 37 countries (Holm et al., 1977, Moore 1975). Convolvulus arvensis L. is one of the most troublesome weed in Europe, western Asia, Canada and the United States, and it is a special problem in several crops grown widely in the temperate region (Holm et al., 1977). On the basis of the IV National Weed Survey C. arvense is the 5th, while C. arvensis is the 6th most important weed in Hungary (Hunyadi et al., 2000). Besides generative reproduction by seeds, their vegetative propagation is also very important and occurs mainly by rootstocks, containing adventitious buds. Rapid distribution of these species in not only due to their considerable reproductive and competitive ability (Evetts and Burnside, 1973, Moore, 1975, Bhownik and Bandeen 1976, Holm et al., 1977, Lehoczky, 1988, Varga, 1998, Hunyadi and Kazinczi 1992, Lehoczky, 2000, Lehoczky et al., 2003), but also due to their allelopathic properties (Bendall, 1975, Wilson, 1981, Kovács et al., 1988, Béres and Csorba, 1992, Solymosi and Nagy, 1999, Béres and Kazinczi, 2000, Kazinczi et al., 1999, 2001).
The aim of our examination was to study allelopathic effect of *A. syriaca*, *C. arvense* and *C. arvensis* in bioassay and pot experiments.

**Materials and Methods**

*Laboratory germination (bioassay)*

Fresh rootstocks and shoots of *A. syriaca* and *C. arvense* were collected at the beginning of flowering in Vecse, Somogy county (Hungary) in July 2003. The roots and shoots were cut into small pieces in a grinder. After grinding 25, 12.5, 5 and 2.5 g fresh biomass was stirred into 100 ml distilled water and left for a day. Then the mixtures were filtered through filter paper (MN 640w) and were denoted as a stock solution, 2x, 5x and 10x dilutions. Double filter paper was kept in each Petri dish, thereafter 8 ml leachate was added per Petri dish. On the top of filter paper 100 seeds of cucumber ‘Delicatesse’ were placed to germinate at 22°C in incubator in four replicates. Germination percentage and the length of radicle were recorded after 48 hours. Seed germinated in distilled water served as control.

*Pot experiments*

Fresh water extracts was made with 25 g fresh *C. arvense* shoots/100 ml distilled water. Water extract was used for irrigation of the pots as needed. Pots were filled with the soil mixture of sand (pH: 6.96, humus: 0.27%) + peat (pH: 6.78, humus: 9.98%) in a ratio of 1:1 and sown with four seeds of wheat ‘Mv-23’, corn ‘Mv-NK 333’, and sunflower ‘Barbara’ in four replicates.

In another experiment 0.8 kg dried shoots of *C. arvensis* was mixed in 10 kg soil mixture and kept moist for three months. After three months of decomposition, pots were filled with the soil mixture containing shoot residues and sown with four seeds each of three test plants spp. i.e. barley, mustard and bean.

Fresh weight of the test plants was recorded 37 days after sowing (DAS).

**Results**

*Laboratory germination (bioassay)*

It has been seemed that inhibition greatly depended on the concentration of the extracts. At higher concentration was a stronger inhibitory effect, due not only to its direct toxic effect but due to increased osmotic potential as well. Radicle length of cucumber was retarded to a greater extent than germination of that. Strongest inhibitory effect was observed in case of *A. syriaca* root water extract, which at the highest concentration reduced radicle length of cucumber by nearly 100% (Table 1). In our previous experiments similar strong inhibitory effect on the germination of sunflower
and *Amaranthus retroflexus* L. was observed with *A. syriaca* shoot and root water extracts, respectively. On the contrary soil incorporated root residues of milkweed stimulated the growth of all test species (Kazinczi et al., 1999, Béres et al., 2001). Our results confirmed to those of Béres et al. (2001), that water extracts of *C. arvense* did not influence the germination of cucumber, however alcoholic ones significantly reduced germination of test plants.

Table 1. The effect of water extracts on the radicle length and germination of cucumber

<table>
<thead>
<tr>
<th></th>
<th>radicle length (mm)</th>
<th>germ %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>S*</td>
<td>SD&lt;sub&gt;5%&lt;/sub&gt;=12</td>
</tr>
<tr>
<td><em>C. arvense</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>shoot</td>
<td>S*</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>2x</td>
<td>39</td>
</tr>
<tr>
<td></td>
<td>5x</td>
<td>62</td>
</tr>
<tr>
<td></td>
<td>10x</td>
<td>59</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>C. arvense</em></td>
<td></td>
<td>SD&lt;sub&gt;5%&lt;/sub&gt;=16.8</td>
</tr>
<tr>
<td>root</td>
<td>S*</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td>2x</td>
<td>67</td>
</tr>
<tr>
<td></td>
<td>5x</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>10x</td>
<td>78</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>A. syriaca</em></td>
<td></td>
<td>SD&lt;sub&gt;5%&lt;/sub&gt;=7.6</td>
</tr>
<tr>
<td>leaf</td>
<td>S*</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>2x</td>
<td>55</td>
</tr>
<tr>
<td></td>
<td>5x</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td>10x</td>
<td>67</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>62</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>A. syriaca</em></td>
<td></td>
<td>SD&lt;sub&gt;5%&lt;/sub&gt;=12.3</td>
</tr>
<tr>
<td>stem</td>
<td>S*</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>2x</td>
<td>53</td>
</tr>
<tr>
<td></td>
<td>5x</td>
<td>61</td>
</tr>
<tr>
<td></td>
<td>10x</td>
<td>61</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>62</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>A. syriaca</em></td>
<td></td>
<td>SD&lt;sub&gt;5%&lt;/sub&gt;=5.3</td>
</tr>
<tr>
<td>root</td>
<td>S*</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>2x</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>5x</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>10x</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>41</td>
</tr>
</tbody>
</table>

*S*, stock solution (25g fresh plant part/100 ml distilled water); 2x, two fold dilution; 5x, five fold dilution; 10x, ten fold dilution; C, control
Pot experiments

Fresh shoot water extracts of *C. arvense* used for irrigation significantly promoted the growth of sunflower and wheat, while had no significant effect on corn (Figure 1). Similar, promoting effect was observed with *Abutilon theophrasti* Medic. water extract (Kazinczi et al., 2001, Béres et al., 2001) and leaf leachates of several cereal weeds (Kazinczi et al., 1997).

Figure 1. The effect of water extracts of *C. arvense* shoots on the development of the test plants in pot experiments

Shoot residues of *C. arvensis* incorporated into the soil significantly reduced the fresh weight of all test species (Figure 2). The inhibition followed the order: mustard > barley > bean.

Figure 2. The effect of shoot residues of *C. arvensis* on the development of the test plants in pot experiments
There are a lot of papers about inhibitory effect of plant residues, although opposite effect had been observed in some cases, when phytoxins present in fresh plant parts gradually decompose due to the microbiological degradation in the soil (Kazinczi et al., 1991, Kazinczi et al., 1999, Béres et al., 2002).

Discussion

It has been seemed that allelopathic effect depends on a lot of factors, i.e. donor and recipient species (varieties), their phenological stages, different plant parts, concentration and method of preparing of the extracts, etc. Latest results indicated that environmental factors (i.e. nutrient and water supply) also influence allelopathic potential (Dávid and Radócz 2002). Nevertheless future investigations are necessary in order to identify allelochemicals from crops and weeds, and to search their application in weed management under field conditions. In allelopathic research, elaboration of a uniform investigation method would be very important in order to better comparison of scientific results.

Acknowledgement

The authors wish to express their thanks to the OTKA (T 037931) for its financial support.

References


281


**Summary**

**ALLELOPATHY OF SOME IMPORTANT PERENNIAL WEEDS**

I. Béres, É. Lehoczky and E. I. Nádasy
University of Veszprém, Georgikon Faculty of Agriculture, Institute for Plant Protection, Keszthely

Laboratory (bioassay) and pot experiments were carried to study allelopathic effect of some important perennial weeds, i.e. *Cirsium arvense*, *Convolvulus arvensis* and *Asclepias syriaca*. In germination tests it has been seemed that inhibition greatly depended on the concentration of the extracts. At higher concentration was a stronger inhibitory effect, due not only to its direct toxic effect but due to increased osmotic potential as well. Radicle length of cucumber was retarded to a greater extent than that of germination %. Strongest inhibitory effect was observed in case of *A. syriaca* root water extract, which at the highest concentration reduced radicle length of cucumber by nearly 100%. Fresh shoot water extracts of *C. arvense* used for irrigation significantly promoted the growth of sunflower and wheat, while had no significant effect on corn. Shoot residues of *C. arvensis* incorporated into the soil significantly reduced the fresh weight of all test species. The inhibition followed the order: mustard › barley › bean.
THE OCCURRENCE OF SPECIES AMBROSIA ARTEMISIIFOLIA L. ON THE TERRITORY OF BIHOR COUNTY

N. Hodisan – N. Csép – V. Bara – C. Daroczi

University of Oradea, Faculty of Environmental Protection, Romania

The presence and expansion of *Ambrosia artemisiifolia* L. in the Western Plain of Romania is a real fact, confirmed by the results presented in this short paper. Central European countries such as: Germany, Czechia, Hungary and countries from the Western part of the continent such as: France, Portugal, Spain and so on, have paid a growing attention to the very strong allergic phenomena, caused by this very dangerous plant, that is included in the group of quarantine weeds. Despite this fact, countries from Eastern Europe, like Romania, have ignored this phenomenon by not taking the appropriate measures of stopping the spreading of this weed. After 1991, a crucial year for the Romanian agriculture (because of the new agricultural reform), significantly large ploughlands have remained uncultivated, fact which led to favourable conditions for the development of the weeds. One of the weeds, that have found suitable conditions to get rooted on these surfaces, is *Ambrosia artemisiifolia* L. Nowadays, we can frequently find it on the two sides of the roads and railways, on the plots, with agricultural crops, found in the immediate proximity of these; at present it is signalled both in the steppe area and forest steppe, reaching the oak tree floor. Its occurrence seems also possible in other geographic areas, even if these individuals have grown out of seeds brought from other areas; here, they can’t produce fruits due to the climate, and thus, they have no chance to form populations.

Thus, the weed has been signalled for the first time on the present territory of Romania, in the year 1908 (Hegi), in Banat area (during that period, this area was under the Austro-Hungarian administration); then it has been signalled at Sighet (Topa and Boscanu, 1965), in Moldavia at Huși and Bârlad (Mititelu, 1970) and in Muntenia at Ploiesti (Negrean, 1971), cited by Hodisan, in 2003. In 1968, Sanda et al. have written on the spreading of this species in the agricultural crops or other places.

**Materials and Methods**

During the travels that we have undertaken in order to localize these species, so as to bound the coverage area in the Bihor county, we have been unpleasantly surprised to notice that, due to the carelessness of the people, corroborated with the disinterest of the competent authorities, *Ambrosia artemisiifolia* L. has pervaded the agricultural cultures, such as: maize, sunflower, sugarbeet, tobacco, as well as the park and entertainment touristical areas.

