THE FIELD EFFICACY OF FUNGICIDES AGAINST MEAN LEAVES PATHOGENS OF BARLEY

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Summary
In the work, the field results of fungicide efficacy are presented. In agroecological conditions of Nitra, the fungicides efficacy was tested against Blumeria graminis f. sp. hordei, Pyrenophora teres, Rhynchosporium secalis, Septoria nodorum and Fusarium spp. infection. The highest biological efficacy (all of evaluated leaves) was decreasing in following order: flusilazole + carbendazim (1,0 l.ha⁻¹), epoxiconazole + tridemorph (0,8 l.ha⁻¹), epoxiconazole + carbendazim (1,0 l.ha⁻¹), kresoxim-methyl + epoxiconazole (1,0 l.ha⁻¹). The highest increasing of yield was observed in following downward order: epoxiconazole + fenpropimorph (1,5 l.ha⁻¹), kresoxim-methyl + epoxiconazole (0,8 l.ha⁻¹ and 1,0 l.ha⁻¹), epoxiconazole + carbendazim (1,0 l.ha⁻¹), flusilazole + carbendazim (1,0 l.ha⁻¹), and epoxiconazole + tridemorph (0,8 l.ha⁻¹ and 0,6 l.ha⁻¹). In all fungicide variants the decreasing of S. nodorum ears attack was observed, the best influence was recorded by using of epoxiconazole + tridemorph. The more markedly decreasing of Fusarium grains attack was observed only by flusilasole + carbendazim.

Key words: fungicide, barley, leaves pathogens

Introduction
In the field conditions, the most important pathogens of barley are Blumeria graminis, Pyrenophora teres and Rhynchosporium secalis. The pathogen reduces yield and on the other hand also the quality of grains. Therefore the chemical protection against them is in place. The most considered fungicides are based on strobilurins (JORGENSEN and NIELSEN, 1998), triazoles compounds (BLATTER, 1998), and etc..

The aim of work was the fungicides efficacy evaluating in field conditions of Nitra.

Material and methods
The field trials were realised in Experimental base of Slovak agricultural university (SPU) Dolná Malanta, near Nitra. The following fungicides were used in different variants: A - kresoxim-methyl + epoxiconazole (as Juwel), dose 1,0 l.ha⁻¹, B - kresoxim-methyl + epoxiconazole (as Juwel), dose 0,8 l.ha⁻¹, C - epoxiconazole + tridemorph (as Tango), dose 0,8 l.ha⁻¹, D - epoxiconazole + tridemorph (as Tango), dose 0,6 l.ha⁻¹, E - flusilazole + carbendazim (as Alert S), dose 1,0 l.ha⁻¹, F - epoxiconazole + fenpropimorph (as Opus Team), dose 1,5 l.ha⁻¹, G - epoxiconazole + carbendazim (as Duett), dose 1,0 l.ha⁻¹, K - control variant.

The tested crop was barley, cv. “Kompakt”. The efficacy of fungicides was appreciated against Blumeria graminis f. sp. hordei, Rhynchosporium secalis, Pyrenophora teres (on leaves); Septoria nodorum (on ears) and Fusarium spp. (in grains). The variants were realised in 3 repetitions, germinative capacity of seeds was 89,0 %. The fungicides were applied in growth stage DC 39, by using 500 l.ha⁻¹ of water. The evaluation were made in growth stages before application - DC 37-39, 14 days after application - DC 71 and finally in growth stage DC 93. There was 3 times per 30 plants tested. In each plant, there were three upper leaves evaluated. The used scale was 1-9 (9 - without infestation, 1 - 100 % infected area). The level of infestation was expressed as attack index and fungicides efficacy in %, according Abbott pattern.

The harvested grains were tested in laboratory. The seeds were surface sterilised in 1% NaOCl solution for 2 minutes, next washed up in redistilled water. The 5 surface sterilised grains were placed on Petri dishes with potato-dextrose agar (PDA) and incubated at 20°C 7-10 days under 12/12 photoperiods. 100 grains in 3 repetition were analysed in each variant. Fusarium colonies, which have overgrew from grains, were detected macroscopically and microscopically as Fusarium spp., without species specification. After incubation, the percentage of Fusarium spp. infected grains was evaluated.

Results and discussion
Evaluation before spraying, DC 37-39: In evaluated growth stage were detected attack of Blumeria graminis f. sp. hordei, Pyrenophora teres and Fusarium spp. infection. The pathogen reduces yield and on the other hand also the quality of grains. Therefore the chemical protection against them is in place. The most considered fungicides are based on strobilurins (JORGENSEN and NIELSEN, 1998), triazoles compounds (BLATTER, 1998), and etc..

