Relevance of seed health for disease development on leaf stripe disease (*Drechslera graminea*) and net blotch (*Drechslera teres*) on spring barley in organic farming

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Abstract

Factors influencing the seed borne infection cycle of leaf stripe were investigated in a three-year project. Important factors concerning the relationship between seed and field infection levels are environmental conditions (e.g. low temperature during field emergence) on one hand, as well as varieties showing a wide variation in susceptibility. Significant differences between varieties have been detected, concerning the relationship between field infection levels including high infected neighbour fields and the harvested new generation of seeds, but none of the tested varieties was resistant in this part of the infection cycle.

The results of the studies on net blotch confirm the importance of the seed borne component of this disease. Especially in early growing stages the disease is highly influenced by the seed infection level. During the growing season factors like variety and environment gain in importance, nevertheless the statistical analysis indicated significant influence of the seed infection in late growing stages as well. The observed yield reduction could be verified by statistical methods in most of the cases.

Introduction

From 2005 until 2007 investigations on the relevance of seed health for development of leaf stripe disease and net blotch were carried out in the scope of a research project on varieties and seeds for organic farming. The main goal of the studies on leaf stripe (*Drechslera graminea*) was the identification and quantification of influencing factors of the seed borne infection cycle, like seed infection level, vegetation conditions, infection level of neighbouring fields or variety properties. Especially the germination temperature and variety susceptibility are reported as important factors (WALTHER, 1980, MÜLLER, 2006, NIELSEN, 2002).

Net blotch (*Drechslera teres*) is partly a seed borne disease as well. Seed infection causes disease symptoms on young plants and influences the further disease development depending on vegetation conditions or variety susceptibility. The importance of the seed borne component of net blotch has been reported and investigated especially in Scandinavian countries (PINNSCHMID et al., 2005, BRODAL, 2006).

Materials and methods

From 2005 to 2007 in total eight trials on leaf stripe disease have been carried out. The trials were scattered over the main spring barley production areas.

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During the whole project period ten varieties were tested; for every variety the same block of plots was sown (Figure 1) in four replications. The most important collected parameters were as follows:

- Seed infection rate with *Drechslera graminea*
- Field infection rate caused by the utilized seed
- Infection rate of the harvested samples caused by infected neighbour plots

Concerning the investigations on net blotch in total twelve trials were carried out, located in the same areas like the trials on leaf stripe. Three different seed infection levels (low – medium – high) and four varieties with different susceptibility against net blotch have been used. The most important collected parameters were as follows:

- Seed infection rate with *Drechslera teres*
- Infection rate in two to three leave stage
- Two (three) further examinations during the growing season and the yield level

For seed health tests the PDA-Method according to ISTA Working Sheet No. 6 (ANONYMUS 1) was used.

**Results and Discussion**

The infection rate with leaf stripe of the harvested samples obtained by healthy plots but neighbouring diseased plots differed strongly and significantly depending on the factor year and environment. The average infection level with leaf stripe was between 1,6% and 31,1% (Tab. 1). When the field was already infected with *D. graminea*, the infection rate of the harvested samples did not increase significantly.

**Tab. 1: Average infection level with *D. graminea* of the harvested samples depending on the health status and depending on the year and the location.**

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</thead>
<tbody>
<tr>
<td>Healthy plots</td>
<td>4,0%</td>
<td>12,9%</td>
<td>1,6%</td>
<td>31,1%</td>
<td>2,6%</td>
<td>6,2%</td>
<td>15,3%</td>
</tr>
<tr>
<td>Infected plots</td>
<td>6,1%</td>
<td>14,8%</td>
<td>2,3%</td>
<td>-N-</td>
<td>3,2%</td>
<td>6,5%</td>
<td>19,4%</td>
</tr>
</tbody>
</table>

The statistical calculation of the data using ANOVA showed a significant influence of the parameter infection level of the harvested sample by the factor variety. Three of the varieties were significantly more susceptible for the infection rate on the harvested seeds (Fig. 2). The ranking of the varieties regarding this parameter was highly comparable over all trials.
Regarding the correlation of seed infection level and rate of diseased plants the varieties showed a wide range of tolerance or susceptibility (Fig. 3).

With some of our tested varieties no or only a small number of infected plants could be identified in spite of high seed infection rate. For other varieties the seed infection level corresponds very well with the rate of infected plants. As far as the varieties were also tested in studies of MÜLLER, 2006 und NIELSEN, 2002, the variety ranking is comparable.

Fig. 2: Infection level of the harvested samples caused by neighbouring high infected plots, in dependence of the variety, 2005-2007 (Duncan-Test, p=0.05)

Fig. 3: Field infection caused by the seed infection level, in dependence of the variety, 2005-2007 (Duncan-Test, p=0.05)

The infection rate with net blotch (*D. teres*) depends in early growing stages (EC12-13) significantly on the level of seed infection. In all applied trials significant correlation
was observed between these two parameters. In these early growing stages for the factor variety no significant influence was detected in our trials. During the further ongoing growing season the influence of variety susceptibility and vegetation conditions increases. Nevertheless in later examinations in most trials the infection level was significantly influenced by the seed infection level as well, especially under suitable growing conditions.

Yield reduction caused by the different seed infection levels was detected in most of the trials, especially in ones with higher yield levels; but in only three trials of our project significance via ANOVA was established.

Conclusions

The results on leaf stripe show that the infection risk of the harvested seeds depends on the evidence of high infected neighbour fields, the vegetation conditions in the growing period, the location and the variety. Otherwise the results show a wide range in the relationship between seed and field infection; some varieties diseased very low even with high seed infection level.

The studies confirmed the seed borne component of net blotch. Especially in early growing stages the seed infection level is the most important factor. During the further plant and disease development other criteria like variety or environment become important, but the influence of the seed infection level was still evident.

Especially for Organic farming the studies confirmed, that seed health is an important precautionary measures to avoid these diseases. A further important aspect is to ensure high phytosanitary standards in all production regions.

Acknowledgments

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References

ANONYMUS 1: ISTA Handbook on Seed Health Testing. Section 2 Working Sheets. International Seed Testing Association, Zürich, Switzerland