During the travels undertaken on the previously mentioned routes, the main ecological areas of the county have been covered, determining the presence and spreading extent of this species. Some samples have been collected for the future determinations regarding the viability of the pollen and seeds issued from the four areas.

**Results**

In order to support some concrete control measures against the expansion of *Ambrosia artemisiifolia* L., known in Romania under the folk name of “Pusta Flower”, we will present the limits of the coverage areas according to the occurrence and spreading extent, on the map of the Bihor county.

- **Area I**, located in the North-Western part of the Bihor county, along the Ier Valley, is characterized by the existence in this area of some large surfaces which usually surpass more hectares, where *A. artemisiifolia* L. has found the most favourable living conditions; due to the transport of cereals or other raw materials that come from this area, new territories are fed with mature seeds ready to germinate where they find favourable conditions (Valea lui Mihai, Curtuișeni, Tarcea, Otomani, Silindru, Cheșteu, Șimian, Cherechiu, Șăcuieri, Diosig).

- **Area II**, located in the Western part of the Bihor county, is characterized by the presence of numerous populations of *A. artemisiifolia* L., which contain individuals grouped in cut-off trenches large of several up to tens of square metres. The area is of major interest because the species has found here the pedoclimatic conditions favourable to reproduction
Figure 1. Map of Bihor county indicated the infected areas by *A. artemisiiifolia*.
- Area III, which forms a cord on the North-Southern axis of the Bihor county, in the immediate proximity of area I and II, is characterized by the fact that within this area there have been signalled individuals of *A. artemisiifolia* L. that live either isolated or in small groups of several individuals. These individuals don’t succeed in reproducing themselves, because in this area the seeds can’t reach adulthood, but it is an area continuously fed with mature seeds issued from areas I and II with which it is in close proximity. Here, the plant is also considered to be dangerous, because it flourishes and produces pollen in significant quantities (Salacea, Buduslău, Marghita, Abrâmuț, Tăuteu, Chișlaz, Ciuhoi, Sălard, Biharia, Husasău de Tinca, Tinca, Tulca, Ciumeghiu, Avram Iancu, Batăr, Olcea, Șoimi, Cociuba Mare Căpâlna).

- Area IV, which is delimited from the beech floor upwards, is an area where the individuals of *A. artemisiifolia* L. species can be found very rarely; here, even if this species flourishes, the pollen that has been produced, is in insignificant quantities to produce allergies.

**Conclusions**

In conclusion, *A. artemisiifolia* L. species have also pervaded the Romanian territory, where as it has been shown above, they have found the most favourable vegetating conditions, thus becoming a real threat for our fellows’ health. For this reason, it is necessary as the Romanian authorities to officially declare the existence of this plant on the Romanian territory and through the elaboration of legislative documents to impose measures fighting against the *Ambrosia artemisiifolia* L. species.

It has been highlighted the necessity of continuing the research regarding the viability of the pollen and seeds issued from different ecological areas as well as the necessity of establishing the most appropriate control measures as regards the presence and expansion of the species.

**References**


286

**Summary**

**THE OCCURRENCE OF SPECIES AMBROSIA ARTEMISIIFOLIA L. ON THE TERRITORY OF BIHOR COUNTY**

**N. Hodisan, N. Csép, V. Bara and C. Daroczi**

University of Oradea, Faculty of Environmental Protection, Oradea, Romania

The purpose of this research was to investigate the presence and the spreading area of common ragweed *Ambrosia artemisiifolia* L. in Bihor county, Romania. The investigation was made in the field and the samples were analyzed in the laboratory confirmed the presence and the expansion of the spreading area of this dangerous weed in the western part of Romania. The ecological areas with different densities were also presented as regards the presence of the weed, regarding for the establishment of some control measures against this weed species.
The formerly cultivated *Asclepias syriaca* L. has become a weed plant again and was first recognised by forest managers in Hungary almost fifty years ago when fallow lands were to utilise by forests. Its chemical weed control has been introduced only in forest areas.

Common milkweed is native in North America. Its vegetative reproduction is very important. According to one observation, one plant can grow 54 propagation roots and 94 young plants on them during a four-year period. It causes yield loss in maize and in soybean, 5-10% and 12-19%, respectively (Hunyadi 1988). Common milkweed as a weed plant causes substantial damage in crop production.

There is a wide variety of its name in the Hungarian language (krepin, krepinfű, selyemkrepin, selyemfű, selyemvirág, vaddohány, pulykavirág, papagájvirág, mézgyapot). *A. syriaca* belongs to the subclass *Asteridae*, order *Gentianales*, family *Asclepiadaceae*, subfamily *Asclepiadoideae* and genus *Asclepias*. Milky weed can be utilised in many ways. It came to Europe in 1629 and was tried to use as an industrial crop in France and in Germany, in the 18th-19th centuries. It brought high hopes (silk, paper, fibre, caoutchouc, oil, raw material production), which then failed: “its beauty misses its usefulness” (Hollen donner 1915).

Its main area of distribution is Canada, USA, Iraq, Hungary, France, Switzerland, Germany, Poland, Caucasus, the Baltic Sea and its region. Common milkweed is an adventive, serious weed of Hungary. It can be found mainly in the Southern part of Hungary on sandy soils (Ujvárosi, 1973).

The rapid spread of this weed was observed from 1980. During the first National Weed Survey (1947-1953) it did not appear on the list of species. According to the result of the second National Weed Survey it came out as the 218th, while the third (1987-1988) and fourth (1996-1997) National Weed Survey put it on the 113th and 76th places, respectively, in the order of importance of weed cover percentage. According to the National Weed Survey results in 1989 more than 16,000 ha of arable lands were infected and it also appeared in forests and orchards. The most severely infected
counties are: Bács-Kiskun, Tolna, Jász-Nagykun Szolnok, Somogy and Pest (Varga, 1998).

It causes substantial damages; the weed kills the cultivated plants on the weed-grown fields resulting in considerable yield loss. It grows on river flats too, and kills native plants. Allelopathy may play an important role in its distribution (Kazinczi et al., 1999, Béres and Kazinczi, 2000, Béres et al., 2001).

Its sudden distribution in the past few years can be explained by dry weather conditions in the past ten years, the increase in frost-free days, the lack of stubble ploughing, soil disturbing, minimum tillage, the killing of competitor plants and infrequent selective weed control (Kőrösmezei, 2000).

Its special plant physiological features contribute to the difficulties in its weed control. It can safely described as dangerous. Its vegetative and generative reproduction is successful. It is a highly competitive plant with both cultivated and weed plants. It tolerates herbicides, regenerates rapidly. Its distribution in arable lands, rural or uncultivated areas, pastures, acacia-forests and in fallow grounds keeps increasing.

Contrary to the fact that milky weed is attacked by pests and pathogens, the decrease in its plant population density cannot be expected. Only the regular, planned and integrated weed control of the perennial weeds, including *Asclepias syriaca*, can be successful.

It is crucial for the effective and economical perennial weed control to apply precision and site-specific weed control on weed patches, especially spraying precision herbicides (Reisinger, 1997, 2000; Reisinger et al., 2002b).

The GPS method can make it possible to determine the exact location of these perennial patches and it may play an important role in perennial control in the future (Reisinger et al., 2002a, 2002c). According to American experiences the elimination of *Asclepias* colonies, cutting its root system and chemical weed control together proved to be effective.

Perennials uptake considerable amounts of nutrients from the soil (Lehoczky, 1988, 1994, 2000; Lukács et al., 1998; Radics, 2002).

In our experiment we followed the nutrient uptake and its changing in *Asclepias syriaca* L.

**Materials and Methods**

*A. syriaca* plants were collected from the fields round of village Vése in Hungary from May to November in 2002. The main characteristics of this soil are below (Table 1).
Table 1. Characteristics of the experimental soil

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Humus:</td>
<td>2.33%</td>
</tr>
<tr>
<td>AL-P$_2$O$_5$</td>
<td>320 mg/kg</td>
</tr>
<tr>
<td>AL-K$_2$O</td>
<td>364 mg/kg</td>
</tr>
<tr>
<td>PH$_{\text{(H}_2\text{O})}$</td>
<td>6.35</td>
</tr>
</tbody>
</table>

Plant samples were collected from the fields (shoots, and roots from the upper 50 cm soil layer) from May to November. We examined nutrition element concentration (N, P, K, Ca % in dry matter) of the samples. We measured the fresh weight of plants and after 40 C° drying the dry mass weight too. Nitrogen concentration was determined by Kjeldahl method, phosphorus concentration by spectrophotometer, potassium and calcium concentration by flame photometer.

**Results and Discussion**

Nitrogen concentration of shoots altered between 0.9-3.1%. Nitrogen concentration of the shoots showed a continuously decreasing trend during the examination period (Figure 1). The nitrogen concentration of the reproductive roots ranged between 0.5-1.1%. The smallest N content was found in July and August, which can be explained by the intensive growth of propagation roots (Figure 2).

Figure 1. Nutrient concentrations in shoots of *Asclepias syriaca* L.
Changes of nutrients concentration of shoots and roots would connect with physiological processes of the plants (Lehoczky, 2000). Phosphorus concentration of the plants varied within the smallest range between 0.15-0.4%. Phosphorus concentration of the shoots 0.18-0.40 was higher than that of the roots 0.15-0.3% until October. Phosphorus content in the shoots reached its highest quantity just before flowering in May, and also during the intensive flowering stage in June and July (Figure 1).

Among the elements included in the study Potassium content was found to be the highest both in shoots and in propagation roots (Figure 1, Figure 2). Potassium content in shoots 2.9-4.2% was much higher than in propagation roots 1.3-2.1%. The initial decline in Potassium content (May, June) can be explained by the intensive shoot growth and by its dilution in the biomass synthesised in a large amount. Following the intensive Potassium uptake the Potassium content in the shoots increased remarkably, which can be explained by the intensive flowering and metabolic processes.

The Potassium content in the roots was initially increasing and its quantity measured in May remained on a steady peak level. This finding can be explained by the reserve nutrient accumulation in roots and by the intensive carbohydrate metabolic processes.

Figure 2. Nutrient concentrations in roots of *Asclepias syriaca* L.

<table>
<thead>
<tr>
<th>date</th>
<th>N%</th>
<th>P%</th>
<th>K%</th>
<th>Ca%</th>
</tr>
</thead>
<tbody>
<tr>
<td>23.05.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12.06.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>09.07</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>26.08.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>04.10.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>07.11.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Calcium concentration was found to be higher 1.2-1.6% at each of the growth stages measured than that in the propagation roots 0.6-0.9%. By the end of the growing season the Calcium concentration in shoots was increased with the simultaneous decline of Calcium concentration in the roots.