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Results and discussion
Evaluation before spraying, DC 37-39: In evaluated growth stage were detected attack of Blumeria graminis f. sp. hordei, Pyrenophora teres and Fusarium spp. occurred sporadically (Table 1). In spots of Blumeria graminis were observed pure sporulation. The Blumieria graminis spots occurred on 2nd and 3rd leaves, the ultimate leaves were without symptoms. In case of ultimate leaves the fungicides spraying was preventive one, in case of other leaves was repressive one.

Evaluation 14 days after fungicides spraying: The occurrence of Rhynchosporium secalis and P. teres was trivial in this growth stage too (Table 2).
Table 1 Attack Index (%) on barley, DC 37 - 39, Malanta 1999

<table>
<thead>
<tr>
<th>Variant</th>
<th>Blumeria graminis</th>
<th>Rhynchosporium secalis</th>
<th>Pyrenophora teres</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>a</td>
<td>b</td>
<td>c</td>
</tr>
<tr>
<td>K</td>
<td>-</td>
<td>10,49</td>
<td>22,59</td>
</tr>
<tr>
<td>A</td>
<td>-</td>
<td>11,36</td>
<td>28,02</td>
</tr>
<tr>
<td>B</td>
<td>-</td>
<td>10,25</td>
<td>26,67</td>
</tr>
<tr>
<td>C</td>
<td>-</td>
<td>11,60</td>
<td>24,45</td>
</tr>
<tr>
<td>D</td>
<td>-</td>
<td>9,26</td>
<td>25,19</td>
</tr>
<tr>
<td>E</td>
<td>-</td>
<td>9,88</td>
<td>24,94</td>
</tr>
<tr>
<td>F</td>
<td>-</td>
<td>7,91</td>
<td>21,24</td>
</tr>
<tr>
<td>G</td>
<td>-</td>
<td>8,52</td>
<td>23,70</td>
</tr>
</tbody>
</table>

- Designation of variants are described in chapter Material and methods
  a - the last leaves (flag), b - the second leaves, c - the third leaves downward

Table 2 Pathogen's damage (attack Index (%)) and fungicides efficacy (BÚ) on barley, Malanta 1999

<table>
<thead>
<tr>
<th>Variant</th>
<th>Erysiphe graminis</th>
<th>Rhynchosporium secalis</th>
<th>Helminthosporium teres</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>a</td>
<td>b</td>
<td>C</td>
</tr>
<tr>
<td>K</td>
<td>19,63</td>
<td>29,63</td>
<td>43,33</td>
</tr>
<tr>
<td>A</td>
<td>12,10</td>
<td>25,93</td>
<td>33,46</td>
</tr>
<tr>
<td>B</td>
<td>11,98</td>
<td>20,99</td>
<td>31,48</td>
</tr>
<tr>
<td>C</td>
<td>10,00</td>
<td>20,86</td>
<td>30,12</td>
</tr>
<tr>
<td>D</td>
<td>10,74</td>
<td>21,11</td>
<td>31,11</td>
</tr>
<tr>
<td>E</td>
<td>10,99</td>
<td>20,86</td>
<td>28,03</td>
</tr>
<tr>
<td>F</td>
<td>11,36</td>
<td>21,85</td>
<td>30,25</td>
</tr>
<tr>
<td>G</td>
<td>11,11</td>
<td>22,72</td>
<td>32,22</td>
</tr>
</tbody>
</table>

- Designation of variants are described in chapter Material and methods
  a - the last leaves (flag), b - the second leaves, c - the third leaves downward, BÚ - biological efficacy of fungicides

The infection gone over the ultimate leaves in all variants. In other leaves the infection increased too, because of up-grade infection, especially in case of *B. graminis*. All fungicides retarded this translocation of pathogens. Just this ultimate leaf is most important for creating of future yield. The best influence on health of ultimate leaves the fungicides reached in following downward order: epoxiconazole + tridemorph (0,6 l.ha⁻¹), epoxiconazole + tridemorph (0,8 l.ha⁻¹), flusilazole + carbendazim (1,0 l.ha⁻¹), epoxiconazole + carbendazim (1,0 l.ha⁻¹), epoxiconazole + fenpropimorph (1,5 l.ha⁻¹), kresoxim-methyl + epoxiconazole (0,8 l.ha⁻¹), kresoxim-methyl + epoxiconazole (1,0 l.ha⁻¹). In case of average biological efficacy (all of evaluated leaves) was the order following: flusilazole + carbendazim (1,0 l.ha⁻¹), epoxiconazole + tridemorph (0,8 l.ha⁻¹), epoxiconazole + tridemorph (0,6 l.ha⁻¹), epoxiconazole + fenpropimorph (1,5 l.ha⁻¹), kresoxim-methyl + epoxiconazole (0,8 l.ha⁻¹), epoxiconazole + carbendazim (1,0 l.ha⁻¹), kresoxim-methyl + epoxiconazole (1,0 l.ha⁻¹). The finally effect - harvested yield is most interesting for agricultural practice (Tab. 3).