**Conclusions**

*Asclepias syriaca* can be described as a perennial weed plant with high nutrient demand. Its nutrient (N, P, K) uptake remains intensive throughout the whole growing season. According to our examination *Asclepias syriaca* L. can uptake potassium in a great quantity. This nutrient can be found in high concentration both in its shoots and propagation roots, between 1,3-4,2%.

During the initial vegetative growing period it takes up nitrogen in large quantities thus resulting in high nitrogen concentration in the shoots (3.1%). The difference between potassium content in shoots and in propagation roots is smaller than regarding the other elements.

Calcium concentration in shoots remains steady and shows an increasing trend towards the end of the growing season.

We established that intensive nutrient uptake has an important roll in considerable competitive capacity of *Asclepias syriaca* especially in competition for nutrients.

**Acknowledgement**

This study was financially supported by the Hungarian National Scientific Research Fund (OTKA) under grant No. T 037931.

**References**


The cereals play a definite role in Hungarian crop production, especially the production of wheat and corn. The national corn production went through a significant transformation during the past decades. The inbred hybrids that have been introduced very fast at the beginning of the 1960’s ensured an adequate genetic basis for the wide use of industry-originated inputs. From the ‘60’s the use of fertilizers dynamically improved, the chemical herbicides spread widely, modern machines, appliances were used. In the production-technology of corn the role of agrotechnological factors have been defined by Győrffy (1976) in the following: fertilizing 27%, hybrid 26%, cultivation 24%, plant density 20%, tillage 3%.

In the 1980’s the national corn production’s world standard was well characterized by the about 6,0 t ha\(^{-1}\) national yield and the fact that in that decade the fluctuation of national yield was really moderate (10-20%). From the beginning of the 1990’s –because of the widely known financial and economical difficulties– the yield of corn –depending on the year– decreased by 0.5-2.0 t ha\(^{-1}\), but because of the use of low level industrial inputs the fluctuation significantly increased (30-50% in the case of the national yield).

One of the important element of corn production is the use of herbicides. The modern weed control should be based on the integrated principles (Berzsenyi, 2000, Széll et al., 1985, Chui et al., 1997). Lately, in the national corn production the significance of early and normal post treatment considerably improved, where the appearance and composition of weed is known. The effect and efficiency of postemergens treatments depends on environment factors (Tapia et al., 1997, Fayolle, 1996) and the sensitivity of hybrids (Bónis et al., 2000, Hart and Wax 1999). During the last years the number of corn and silage maize recognized by the state is largely improved, which is near to 400 together. These different genotypes significantly differ in their agrotechnological response, thus show a different hybrid reaction. It is also important to emphasize that all herbicides treatments mean a lower-higher stress effect on the growth-improvement of corn, which appears in the agronomical, fenometrical characteristics and also in the yield.
Materials and Methods

The small, plot experiments have been performed at the Experimental Station at Látókép of the University of Debrecen, Centre of Agriculture, Faculty of Agriculture, Department of Crop Production and Applied Ecology on calcareous chernozem soil. The soil of the experiment was nearly neutral (pH$_{KCl}$ 6.46), with average phosphorus and potassium content – according to soil examination - (Al soluble P$_2$O$_5$ 133 mg/kg, Al soluble, K$_2$O 240 mg/kg). The soil of the experiment has favourable water husbandry and water holding characteristics, is in good condition, and perfectly suitable for corn production. The force crop was winter wheat. The agrotechnical elements met the requirements of modern crop production.

In the experiment the following hybrids have been examined:
- A De 377 SC
- B Katinka
- C Veronika
- D Borbála
- E Gazda
- F Maraton
- G Norma

The sowing of the experiment performed 22, April 2002 with 68,000 seeds/hectare.

In the experiment the following herbicide-treatment have been adjusted:
1. Weedy control
2. Hoed control
3. Escort 4,0 l/ha (early post)
4. Merlin SC 0,22 L/ha + Dezormon 1,0 l/ha (early post)
5. Escort 4,0 l/ha (normal post)
6. Merlin SC 0,22 L/ha + Dezormon 1,0 l/ha (normal post)
7. Motivel 1,0 l/ha + Cambio 3,0 l/ha (normal post)
8. Titus 25 DF 40 g/ha + Callisto 0,25 l/ha + Trend 0,1% (normal post)
9. Motivel 1,0 l/ha + Cambio 3,0 l/ha (late post)
10. Titus 25 DF 40 g/ha + Callisto 0,25 l/ha + Trend 0,1% (late post)

The experimental treatments have been performed at the following time and state of development:
Hoeing (hand) 24, May 2002
02, June 2002

Early postemergens 07, May 2002
2-3 leaves of development

Normal postemergens 14, May 2002
5 leaves of development

Late postemergens 20, May 2002
7-8 leaves of development

The harvest of the experiment has been performed at 9, October 2002 with a Sampo combine.
In the range of the research project examinations of crop-dynamical, agronomical, plant-health, weed-dynamical, fitotoxical, crop producing factors have been accomplished, the yields and the water-content of seeds at harvesting have been measured.

Results and Discussion

The results of the experiments in 2002 prove that during the vegetation period the weed-coverage indicators – depending on the herbicide-treatments – increased form step by step. At the end of the vegetation period (1st treatment) the weed-coverage indicators of the weedy control were between 7,6% and 8,6%, while in the hoed control they were 4,3-5,1%. As a result of the herbicide-treatments the weed-coverage significantly decreased (measurements at 14, May; 20, May; 02, June).

The herbicide-treatments were characterized with adequate efficiency in this year’s experiments, which have been proved by the weed-examinations before harvesting (time of measurement: 29, September):

3. treatment 4,9-6,0% weed-coverage
4. treatment 1,4-1,9% weed-coverage
6. treatment 1,4-1,7% weed-coverage
7. treatment 1,1-1,4% weed-coverage
8. treatment 1,0-1,4% weed-coverage
9. treatment 2,2-2,4% weed-coverage
10. treatment 2,1-2,4% weed-coverage

Adequate yields have been achieved as a result of favourable weather in 2002. The yields (without the extreme herbicide-treatment) were between 8-13 t ha$^{-1}$ –according to the genotype, the time of herbicide-treatment and herbicide agent. In the vegetation period in 2002 the most favourable yields
(Table 1) were given by Maraton, Veronika and Norma hybrids (yields of 10-13 t ha⁻¹).

Table 1. Effects of herbicides on the yield of maize (average of hybrids, Debrecen, 2002)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Yield kg/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Weed control</td>
<td>9 875</td>
</tr>
<tr>
<td>2. Hoed control</td>
<td>10 739</td>
</tr>
<tr>
<td>3. Escort (early)</td>
<td>7 225</td>
</tr>
<tr>
<td>4. Merlin+Dezormon (early)</td>
<td>9 331</td>
</tr>
<tr>
<td>5. Escort (normal)</td>
<td>-</td>
</tr>
<tr>
<td>6. Merlin+Dezormon (normal)</td>
<td>10 266</td>
</tr>
<tr>
<td>7. Motivel+Cambio (normal)</td>
<td>10 016</td>
</tr>
<tr>
<td>8. Titus+Callisto+Trend (normal)</td>
<td>10 374</td>
</tr>
<tr>
<td>9. Motivel+Cambio (late)</td>
<td>9 552</td>
</tr>
<tr>
<td>10. Titus+Callisto+Trend (late)</td>
<td>9 043</td>
</tr>
</tbody>
</table>

In the average of hybrids, we achieved similar yields to the hoed control (10.739 kg/ha) in the 6. treatment (Merlin+Dezormon normal post, 10.26 kg/ha), 7. and 8. treatments (Titus+Cambio+Trend normal post, 10.374 kg/ha) (Table 2.).

Table 2. Effects of herbicides on the yields of maize genotypes (Debrecen, 2002)

<table>
<thead>
<tr>
<th>Hybrid</th>
<th>Weed control kg/ha</th>
<th>Hoed Control kg/ha</th>
<th>The best herbicide kg/ha</th>
<th>Yield difference (kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>De 377 Sc</td>
<td>8 807</td>
<td>10 258</td>
<td>10 433</td>
<td>1 451</td>
</tr>
<tr>
<td>Katinka</td>
<td>8 990</td>
<td>10 247</td>
<td>9 764</td>
<td>1 257</td>
</tr>
<tr>
<td>Veronika</td>
<td>10 455</td>
<td>11 094</td>
<td>10 893</td>
<td>639</td>
</tr>
<tr>
<td>Borbála</td>
<td>9 449</td>
<td>9 860</td>
<td>9 429</td>
<td>411</td>
</tr>
<tr>
<td>Gazda</td>
<td>9 447</td>
<td>10 514</td>
<td>10 263</td>
<td>1 067</td>
</tr>
<tr>
<td>Maraton</td>
<td>12 531</td>
<td>13 022</td>
<td>12 693</td>
<td>491</td>
</tr>
<tr>
<td>Norma</td>
<td>9 445</td>
<td>10 178</td>
<td>10 136</td>
<td>733</td>
</tr>
</tbody>
</table>

The use of herbicides meant a lower-higher stress factor to the corn crops in all treatments, and it depends mostly on the time of use and the herbicide agent (Table 3).
Table 3. General and specific herbicide effects on the yield of difference maize genotypes (Debrecen, 2002)

<table>
<thead>
<tr>
<th>Hybrid</th>
<th>Average of herbicides kg/ha</th>
<th>The best herbicide treatment kg/ha</th>
<th>Worst herbicide treatment kg/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>De 377 Sc</td>
<td>9.471</td>
<td>10.433</td>
<td>8.453</td>
</tr>
<tr>
<td>Katinka</td>
<td>8.867</td>
<td>9.764</td>
<td>6.509</td>
</tr>
<tr>
<td>Veronika</td>
<td>10.111</td>
<td>10.893</td>
<td>9.247</td>
</tr>
<tr>
<td>Borbála</td>
<td>7.632</td>
<td>9.429</td>
<td>2.838</td>
</tr>
<tr>
<td>Gazda</td>
<td>7.812</td>
<td>10.263</td>
<td>7.213</td>
</tr>
<tr>
<td>Maraton</td>
<td>11.334</td>
<td>12.693</td>
<td>10.152</td>
</tr>
<tr>
<td>Norma</td>
<td>8.973</td>
<td>10.136</td>
<td>3.997</td>
</tr>
</tbody>
</table>

References


Summary

HYBRID-SPECIFIC WEED CONTROL IN MAIZE PRODUCTION

Pepó, P., Zsombik, L., Szabó, A., and Ágoston, T.
University of Debrecen, Centre of Agriculture, Faculty of Agriculture, Department of Crop Production and Applied Ecology

The rate of weed – coverage is affected by the herbicide, the time of use, the state of weeds and the competence of corn – hybrids. The postemergens herbicides have a stress effect on the corn features and productivity. The effect of stress depends on:
- time of use
- active substance of herbicide
- genotype

Besides the „general” herbicide – tolerance of the hybrids we must take into consideration the „specific” tolerance.
Perennial weeds cause a special part of weed problems. The species with dominating vegetative reproduction like *Cirsium arvense* (Béres et al. 2000, Lehoczky et al. 2003) can be detected on the plots through several years. Therefore surveying them bears a prognostic value and the data received can be used for more years. Perennial weeds often spread in patches and precision weed control has special importance in protection against them. Precise surveys provide further possibilities in the field of weed-biology research as perennial weeds can attract attention not only because of occupation of a place and their features but because of their nutrition needs and uptake (Lehoczky 1994, 2000).

The Balázs-Ujvárosi method is used for nation-wide surveys and analysis at company level in Hungary in the last decades. The method is based on estimating the weed cover (Reisinger 2000, 2001). The method is applied with 6 hectare sampling density therefore it provides only monitoring-type data on the weed flora in the relevant territory. As a result of our investigations a method based on sample taking cannot produce significant data to determine the distribution of weed species within a plot exactly, even if it uses a relatively high sampling density with 2-5 sample areas ha\(^{-1}\) (Reisinger et al. 2003).

The GPS technology (Stafford et al. 1996) contributes to the exact survey of perennial weed patches. With the help of a GPS receiver the contours, the position and location of the patches can be traced and recorded. Weed patches are able to infest from some percentage of a field to 80% (Brown et al. 1990, Thompson et al. 1991, Johnson et al. 1995, Rew et al. 1996). Perennial weed species can easily be surveyed on cereal stubble, in root plants in the period after field emergence. In that respect methods using remote sensing (Campbell 1996) can give an indication for planning the survey or they can even replace it (Christensen et al. 1994, Johannsen et al. 1998, Lamb et al. 2000).

Mapping the distribution of perennial weeds within a plot can help to make site-specific application plans, which can result in a reduction of herbicide use by 80%.

300
Materials and Methods

We carried out our investigations on a 7.4 ha large part of a maize field on 4th June 2003 in Mosonmagyaróvár. Maize plants were 30-40 cm high and the crop was in a stage before closing the rows. Pre-emergent treatment of the field (acetochlor 1600 g ha\(^{-1}\) + AD-67 160 g ha\(^{-1}\) and atrazine 900 g ha\(^{-1}\)) provided good results, *Cirsium arvense* (L.) Scop. and *Lepidium draba* L. were to be detected at high density only on smaller patches, which were located at the edges of the plots.

Weed patches were located with a Trimble Pathfinder Power GPS receiver by 5-7 satellite sensing at the same time on average with the application of Omnistar signal-correction of submeter accuracy. Field walking happened alongside a 20-30 m wide strip of land by walking around the patches on the way. Weed patches were recorded as polygons by registering their position at every 10 seconds. Patches smaller than 1m\(^2\) were not taken into account. We could find *Cirsium* patches easily as the infestation concentrated on patches with higher N-supply because of the uneven N-supply.

The data-file set up during the field-work was converted into an ESRI shapefile and was processed and maps were made using ArcView GIS 3.2 software. Our field walking revealed that the same weed species were surveyed repeatedly or overlapped by other patches in 14 cases so we united these patches on the map.

Overlapping of the contours of the plot was eliminated in order to circle the area with one line. The contours of the weed patches were corrected if necessary (overlapping, multi-polygons, not completely closed forms).

Results

With the help of the ArcView software and after the needed corrections of the data maps were produced, where the distribution of *Cirsium arvense* and *Lepidium draba* were described. 116 patches of *Cirsium arvense* and 4 patches of *Lepidium draba* were surveyed altogether in the field. After eliminating the repeated surveys and overlapping 106 patches of *Cirsium arvense* and 3 patches of *Lepidium draba* remained on the plot (Figures 1-3). Altogether 109 patches were surveyed on an area of 7.4 hectares.
Figure 1. *Lepidium draba* patches in the field

Figure 2. Distribution of *Cirsium arvense* in the field
Figure 3. Distribution of *Cirsium arvense* and *Lepidium draba* in the field

![Figure 3. Distribution of *Cirsium arvense* and *Lepidium draba* in the field](image)

Table 1. Distribution of weed patches as per size, total and average area and the rate of area compared to the total area of the field

<table>
<thead>
<tr>
<th>Area (m²)</th>
<th><em>Cirsium arvense</em> patch /pc</th>
<th><em>Lepidium draba</em> Patch /pc</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 20</td>
<td>27</td>
<td>1</td>
</tr>
<tr>
<td>20-50</td>
<td>37</td>
<td>2</td>
</tr>
<tr>
<td>50-100</td>
<td>22</td>
<td>-</td>
</tr>
<tr>
<td>100-200</td>
<td>9</td>
<td>-</td>
</tr>
<tr>
<td>200-300</td>
<td>10</td>
<td>-</td>
</tr>
<tr>
<td>300 &lt;</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>Totally:</td>
<td>106</td>
<td>3</td>
</tr>
<tr>
<td>Total area</td>
<td>7,067.59</td>
<td>89,79</td>
</tr>
<tr>
<td>Average</td>
<td>66.68</td>
<td>29.93</td>
</tr>
<tr>
<td>Area of the field</td>
<td>73,774</td>
<td>73,774</td>
</tr>
<tr>
<td>Rate of area(%)</td>
<td>9.58</td>
<td>0.12</td>
</tr>
</tbody>
</table>

The total area of *Cirsium arvense* covered 7,068 m² and *Lepidium draba* patches covered 90 m² altogether.
Since the total area of the field covers 73 774 m² they equal 9.6 respectively 12% of the total area. Therefore we can say that in spite of the great numbers of weed patches their total occurrence does not approach 10% of the field area.

Analysing the data in Table 1 we can conclude that the average *Cirsium* patch size is 66.68 m², and *Lepidium* patches cover 29.93 m². Figures clearly show that the extension of weed patches is not strip-like, so the average diameter of a weed patch does not exceed 10 meters. As a result we recommend to section the spraying frame in order to carry out a precise application with maximum possible reduction of herbicide use on the test plot.

Investigating the distribution of the size of weed patches we can see that most of *Cirsium* patches are smaller than 100 m² and only one patch is larger than 300 m² (330 m²). Most patches belong to the category of 20-50 m². *Lepidium* patches are smaller than 50 m².

**Discussion**

Patches of weed species on a plot can be detected with the help of a GPS receiver very accurately and efficiently. The spread of these weed species cannot accurately be mapped with the use of methods that are based on marking the sample area randomly or systematically.

The performance of the survey depends on the number and size of weed patches, since patches fewer in number and larger at size can be registered more efficiently. According to our experience 2-5 ha hour⁻¹ can be surveyed by walking around the weed patches.

The efficiency of the method is greatly influenced by the smallest patch size that is still to be surveyed. Small size patches (much smaller than 1m²) cannot always be surveyed economically and stressing the zero tolerance contradicts the principle of weed control.

The smallest weed patch that is to be surveyed usually depends on the average patch size, the accuracy of the GPS receiver and the technical parameters of the automatic spraying equipment used in the application.

Larger areas can be surveyed more efficiently if we use a jeep or eventually a motorbike (quad).

If the soil is wet and the crop is low weed patches can be detected more easily and of course our own tracks, too. This fact can reduce overlapping and repeated surveys. Also, if we mark the surveyed patches it will help to avoid repeated detection.

If an air-photo of the area infested with perennial weeds is available it can be used to plan the work. If there is a chance to make an ortho-image from this air-photo a field walking can be avoided.
Walking around the weed patches is relatively subjective especially if the population density is low. It is obvious that dense weed populations should be surveyed.

The method is of special importance in root crop growing when there are only perennial weeds in the area after an efficient basic treatment. We can save even 70-80% of the herbicide quantity if we carry out a site-specific treatment based on the data of the survey. Walking around the weed patches registered by GPS perennial every weed species can be registered accurately, but this method can also be used for detecting annual weed species occurring in patches owing to certain causes (low lying field parts, altering soil patches etc.).

With the help of the weed patch maps supplemented by the necessary puffer areas and adequate software we can prepare plan of herbicide application for the automatic sprayers guided by GPS. The rate of the area was infested by perennial weed species do not reach 10% of the total area involved into our investigations.

If we survey the perennial weed patches for several years it will provide us information about the changes in population dynamic.

If we survey perennial weed species once it can be provide information for several years due to the reproduction practice.

References


Protection against perennial weed species is a special field of weed control. Postemergent technologies can be applied against these species effectively, either alone or after pre-emergent treatments. Perennial weed species often spread on farm lands in patches. Site-specific treatment of the patches help to save a considerable amount of herbicides. The aim of our trial is to survey the distribution of the patches of *Cirsium arvense* (L.) Scop. and *Lepidium draba* L. in maize by DGPS as well as to analyse the rate of the patch size compared to the territory and followed by making maps for planning precision treatments.
CROP-WEED COMPETITION: CANNABIS SATIVA L. IN WINTER WHEAT

Éva Lehoczky¹ – Péter Reisinger² – Sándor Nagy² – Tamás Kömives³

¹Georgikon Faculty of Agricultural Sciences Keszthely, Veszprém University, Keszthely, Hungary
²Faculty of Food and Agricultural Sciences, University of West-Hungary, Mosonmagyaróvár, Hungary
³Plant Protection Institute of the Hungarian Academy of Sciences, Budapest, Hungary

Industrial hemp (Cannabis sativa L.) has been grown for its long and high-quality fibers for many centuries. However, its importance has been decreased during the last decade by the introduction of synthetic fibers, the mechanization of cotton production, and drug prohibition laws [1,2]. Industrial hemp is still grown in Hungary, but, since its acreage has been reduced to less than 5000 ha, it is not listed any more among the important crop plants of the country [3]. However, recently a wild variety (Cannabis sativa ssp. spontanea) of industrial hemp has appeared as a fast-growing, tall weed in almost all of the agricultural lands in Hungary. The plant forms sizeable patches in cereals, especially in areas where the density of the crop plant is reduced by poor germination, plant disease or low crop vigor [3]. Wild hemp became a problematic weed, because a) it reduces the crop yield via competition for light, water, and nutrients, b) it also contains a number of biologically active (antimicrobial, allelopathic, and narcotic) substances [4], and c) it is a host of the parasitic plants Orobanche and Cuscuta spp. [5].

The introduction of information technology resulted in major advances in site- and time-specific crop management. Thus, mapping of fields for differences in nutrient concentrations, pH, and physical properties has allowed the application of fertilizers in different doses at selected parts of the field, resulting in ecological and financial benefits [6]. However, in case of weed control, uncertain knowledge on weed seed distribution, viability, and short and long term responses to control measures make site- and time-specific technologies less than obvious. Therefore, on-farm research is necessary to assess all the uncertainties related to weed management [6,7]. The objectives of this research were to develop a site-specific wild hemp management method in winter wheat based on the competitiveness of this weed plant.