Table 3 Influence of fungicides application on yield characteristic, Malanta 1999

<table>
<thead>
<tr>
<th>Variant</th>
<th>Number of fertile tillers (pc)</th>
<th>Length of ears (mm)</th>
<th>Number of grains per ear (g)</th>
<th>Weight of ear grains (g)</th>
<th>Weight of thousand seeds (g)</th>
<th>Yield (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>K</td>
<td>395</td>
<td>57,4</td>
<td>22</td>
<td>1,01</td>
<td>48,31</td>
<td>388,95</td>
</tr>
<tr>
<td>A</td>
<td>515</td>
<td>63,8</td>
<td>23</td>
<td>1,19</td>
<td>51,58</td>
<td>529,23</td>
</tr>
<tr>
<td>B</td>
<td>525</td>
<td>63,8</td>
<td>24</td>
<td>1,17</td>
<td>49,18</td>
<td>536,99</td>
</tr>
<tr>
<td>C</td>
<td>393</td>
<td>65,6</td>
<td>24</td>
<td>1,17</td>
<td>49,74</td>
<td>448,61</td>
</tr>
<tr>
<td>D</td>
<td>558</td>
<td>62,1</td>
<td>23</td>
<td>1,11</td>
<td>47,86</td>
<td>441,57</td>
</tr>
<tr>
<td>E</td>
<td>529</td>
<td>62,9</td>
<td>24</td>
<td>1,23</td>
<td>51,93</td>
<td>516,31</td>
</tr>
<tr>
<td>F</td>
<td>485</td>
<td>63,3</td>
<td>24</td>
<td>1,21</td>
<td>50,49</td>
<td>541,53</td>
</tr>
<tr>
<td>G</td>
<td>554</td>
<td>63,1</td>
<td>24</td>
<td>1,24</td>
<td>51,09</td>
<td>528,73</td>
</tr>
</tbody>
</table>

- Designation of variants are described in chapter Material and methods
The highest increasing of yield was observed in following downward order: epoxiconazole + fenpropimorph (1.5 l.ha⁻¹), kresoxim-methyl + epoxiconazole (0.8 l.ha⁻¹ and 1.0 l.ha⁻¹), epoxiconazole + carbendazim (1.0 l.ha⁻¹), flusilazole + carbendazim (1.0 l.ha⁻¹), and epoxiconazole + tridemorph (0.8 l.ha⁻¹ and 0.6 l.ha⁻¹). The most notable differences are in case of epoxiconazole + tridemorph, which was the best in biological efficacy, but the yield was not the highest. Other way round the kresoxim-methyl + epoxiconazole had not the best efficacy, but the increasing of yield was evident. This situation was caused by so-called ‘green effect’, which is well known by this fungicide and other strobilurins (GERHARD et al., 1999). The positive effect of all fungicides on yield increasing was observed in all variants. It comes to this, that transmission of pathogen to ultimate leaves markedly decreased the yield (Lockley et al., 1998). In case of kresoxim-methyl + epoxiconazole application was observed interesting phenomenon, the sprayed plants was lighter in growth stage full ripe, because of less Cladosporium spp. and Alternaria spp. infection than in other variants.

Laboratory analysis of grains: In all fungicide variants the decreasing of S. nodorum ears attack was observed in comparison to the control (Tab. 4). The best influence was recorded by using of epoxiconazole + tridemorph, according to the highest biological efficacy in previous evaluation.

<table>
<thead>
<tr>
<th>Number of evaluated ears</th>
<th>K</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
</tr>
</thead>
<tbody>
<tr>
<td>S. nodorum attack (%)</td>
<td>4.55</td>
<td>1.62</td>
<td>2.54</td>
<td>3.64</td>
<td>0.30</td>
<td>2.22</td>
<td>2.41</td>
<td>0.78</td>
</tr>
<tr>
<td>Germinate capacity of seeds (%)</td>
<td>78.0</td>
<td>92.0</td>
<td>91.0</td>
<td>86.0</td>
<td>87.0</td>
<td>90.0</td>
<td>90.0</td>
<td>79.0</td>
</tr>
<tr>
<td>Fusarium attack (%)</td>
<td>26</td>
<td>18</td>
<td>17</td>
<td>20</td>
<td>27</td>
<td>6</td>
<td>21</td>
<td>24</td>
</tr>
</tbody>
</table>

Designation of variants are described in chapter Material and methods

Occurrence of Fusarium species on ears and grains is dangerous as potential for direct damages and mycotoxins contamination (Mirocha et al., 1977). The more markedly decreasing of Fusarium grains attack was observed by flusilazole + carbendazim. Other differences have trivial meaning, because of smaller differences and early application. The more effective application is considered in latest period, in the beginning or during flowering (Suty et al., 1977).

References