This study was initiated to determine the competitiveness of wild hemp against winter wheat and other weeds in order to develop a wild hemp
managment method. Therefore, we measured the dominance properties and
the biomass production of wild hemp in a winter wheat field and compared
them with those of the crop plant. The literature regarding fertilization
requirements for industrial hemp consistently indicates a need for NPK
application (generally at a rate consistent with wheat production), because
hemp removes large quantities of minerals from the soil [1,8]. Therefore,
nutrient uptake by wild hemp and winter wheat were also determined and
compared.

Materials and Methods

The experiments were carried out on April 3, 2002 in a 36-hectare wheat
field at Baracska (Fejer county, Hungary; soil properties are listed in Table
1). Wheat (cv Gyozo, Martonvasar Seeds, Martonvasar, Hungary) was sown
on October 16, 2001, following the application of NPK (nitrogen,
phosphorus, and potassium) fertilizer (39, 78, and 78 kg ha\(^{-1}\), respectively).
On March 16, 2002, a further 50 kg ha\(^{-1}\) nitrogen fertilizer was applied.
Crop was harvested on July 10, 2002 (average yield was 4.46 t ha\(^{-1}\)).

Table 1. Soil properties (means [variances]) of the project area (Baracska,
Fejer county, Hungary)

<table>
<thead>
<tr>
<th>Type</th>
<th>Texture</th>
<th>Organic matter, %</th>
<th>pH</th>
<th>CaCO(_3), %</th>
<th>P(_2)O(_5), mg kg(^{-1})</th>
<th>K(_2)O, mg kg(^{-1})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcaric phaeosem</td>
<td>Mollisol</td>
<td>Loam 3.2 [0.83]</td>
<td>7.5 [1.8]</td>
<td>5.7 [1.2]</td>
<td>283 [54]</td>
<td>314 [39]</td>
</tr>
</tbody>
</table>

For evaluating weed populations the 36-hectare project area was divided to
18 x 250 m blocks (altogether 80, 0.45 ha each) and within the blocks 2 x 2
m sampling areas were assigned and identified by GPS coordinates. Weed
populations were assayed by using the Balázs-Ujvárosi coenological method
[5], and samples of crop (wheat) and weed plants were taken and analyzed
for phosphorus, potassium, nitrogen and calcium concentrations by using
spectrophotometric and flame photometric methods [9,10]. From the
recorded plant population densities dominance values of the weed species
were determined and weed maps were constructed by using Imagine 8.5
Professional software (Erdas, Atlanta, GA, USA).
Results and Discussion

Although wild hemp has been considered a late summer weed in Hungary [5], our studies indicate that it can massively germinate early in the spring even in established and well growing wheat. At the time of weed survey (April 3, 2001) high numbers of 2-4 leaf stage wild hemp plants were observed (Figure 1) and wild hemp had the highest coverage among the 15 weed species identified in the field (Table 2). Wild hemp plant numbers reached 302 plants m\(^{-2}\) (Figure 1) (average 143 plants m\(^{-2}\)), and coverage values as high as 25.8 % (average 11.6 %) were recorded. Still, in spite of its large plant density at the time of our weed survey the net biomass (on dry weight basis) of wild hemp was only 1.1 % of the crop plant (Table 3).

Figure 1. Wild hemp (Cannabis sativa spp. spontanea) weed map of the project area (April 4, 2002; Baracska, Fejer county, Hungary) with 5% weed cover interval contour lines. Lowest and highest weed densities: A-weed cover 0%; B-weed cover >25% to 30%
Table 2. Coverage of weeds in the project area (Baracska, Fejér County, Hungary)

<table>
<thead>
<tr>
<th>Rank</th>
<th>Weed species</th>
<th>Coverage, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Cannabis sativa ssp. spontanea</td>
<td>11.61</td>
</tr>
<tr>
<td>2.</td>
<td>Sisymbrium sophia</td>
<td>0.28</td>
</tr>
<tr>
<td>3.</td>
<td>Papaver rhoes</td>
<td>0.25</td>
</tr>
<tr>
<td>4.</td>
<td>Bilderdykia convolvulus</td>
<td>0.20</td>
</tr>
<tr>
<td>5.</td>
<td>Cirsium arvense</td>
<td>0.14</td>
</tr>
<tr>
<td>6.</td>
<td>Chenopodium album</td>
<td>0.04</td>
</tr>
<tr>
<td>7.</td>
<td>Chenopodium hybridum</td>
<td>0.02</td>
</tr>
<tr>
<td>8-15.</td>
<td>Others</td>
<td>0.04</td>
</tr>
<tr>
<td></td>
<td>Total weeds</td>
<td>12.57</td>
</tr>
</tbody>
</table>

A comparison of the nutrient content of the aerial plant parts showed that winter wheat contained significantly higher concentration of nitrogen than wild hemp (Table 3).

Table 3. Nutrient element content (expressed in percentage of dry weight) and biomass (fresh and dry weight) of winter wheat (Triticum aestivum L.) and wild hemp (C. sativa ssp. spontanea), (Baracska, Fejér County, Hungary)

<table>
<thead>
<tr>
<th>Nutrients in plants (dry weight%) and plant biomass (g m⁻²)</th>
<th>Winter wheat</th>
<th>Wild hemp</th>
<th>LSD₅%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen</td>
<td>3.66 ± 0.48</td>
<td>2.52 ± 0.26</td>
<td>0.29</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>0.37 ± 0.04</td>
<td>0.48 ± 0.05</td>
<td>0.04</td>
</tr>
<tr>
<td>Potassium</td>
<td>3.01 ± 0.32</td>
<td>2.86 ± 0.37</td>
<td>0.26</td>
</tr>
<tr>
<td>Calcium</td>
<td>0.54 ± 0.04</td>
<td>2.17 ± 0.45</td>
<td>0.24</td>
</tr>
<tr>
<td>Biomass</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fresh weight</td>
<td>1607 ± 374</td>
<td>24.0 ± 13.9</td>
<td>201</td>
</tr>
<tr>
<td>Dry weight</td>
<td>532 ± 105</td>
<td>5.95 ± 0.40</td>
<td>56</td>
</tr>
</tbody>
</table>

However, other data in Table 3 clearly indicate that wild hemp competes with winter wheat for water and for all of the mineral nutrients studied (especially for phosphorus and calcium). The high competitiveness of wild hemp for nutrients compares well with the high nutrient needs of industrial
hemp varieties [1,2,8]. Our data also show that early in the vegetation period nutrient uptake by wild hemp plants growing in winter wheat crop is relatively small. However, with the rise of the daily average temperatures wild hemp grows more rapidly and soon reaches the height of the wheat plants (data not shown). Therefore, to keep a low competitiveness of the weed, a postemergent herbicide treatment to suppress wild hemp is necessary. Thus, after localization the patches of wild hemp and other weeds in the field, weed contour maps were created, divided into manageable blocks, and a site-specific weed control technology was designed.

Acknowledgements

Financial support of this work was provided by the Hungarian OTKA Research Fund (T029121 and T43476) and by the National Research and Development Fund of the Ministry of Education of Hungary.

References

Wild hemp (*Cannabis sativa ssp. spontanea*) is a rapidly spreading weed in Hungary that forms large and stable patches in most agricultural fields. To evaluate the competitiveness and the nutrient uptake of wild hemp experiments were carried out in a 36-hectare agricultural field, using 80 evenly distributed sampling areas that were identified by GPS coordinates. Field maps of wild hemp infestations were formulated to determine the density and dominance of this weed, and plants were analyzed for macroelement (nitrogen, phosphorus, potassium, and calcium) contents.

Wild hemp showed significant competitiveness against winter wheat, greatly reducing the availability of nutrients to the crop plant. After localizing patches of wild hemp and other weeds in the field by GPS coordinates a weed contour map was created. These maps were divided into manageable blocks and a site-specific weed control technology was designed in order reduce herbicide use, thereby decreasing the costs and environmental impact of wild hemp control.
SPREAD OF ALLELOPATHIC WEEDS IN CULTIVATED AREAS IN HUNGARY, THE ROLE OF ALLELOPATHY IN SPREADING

Ádám Tóth¹ — László Szentey² — Mária Torma³

¹Central Service for Plant Protection and Soil Conservation, Budapest, Hungary
²Ministry of Agriculture and Regional Development, Department for Plant Protection and Agro-environment, Budapest, Hungary
³Szeged University, College of Agriculture, Hódmezővásárhely, Hungary

Professionals have been monitoring weed infestation, spreading and abundance of the particular weed plants in Hungarian cultivated areas since 1950. Four national surveys have been conducted to the present (1950, 1970, 1988 and 1997). In addition to their botanical importance, such surveys have been of great interest for plant protection, because one of the most important elements of successful weed control is to know: which species are present at a particular place and how high their abundance maybe. Moreover, weed management programmes cannot be developed without being aware of the trends of weed spreading.

As a result of the surveys we could monitor changes of weed populations on cultivated areas (Table 1).

Table 2 shows the weed species whose increased spreading and infestation area have been conspicuous in the past 50 years.

We wanted to find the ecological and economic reasons for increased or decreased importance of certain weeds. During the in-depth studies, in the cases of the species with especially high increase, we found several relationships, such as changes of crop management programmes, building-up of resistance, slow warming and the use of new herbicides on extended areas. Studying these causes for Ambrosia artemisifolia, Cirsium arvense, Abutilon theophrasti, Asclepias syriaca, dividing them to factors under the influence of men and to ones independent of human activity, we found the following share given in Annexes 1-4.
Table 1. Monitoring of weed population changes in field areas

<table>
<thead>
<tr>
<th>Species</th>
<th>Rank</th>
<th>Cover %</th>
<th>Rank</th>
<th>Cover %</th>
<th>Rank</th>
<th>Cover %</th>
<th>Rank</th>
<th>Cover %</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMBROSIA ARTEMISIIFOLIA L.</td>
<td>21</td>
<td>0.3926</td>
<td>8</td>
<td>0.8734</td>
<td>4</td>
<td>2.5724</td>
<td>1</td>
<td>4.7030</td>
</tr>
<tr>
<td>ECHINOCHLOA CRUS-GALLI P.B. VAR.</td>
<td>9</td>
<td>0.8557</td>
<td>1</td>
<td>3.7280</td>
<td>1</td>
<td>4.4192</td>
<td>2</td>
<td>3.9095</td>
</tr>
<tr>
<td>AMARANTHUS RETROFLEXUS L.</td>
<td>17</td>
<td>0.5079</td>
<td>5</td>
<td>1.4658</td>
<td>3</td>
<td>3.0610</td>
<td>3</td>
<td>3.6290</td>
</tr>
<tr>
<td>CHENOPODIUM ALBUM L.</td>
<td>3</td>
<td>1.5319</td>
<td>3</td>
<td>2.0662</td>
<td>2</td>
<td>3.0816</td>
<td>4</td>
<td>2.8988</td>
</tr>
<tr>
<td>CIRSIUM ARVENSE (L.) SCOP.</td>
<td>2</td>
<td>2.0031</td>
<td>7</td>
<td>1.1245</td>
<td>8</td>
<td>0.7090</td>
<td>5</td>
<td>1.8070</td>
</tr>
<tr>
<td>MATRICARIA INODORA L.</td>
<td>66</td>
<td>0.0657</td>
<td>26</td>
<td>0.2316</td>
<td>6</td>
<td>1.2984</td>
<td>6</td>
<td>1.5429</td>
</tr>
<tr>
<td>CONVOLVULUS ARvensis L.</td>
<td>1</td>
<td>7.9266</td>
<td>2</td>
<td>2.5144</td>
<td>5</td>
<td>1.9439</td>
<td>7</td>
<td>1.4532</td>
</tr>
<tr>
<td>DATURA STRAMONIUM L.</td>
<td>177</td>
<td>0.0055</td>
<td>59</td>
<td>0.0619</td>
<td>19</td>
<td>0.3847</td>
<td>8</td>
<td>1.0694</td>
</tr>
<tr>
<td>AMARANTHUS CHLOROSTACHYS WILLD.</td>
<td>105</td>
<td>0.0231</td>
<td>18</td>
<td>0.3948</td>
<td>13</td>
<td>0.5691</td>
<td>9</td>
<td>0.9435</td>
</tr>
<tr>
<td>GALIUM APARINE L.</td>
<td>137</td>
<td>0.0103</td>
<td>50</td>
<td>0.0875</td>
<td>12</td>
<td>0.5858</td>
<td>10</td>
<td>0.8716</td>
</tr>
<tr>
<td>SORGHUM HALEPENSE (L.) PERS.</td>
<td>94</td>
<td>0.0249</td>
<td>18</td>
<td>0.4040</td>
<td>11</td>
<td>0.8204</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ELYMUS REPENS (L.) GOUlD</td>
<td>27</td>
<td>0.2800</td>
<td>12</td>
<td>0.5065</td>
<td>20</td>
<td>0.3845</td>
<td>12</td>
<td>0.6483</td>
</tr>
<tr>
<td>PANICUM MiliACEUM L.</td>
<td>199</td>
<td>0.0032</td>
<td>192</td>
<td>0.0045</td>
<td>23</td>
<td>0.2905</td>
<td>13</td>
<td>0.6027</td>
</tr>
<tr>
<td>XANTHIUM STRUMARIUM L. SSP. STUM.</td>
<td>130</td>
<td>0.0129</td>
<td>113</td>
<td>0.0148</td>
<td>24</td>
<td>0.2709</td>
<td>14</td>
<td>0.5752</td>
</tr>
<tr>
<td>POLYGONUM LApATHILOIUM L.</td>
<td>29</td>
<td>0.2524</td>
<td>16</td>
<td>0.3994</td>
<td>10</td>
<td>0.6060</td>
<td>15</td>
<td>0.5273</td>
</tr>
<tr>
<td>BILDERDYKIA CONVOLVULUS L.</td>
<td>14</td>
<td>0.7110</td>
<td>6</td>
<td>1.1441</td>
<td>11</td>
<td>0.6000</td>
<td>16</td>
<td>0.5210</td>
</tr>
<tr>
<td>APERA SPICA-VENTI (L.) BEAUv.</td>
<td>56</td>
<td>0.0762</td>
<td>36</td>
<td>0.1435</td>
<td>14</td>
<td>0.4617</td>
<td>17</td>
<td>0.4896</td>
</tr>
<tr>
<td>HELIANTHUS ANNuUS L.</td>
<td>206</td>
<td>0.0030</td>
<td>119</td>
<td>0.0141</td>
<td>16</td>
<td>0.4245</td>
<td>18</td>
<td>0.4892</td>
</tr>
<tr>
<td>SETARIA GLAUCA (L.) P.BEAUV.</td>
<td>7</td>
<td>1.1054</td>
<td>4</td>
<td>1.9544</td>
<td>7</td>
<td>0.7208</td>
<td>19</td>
<td>0.4872</td>
</tr>
<tr>
<td>PAPAVER RHOEAS L.</td>
<td>24</td>
<td>0.3505</td>
<td>21</td>
<td>0.3193</td>
<td>15</td>
<td>0.4293</td>
<td>20</td>
<td>0.4664</td>
</tr>
</tbody>
</table>
Table 2. Changes in importance of weed species between 1950 and 1977

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rank</td>
<td>Cover%</td>
<td>Rank</td>
<td>Cover%</td>
</tr>
<tr>
<td>ECHINOCHLOA CRUS-GALLI P.B. VAR.</td>
<td>W</td>
<td>2</td>
<td>2</td>
<td>6,4906</td>
</tr>
<tr>
<td>AMARANTHUS RETROFLEXUS L.</td>
<td>H</td>
<td>8</td>
<td>0,8413</td>
<td>4</td>
</tr>
<tr>
<td>AMBROSIA ELATIOR L.</td>
<td>H</td>
<td>20</td>
<td>0,4116</td>
<td>8</td>
</tr>
<tr>
<td>CHENOPODIUM ALBUM L.</td>
<td>H</td>
<td>4</td>
<td>1,8853</td>
<td>2</td>
</tr>
<tr>
<td>CONVOLVULUS ARVENSIS L.</td>
<td>W</td>
<td>1</td>
<td>7,6541</td>
<td>3</td>
</tr>
<tr>
<td>DATURA STRAMONIUM L.</td>
<td>W</td>
<td>101</td>
<td>0,0101</td>
<td>34</td>
</tr>
<tr>
<td>CIRSIUM ARVENSE (L.) SCOP.</td>
<td>H</td>
<td>3</td>
<td>1,9751</td>
<td>6</td>
</tr>
<tr>
<td>AMARANTHUS CHLOROSTACHYS WILLD.</td>
<td>H</td>
<td>69</td>
<td>0,2441</td>
<td>17</td>
</tr>
<tr>
<td>SORGHUM HALEPENSE (L.) PERS.</td>
<td>W</td>
<td>57</td>
<td>0,2994</td>
<td>14</td>
</tr>
</tbody>
</table>
Table 2 (continued)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rank</td>
<td>Cover%</td>
<td>Rank</td>
<td>Cover%</td>
</tr>
<tr>
<td>PANICUM MILIACEUM L.</td>
<td>-</td>
<td>40</td>
<td>0,0907</td>
<td>137</td>
</tr>
<tr>
<td>ELYMUS REPENS (L.) GOULD</td>
<td>-</td>
<td>18</td>
<td>0,4723</td>
<td>12</td>
</tr>
<tr>
<td>XANTHIUM STRUMARIUM L. SSP. STUM.</td>
<td>W</td>
<td>71</td>
<td>0,0229</td>
<td>71</td>
</tr>
<tr>
<td>POLYGONUM LAPATHIFOLIUM L.</td>
<td>W</td>
<td>23</td>
<td>0,3479</td>
<td>13</td>
</tr>
<tr>
<td>SETARIA GLAUC A (L.) P.BEAUV.</td>
<td>W</td>
<td>6</td>
<td>1,4587</td>
<td>5</td>
</tr>
<tr>
<td>HIBISCUS TRIONUM L.</td>
<td>13</td>
<td>0,6605</td>
<td>9</td>
<td>0,8089</td>
</tr>
<tr>
<td>SINAPIS ARvensis L.</td>
<td>W</td>
<td>15</td>
<td>0,6578</td>
<td>7</td>
</tr>
<tr>
<td>HELIANThUS ANNUUS L.</td>
<td>W</td>
<td>124</td>
<td>0,0054</td>
<td>22</td>
</tr>
<tr>
<td>ABUTILON THEOPHRASTI MEDIC.</td>
<td>W</td>
<td>220</td>
<td>0,0005</td>
<td>43</td>
</tr>
<tr>
<td>CHENOPODIUM HYBRIDUM L.</td>
<td>-</td>
<td>43</td>
<td>0,0712</td>
<td>35</td>
</tr>
<tr>
<td>AMARANTHUS BLITOIDES S.WATS.</td>
<td>H</td>
<td>63</td>
<td>0,0302</td>
<td>31</td>
</tr>
</tbody>
</table>
Looking for the common factor or trait the drastic spread can be attributed to, considering a part of the rapidly increasing weeds in Hungary, *Ambrosia artemisifolia*, *Amaranthus retroflexus*, *Chenopodium album*, *Cirsium arvense*, *Matricaria inodora*, *Datura stramonium*, *Sorghum halepense*, *Elymus repens*, *Helianthus annuus*, *Xanthium spp.*, *Abutilon theophrasti*, *Asclepias syriaca*, we found only one factor out of human control for the time being, which can be observed in all of the listed weed species, namely **ALLELOPATHY**. We concluded that the weed species possessing this trait has an advantage under Hungarian conditions over the majority of the other weed species and the crops during their competition. Their abundance is increasing accordingly, and they also spread more rapidly than the majority of the other occurring weeds. Photos (1-6) show how highly the populations of the above species can increase.

**ANNEX 1**

**MAIN REASONS OF MASS POPULATION INCREASE OF COMMON RAGWEED (AMBROSIA ARTEMISIFOLIA) INFLUENCED BY HUMAN ACTIVITY**

- HOBBY GARDENS
- USE OF SEEDS INFESTED WITH WEED SEEDS
- HUMAN FACTOR (RAGWEED IS A NICE PLANT)
- SHORTAGE AND HIGH COST OF SUCCESSFUL WEED MANAGEMENT PROGRAMMES
- CONTRACTED WORK (IMPLEMENTS FOR CULTIVATION, HARVESTING, TRANSPORT)
- RESISTANCE
- INCREASE OF FALLOW AREAS
- STUBBLES LET UNCULTIVATED
- MISSING OF INITIAL CONTROL (WHEN ONLY SOME PLANTS OF THE WEED ARE PRESENT IN THE FIELD)

- LACK OF PROFESSIONAL SKILLS (SMALL-SCALE FARMERS)
- SHORT-TERM EFFECT OF UREA HERBICIDES
- INCREASE OF WEEDY FIELD EDGES
- LOW FREQUENCY OF CROP ROTATION PRACTICE (BI-AND MONOCULTURE)
- BIG CONSTRUCTIONS LASTING FOR SEVERAL YEARS (e.g. HIGHWAYS)
REASONS OF MASS POPULATION INCREASE OF COMMON RAGWEED \textit{(AMBROSIA ARTEMISIFOLIA)} OUT OF HUMAN CONTROL

- CHANGED BIOLOGY OF GERMINATION (GERMINATION ABILITY REMAINS FOR \textit{15-20 YEARS})
- ALLELOPATHY
- LACK OF NATURAL ENEMIES
- INCREASED COLD HARDINESS
- GOOD COMPETITION ABILITY (E.G. IN SUNFLOWER RAGWEED CAN REACH 3-3.5 M HEIGHT)
- RESISTANCE TO DRAUGHT
- POOR HERBICIDE CHOICE FOR EXTREME SOILS (E.G. SAND)
- HIGH REGROWTH ABILITY
- SOIL TYPES
- DECREASING COMPETITIVE ABILITY OF CROPS
- INCREASE OF FROST-FREE DAYS IN THE PAST \textit{10-15 YEARS}
- LONG GERMINATION PERIOD (FROM APRIL TO SEPTEMBER)
- POOR PALATABILITY FOR VERTEBRATES

ANNEX 2

MAIN REASONS OF MASS POPULATION INCREASE OF CANADA THISTLE \textit{(CIRSIUM ARVENSE)} INFLUENCED BY HUMAN ACTIVITY

- SHALLOW TILLAGE
- STUBBLES LET UNCULTIVATED FOR A LONG TIME
- INCREASE OF FALLOW AREAS
- SPLITTING OF FIELDS
- REDUCED AREAS WITH APPLICATION OF HERBICIDES WITH HORMONAL ACTIVITY
- REDUCED CEREAL AREAS WITH WEED CONTROL (ESPECIALLY SMALL-SCALE FARMERS)
- USE OF SEEDS INFESTED WITH WEED SEEDS
- WRONG CROP ROTATION PRACTICE (E.G. WHEAT - SUNFLOWER)
- SIGNIFICANT INCREASE OF SUNFLOWER AREAS
- USE OF POOR QUALITY SEEDS (SEEDS HARVESTED BY FARMERS)
- HIGH PRICE OF THE SELECTIVE HERBICIDE (LONTREL 300)
- LACK OF PROFESSIONAL SKILLS (SMALL-SCALE FARMERS)
- CONTRACTED WORK (IMPLEMENTS FOR CULTIVATION, HARVESTING, TRANSPORT)
- LOW DENSITY CEREAL STANDS (ITS MAIN REASONS)
- CHANGES IN CROP MANAGEMENT PROGRAMMES
  — INAPPROPRIATE USE OF SULFONYLUREAS

**REASONS OF MASS POPULATION INCREASE OF CANADA THISTLE (*Cirsium arvense*) OUT OF HUMAN CONTROL**

- MILD WINTERS
- RESISTANCE
- ALLELOPATHY
- DIFFERENT LEVELS OF RESISTANCE TO HERBICIDES OF THE FOUR TYPES OF THE WEED
- SOIL TYPE
- ANNUAL INCREASE OF FROST-FREE DAYS

**ANNEX 3**

**MAIN REASONS OF MASS POPULATION INCREASE OF VELVETLEAF (*Abutilon theophrasti*) INFLUENCED BY HUMAN ACTIVITY**

- USE OF SEEDS INFESTED WITH WEED SEEDS
- NEGLECTED DITCHES AND WATER CHANNELS
- ORGANIC MANURE (WEED SEEDS GET THROUGH THE INTESTINAL TRACT OF ANIMALS UNAFFECTED)
- INAPPROPRIATE CROP ROTATION (SUGARBEET – SUNFLOWER)
- OMISSION OF STUBBLE STRIPPING
- CONTRACTED WORK (IMPLEMENTS FOR CULTIVATION, HARVESTING, TRANSPORT)
- LACK OF PROFESSIONAL SKILLS (POOR KNOWLEDGE OF WEEDS AND HERBICIDES)
REASONS OF MASS POPULATION INCREASE OF
VELVETLEAF (ABUTILON THEOPHRASTI) OUT OF HUMAN CONTROL

- ANNUAL INCREASE OF FROST-FREE DAYS (VELVETLEAF IS A PLANT OF HIGHER TEMPERATURE DEMAND)
- ALLELOPATHY
- ELAYED EMERGENCE
- RESISTANCE
- SOIL TYPE

ANNEX 4

MAIN REASONS OF MASS POPULATION INCREASE OF
COMMON MILKWEED (ASCLEPIAS SYRIACA)
INFLUENCED BY HUMAN ACTIVITY

- INCREASE OF FALLOW AREAS
- SHORTAGE OF WEED CONTROL PROGRAMMES AND EFFICIENT HERBICIDES
- STUBBLES LET UNCULTIVATED FOR A LONG TIME
- HUMAN FACTOR (RAGWEED IS A NICE PLANT, IT IS EVEN PROPAGATED)
- OMISSION OF STUBBLE TREATMENTS
- CONTRACTED WORK (IMPLEMENTS FOR CULTIVATION, HARVESTING, TRANSPORT)
- INCREASE OF WEEDY FIELD EDGES

REASONS OF MASS POPULATION INCREASE OF
COMMON MILKWEED (ASCLEPIAS SYRIACA) OUT OF HUMAN CONTROL

- ANNUAL INCREASE OF FROST-FREE DAYS (COMMON MILKWEED IS A PLANT OF HIGHER TEMPERATURE DEMAND)
- DRY WEATHER PERIODS
- ALLELOPATHY
- INCREASED REGROWTH ABILITY
- SOIL TYPE
In the southern regions of Hungary, large acreages of vegetables grown under glasshouses and plastics, are located. Protected crops are the main source of employment for several thousands of families in Hungary. Protected pepper (*Capsicum annum* L.) is grown on about 2,250 hectares (ha) while protected tomato (*Lycopersicon esculenum* L.) is grown on about 1,200 ha (1999 data). This represents about 64% of the total greenhouse area of 5400 ha in Hungary.

Under the conditions found in the South-Eastern part of Hungary, and particularly in sandy soils, *Meloidogyne* spp. (mainly *M. hapla* and *M. incognita*) nematodes are the most important pests. The high level of infestation causes significant losses, so soil application has to be performed on a routine basis.

In the last few years the cotton-bollworm (*Helicoverpa armigera*) became one of the most severe pests in greenhouse production, too. Its grub attacks mostly pepper and tomato. The damaged yield usually rots. The effective treatment is a difficult task, because the larvae live hidden. The foliage has to be covered permanently by insecticides.

The most severe diseases of the protected crops (pepper, tomato) are caused by viruses. The average infection level is generally about 10-60%, but in some cases 100% virus infection can be detected in pepper and tomato.

Regular epidemic survey has been made since the 1970’s. Studies confirmed that the TMV (*Tobacco mosaic virus*), ToMV (*Tomato mosaic virus*), CMV (*Cucumber mosaic virus*), AMV (*Alfalfa mosaic virus*), and PVY (*Potato Y virus*) are the most wide-spread viruses causing severe yield losses, particularly if complex infection occurs. Since 1994, spread of TSWV (*Tomato spotted wilt virus*) has been observed, causing however, severe damages. During the past years, the spread of thrips virus vectors, namely *Frankliniella occidentalis* Pergande, has caused explosive appearance of TSWV. The spread of this virus has still not been general, actually it occurs in isolated locations particularly in the southern regions of Hungary. One can expect the spread of TSWV in the future, if no preventive measures are taken, the most important being the eradication of the possible virus sources, weed control and effective control of thrips.
Participants of 3rd IPPS
15-16 October, 2003, Debrecen
Ágoston, T. (University of Debrecen, Faculty of Agriculture, Department of Crop Production and Applied Ecology, Debrecen, Hungary)
Ahmet, Ç (Department of Plant Protection, Tekirdag Faculty of Agriculture, Trakya University, Tekirdag, Turkey)
Antal, K. (Plant and Soil Protection Service of Fejér County, Velence, Hungary)
Bakcsa, F. (University of West-Hungary, Agricultural Faculty, Mosonmagyaróvár, Hungary)
Bakonyi, J. (Department of Plant Pathology, Plant Protection Institute, Hungarian Academy of Sciences, Budapest, Hungary)
Bálint, S. (DuPont Hungary Ltd., Budapest, Hungary)
Bara, V. (University of Oradea, Oradea, Romania)
Békési, P. (National Institute for Agricultural Quality Control, Budapest, Hungary)
Benedek, P. (University of West-Hungary, Agricultural Faculty, Mosonmagyaróvár, Hungary)
Béres, I. (University of Veszprém, Georgikon Faculty of Agriculture, Institute for Plant Protection, Keszthely, Hungary)
Blagojevic, D. (Institute for Biological Research "Sinisa Stankovic", Belgrade, Serbia-Montenegro)
Bognár, S. (Szent István University, Department of Entomology, Budapest, Hungary)
Bojan, K. (Faculty of Agriculture, Department for Environmental and Plant Protection, Novi Sad, Serbia-Montenegro)
Boronkay, F-né (College of Nyíregyháza, Hungary)
Bozsik, A. (Department of Plant Protection, University of Debrecen, Debrecen, Hungary)
Branko, K. (Faculty of Agriculture, Department for Environmental and Plant Protection, Novi Sad, Serbia-Montenegro)
Budai, Cs. (Laboratory for Biological Control and Quarantine Development of Plant Health and Soil Conservation Service of Csongrád County, Hódmezővásárhely, Hungary)
Bujdos, L. (NYIDOTÉR /Nyíregyháza Tobacco Producer Group/, Nyíregyháza, Hungary)
Bukai, A. (Agrotab Ltd., Debrecen-Pallag, Hungary)
Bürgés, G. (University of Veszprém, Georgikon Faculty of Agriculture, Institute for Plant Protection, Keszthely, Hungary)
Canard, M. (47 chemin Flou de Rious, F-31400 Toulouse, France)
Cesare, D. (Istituto Sperimentale per la Frutticoltura di Roma, Ciampino Aeroporto (RM), Italy)
Csép, N. (University of Oradea, Oradea, Romania)
Csiszár, V. (St. András Hospital, Hévíz, Hungary)
Csonka, É. (Szent István University, Department of Entomology, Budapest, Hungary)
Csósz, M. (Cereal Research Non-profit Company, Szeged, Hungary)
Daroczi, C. (University of Oradea, Oradea, Romania)
Dávid, I. (University of Debrecen, Faculty of Agriculture, Department of Plant Protection, Debrecen, Hungary)
Detre, T. (Vet-Pharma Ltd., Budapest, Hungary)
Deutsch, B. (Université Catholique de l'Ouest, Angers, France)
Dobozi, M. (University of Veszprém, Georgikon Faculty of Agricultural Sciences, Keszthely, Hungary)
Dragana, S. (Faculty of Agriculture, Department for Environmental and Plant Protection, Novi Sad, Serbia-Montenegro)
El-Hamady, S.E. (Plant Protection Department, Faculty of Agriculture, Tanta University, Kafr El-Sheikh, Egypt)
El-Sheshtawi, M. (Faculty of Agriculture, Mansoura University, Mansoura, Egypt)
Érsek, T. (Department of Plant Pathology, Plant Protection Institute, Hungarian Academy of Sciences, Budapest, Hungary)
Fekete, E. (Department of Microbiology and Biotechnology, Faculty of Sciences, University of Debrecen, Debrecen, Hungary)
Fekete, T. (Universal Leaf Tobacco, Nyíregyháza, Hungary)
Fodor, J. (Plant Protection Institute, Hungarian Academy of Sciences Budapest, Hungary)
Furlan, L. (Padove University, Padova, Italy)
Gáborjányi, R. (University of Veszprém, Georgikon Faculty of Agriculture, Keszthely, Hungary)
Garai, A. (Plant Protection and Soil Conservation Service of Borsod-Abaúj-Zemplén County, Miskolc, Hungary)
Gaspar, Ch. (Zoologie générale et appliquée, Faculté des Sciences agronomiques de Gembloux, Gembloux, Belgium)
Gyulai, P. (Plant Protection and Soil Conservation Service of Borsod-Abaúj-Zemplén County, Miskolc, Hungary)
Hafez, Y.M. (Plant Protection Institute, Hungarian Academy of Sciences Budapest, Hungary)
Hatvani, A. (Faculty of Horticulture, College of Kecskemét, Hungary)
Haubruge, E. (Zoologie générale et appliquée, Faculté des Sciences agronomiques de Gembloux, Gembloux, Belgium)
Hertelendy, P. (National Institute for Agricultural Quality Control, Budapest, Hungary)
Hlavács, B. (Laboratory for Biological Control and Quarantine Development of Plant Health and Soil Conservation Service of Csongrád County, Hódmezővásárhely, Hungary)
Hodisan, N. (University of Oradea, Oradea, Romania)
Holb, I. (Department of Plant Protection, Centre for Agricultural Sciences, University of Debrecen, Debrecen, Hungary)
Horn, A. (Summit-Agro Hungaria Ltd, Budapest, Hungary)
Horváth, J. (University of Veszprém, Georgikon Faculty of Agriculture, Keszthely, Hungary)
Horváth, Z. (Faculty of Horticulture, College of Kecskemét, Hungary)
Ilbagi, H. (Department of Plant Protection, Tekirdag Faculty of Agriculture, Trakya University, Tekirdag, Turkey)
Ilijin, L. (Institute for Biological Research "Sinisa Stankovic", Belgrade, Serbia-Montenegro)
Jablonkai, I. (Institute of Chemistry, Chemical Research Center, Hungarian Academy of Sciences, Budapest, Hungary)
Karaffa, L. (Department of Microbiology and Biotechnology, Faculty of Sciences, University of Debrecen, Debrecen, Hungary)
Kayihan, K.Z. (Department of Field Crop, Tekirdag Faculty of Agriculture, Trakya University, Tekirdag, Turkey)
Kazinczi, G. (Office for Academy Research Groups Attached to Universities and Other Institutions, University of Veszprém, Keszthely, Hungary)
Király, Z. (Plant Protection Institute, Hungarian Academy of Sciences, Budapest, Hungary)
Kiss, F.E. (Laboratory for Biological Control and Quarantine Development of Plant Health and Soil Conservation Service of Csongrád County, Hódmezővásárhely, Hungary)
Komáromi, I. (Vet-Pharma Ltd., Budapest, Hungary)
Kopahnke, D. (Federal Centre for Breeding Research on Cultivated Plants Institute for Epidemiology and Resistance, Aschersleben, Germany)
Kormány, B. (College of Nyíregyháza, Hungary)
Kőmíves, T. (Plant Protection Institute of the Hungarian Academy of Sciences, Budapest, Hungary)
Kövics, G.J. (University of Debrecen, Centre for Agricultural Sciences, Department of Plant Protection, Debrecen, Hungary)
Kubiak, R. (Ecology Department, SLFA, Neustadt / W., Germany)
Kubicek, C.P. (TU Vienna, Institute of Chemical Engineering, Division Applied Biochemistry and Gene Technology, Area Molecular Biotechnology, Vienna, Austria)
Lakatos, L. (Department of Fruit Growing, Centre of Agricultural Sciences, University of Debrecen, Debrecen, Hungary)
Lazarevic, J. (Institute for Biological Research "Sinisa Stankovic", Belgrade, Serbia-Montenegro)
Lazarevic, J. (Institute for Biological Research "Sinisa Stankovic", Belgrade, Serbia-Montenegro)
Lehoczky, É. (University of Veszprém, Georgikon Faculty of Agriculture, Institute for Plant Protection, Keszthely, Hungary)
Lenti, I. (College of Nyíregyháza, Hungary)
Letardi, A. (ENEA - C.R. Casaccia, Biotec-SIC, S. Maria de Galeria, Roma, Italy)
Loboda, Z. (Plant Protection and Soil Conservation Service of Borsod-Abaúj-Zemplén County, Miskolc, Hungary)
Maja, M. (Faculty of Agriculture, Department for Environmental and Plant Protection, Novi Sad, Serbia-Montenegro)
Manninger, K. (Plant Protection Institute, Hungarian Academy of Sciences, Budapest, Hungary)
Matola, T. (Institute of Chemistry, Chemical Research Center, Hungarian Academy of Sciences, Budapest, Hungary)
Mesterházy, Á. (Cereal Research Non-profit Company, Szeged, Hungary)
Molnár, I. (DuPont Hungary Ltd., Budapest, Hungary)
Murányi, I. (Rudolf Fleischmann Research Institute of the Róbert Károly College, Kompol, Hungary)
Nádasy, I.E. (University of Veszprém, Georgikon Faculty of Agriculture, Institute for Plant Protection, Keszthely)
Nádasy, M. (University of Veszprém, Georgikon Faculty of Agriculture, Keszthely, Hungary)
Nagy, M. (Crop and Soil Protection Service of Szabolcs-Szatmár-Bereg County, Nyíregyháza, Hungary)
Nagy, S. (Faculty of Food and Agricultural Sciences, University of West-Hungary, Mosonmagyaróvár, Hungary)
Nagy, Z.Á. (Department of Plant Pathology, Plant Protection Institute, Hungarian Academy of Sciences, Budapest, Hungary)
Nagyhaska, E. (Cereal Research Non-profit Company, Szeged, Hungary)
Nowinszky, L. (Berzsenyi, Dániel College, Szombathely, Hungary)
Oros, Gy. (Plant Protection Institute of Hungarian Academy of Sciences /HAS/, Budapest, Hungary)
Paulian, M. (Institutul de Cercetari pentru Protectia Plantelor, Bucuresti, Romania)
Pavlovic, S. (Institute for Biological Research "Sinisa Stankovic", Belgrade, Serbia-Montenegro)
Pepó, Péter (University of Debrecen, Faculty of Agriculture, Department of Crop Production and Applied Ecology, Debrecen, Hungary)
Peric-Mataruga, V. (Institute for Biological Research "Sinisa Stankovic", Belgrade, Serbia-Montenegro)
Peric-Mataruga, V. (Institute for Biological Research "Sinisa Stankovic", Belgrade, Serbia-Montenegro)
Piskolczi, M. (University of Debrecen, Centre for Agricultural Sciences, Agro-meteorological Observatory, Debrecen, Hungary)
Pocsai, E. (Plant Protection and Soil Conservation Service of County Fejér, Velence, Hungary)
Puskás, J. (Berzsenyi, Dániel College, Szombathely, Hungary)
Pusztai, I. (Cereal Research Non-profit Company, Szeged, Hungary)
Racskó, J. (Institute for Extension and Development, Centre of Agricultural Sciences, University of Debrecen, Debrecen, Hungary)
Radócz, L. (University of Debrecen, Faculty of Agriculture, Department of Plant Protection, Debrecen, Hungary)
Reisinger, P. (Faculty of Food and Agricultural Sciences, University of West-Hungary, Mosonmagyaróvár, Hungary)
Rejtő, L. (Vet-Pharma Ltd., Budapest, Hungary)
Ripka, G. (Central Service for Plant Protection and Soil Conservation, Budapest, Hungary)
Sándor, E. (Department of Plant Protection, Faculty of Agriculture, University of Debrecen, Debrecen, Hungary)
Somlyay, I. (DuPont Hungary Ltd., Budapest, Hungary)
Szabó, A. (University of Debrecen, Faculty of Agriculture, Department of Crop Production and Applied Ecology, Debrecen, Hungary)
Szabó, I. (University of West-Hungary, Institute of Forest and Wood Protection, opron, Hungary)
Szabó, T. (National Institute for Agricultural Quality Control, Budapest, Hungary)
Szarukán, I. (Debrecen University, Centre for Agricultural Science, Debrecen, Hungary)
Szegő, A. (Vet-Pharma Ltd., Budapest, Hungary)
Szentey, L. ‘Ministry of Agriculture and Regional Development, Department for Plant Protection and Agro-environment, Budapest, Hungary)
Szentirmai, A. (Department of Microbiology and Biotechnology, Faculty of Sciences, University of Debrecen, Debrecen, Hungary)
Szentkirályi, F. (Plant Protection Institute of Hungarian Academy of Sciences /HAS/, Budapest, Hungary
Szlávik, Sz. (National Institute for Agricultural Quality Control, Budapest, Hungary)
Szőke, L. (Crop and Soil Protection Service of Szabolcs-Szatmár-Bereg County, Nyíregyháza, Hungary)
Tabilio, M. R. (Istituto Sperimentale per la Frutticoltura di Roma, Ciampino Aeroporto (RM), Italy)
Takács, A.P. (Office for Academy Research Groups Attached to Universities and Other Institutions, University of Veszprém, Keszthely, Hungary)
Tarcali, G. (University of Debrecen, Centre for Agricultural Sciences, Department of Plant Protection, Debrecen, Hungary)
Thierry, D. (Université Catholique de l'Ouest, Angers, France)
Torma, M. (Szeged University, College of Agriculture, Hódmezővásárhely, Hungary)
Tóth, Ádám (Central Service for Plant Protection and Soil Conservation, Budapest, Hungary)
Tóth, Ágnes (University of Veszprém, Georgikon Faculty of Agricultural Sciences Keszthely, Hungary)
Tóth, E. (DuPont Hungary Ltd., Budapest, Hungary)
Tóth, M. (Plant Protection Institute of Hungarian Academy of Sciences, Budapest, Hungary)
Tóth, O. (Debrecen University, Centre for Agricultural Science, Debrecen, Hungary)
Ujváry, I. (Central Chemistry Institute of HAS, Budapest, Hungary)
Varga, Sz. (University of West-Hungary, Institute of Forest and Wood Protection, opron, Hungary)
Vida Gy. (Agricultural Research Institute of the Hungarian Academy of Sciences, Martonvásár, Hungary)
Villenave, J.3 (Institut National d'Horticulture, Protection des Plantes, Angers, France)
Viola J.-né (National Institute for Agricultural Quality Control, Budapest, Hungary)
Vlahovic, M. (Institute for Biological Research "Sinisa Stankovic", Belgrade, Serbia-Montenegro)
Yatsynin, V.G. (Krasnodarskiy NIISKh im. P.P. Lukyanenko, Krasnodar, Russia)
Zala, F. (Franciska BT., Kecskemét, Hungary)
Zalka, A. (National Institute for Agricultural Quality Control, Budapest, Hungary)
Zsombik, L. (University of Debrecen, Faculty of Agriculture, Department of Crop Production and Applied Ecology, Debrecen, Hungary)