Survey about the Infestation of Dwarf Bunt (Tilletia controversa) and Common Bunt (Tilletia caries) of Wheat upon Seeds and in Soil

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Outline

- Introduction
- Aim of this research project
- Material and methods
  - Laboratory methods
  - Field trials
    - *Tilletia controversa* (2-factorial)
    - *Tilletia caries* (3-factorial)
- Results
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Introduction

Dwarf Bunt (*Tilletia controversa*) and Common Bunt of wheat (*Tilletia caries*) are the most important pathogens in Organic Farming.

What are the reasons for that?

- sowing of not certified seed (that means sowing of self-produced, not analyzed seed)
- low acceptance of seed treatments in Organic Farming
- laborious and difficult seed treatment methods (practices) in Organic Farming
- weather conditions (not influenceable)
Infestation

Dwarf Bunt of wheat (*Tilletia controversa*)

- infestation takes place during tillering
- best infestation conditions are at temperatures from 0 - 5 °C, diffuse light and snow covered, not frozen soil

Common Bunt of wheat (*Tilletia caries*)

- infestation takes place during germination
- best infestation conditions are at temperatures between 7 - 10 °C and “less wet or dry” soil (if you have such conditions you will get a high infestation level)
- infestation decreases clearly if the temperatures are less than 5 °C and higher than 15 °C
Aim of this research project

If farmers have already “Bunt-problems” on their fields they need threshold values for the seed and if useful for the soil as well. This threshold values should support wheat cultivation in Organic Farming.

The present situation in Bavaria is as follows:

**Dwarf Bunt of wheat**
- a threshold value
  - for seed – does not exist
  - for soil – does not exist

**Common Bunt of wheat**
- a threshold value
  - for seed – does exist
  - for soil – does not exist

The main question of my research work is:

Is a threshold value for seed sufficient or must the infection potential in the soil be considered as well?
Laboratory methods

**Determination of spore infestation on the seed**

- Filtration method according to ISTA  
  (ISTA Handbook on Seed Health Testing, Working Sheet No 53)

**Determination of the spore potential in the soil (New!)**

- Combination of a “wet-sieving-procedure“ and the filtration method according to ISTA (developed during this research project)
### Field trials – Dwarf Bunt of wheat (*Tilletia controversa*)

<table>
<thead>
<tr>
<th><strong>Design:</strong></th>
<th>2-factorial split-plot (variety, treatment), 3 years, 3 sites, 4 replications, plot size (12-13.5 m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Varieties:</strong></td>
<td><strong>wheat</strong>&lt;br&gt;variety A (s) <strong>spelt wheat</strong>&lt;br&gt;variety A (s) <strong>wheat</strong>&lt;br&gt;variety B (ls) <strong>spelt wheat</strong>&lt;br&gt;variety B (ls)</td>
</tr>
<tr>
<td><strong>Treatments:</strong></td>
<td>1 untreated control&lt;br&gt;2 soil infestation (0.5 g spores/m²)&lt;br&gt;3 seed infestation (20 spores/kernel)&lt;br&gt;4 seed infestation (100 spores/kernel)</td>
</tr>
<tr>
<td><strong>Sites:</strong></td>
<td>Bavaria, Baden-Württemberg, Upper Austria</td>
</tr>
</tbody>
</table>

(s) = susceptible to Dwarf Bunt of wheat  
(ls) = low susceptible to Dwarf Bunt of wheat
# Field trials – Common Bunt of wheat (*Tilletia caries*)

**Design:**
3-factorial split-plot (variety, sowing date, treatment),
3 years, 4 sites, 4 replications, plot size (10 – 13 m²)

**Wheat varieties:**
- variety A (s)
- variety E (ls)

**Sowing date:**
- early (on or about October 5\(^{th}\))
- late (after October 25\(^{th}\))

**Treatments:**
1. untreated control
2. seed infestation (20 spores/kernel)
3. seed infestation (100 spores/kernel)

**Sites:**
- Bavaria, Baden-Württemberg,
- North Rhine-Westphalia, Saxony

(s) = susceptible to Common Bunt of wheat
(ls) = low susceptible to Common Bunt of wheat

Photos: Dressler
Dwarf Bunt of wheat (*Tilletia controversa*)

Infestation of the crop 2009 (spores/kernel), spelt wheat varieties

<table>
<thead>
<tr>
<th>Varieties</th>
<th>Bavaria</th>
<th>Baden-Württemberg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Untreated control A</td>
<td>13 16'658</td>
<td>12 5'486</td>
</tr>
<tr>
<td>Untreated control B</td>
<td>78 18'097</td>
<td>58 18'450</td>
</tr>
<tr>
<td>0.5 g spores/m² A</td>
<td>11 31'615</td>
<td>5 20'000</td>
</tr>
<tr>
<td>0.5 g spores/m² B</td>
<td>10 18'450</td>
<td>9 10'000</td>
</tr>
<tr>
<td>20 spores/kernel A</td>
<td>20 9'640</td>
<td>9 9'393</td>
</tr>
<tr>
<td>20 spores/kernel B</td>
<td>20 2'656</td>
<td>9 3'593</td>
</tr>
<tr>
<td>100 spores/kernel A</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>100 spores/kernel B</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

varieties A = susceptible

varieties B = low susceptible
Dwarf Bunt of wheat (*Tilletia controversa*)

Spore potential in soil prior to the seed 2008 and after harvest 2009, spelt wheat varieties

<table>
<thead>
<tr>
<th>varieties</th>
<th>treatments</th>
<th>Bavaria</th>
<th>Baden-Württemberg</th>
<th>Upper Austria</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>spores in 10 g soil</td>
<td>spores in 10 g soil</td>
<td>spores in 10 g soil</td>
</tr>
<tr>
<td>A</td>
<td>untreated control</td>
<td>30</td>
<td>72</td>
<td>101</td>
</tr>
<tr>
<td>B</td>
<td>untreated control</td>
<td>0</td>
<td>29</td>
<td>72</td>
</tr>
<tr>
<td>A</td>
<td>soil infestation 0.5 g spores/m²</td>
<td>245</td>
<td>346</td>
<td>274</td>
</tr>
<tr>
<td>B</td>
<td>soil infestation 0.5 g spores/m²</td>
<td>302</td>
<td>562</td>
<td>116</td>
</tr>
<tr>
<td>A</td>
<td>20 spores/kernel</td>
<td>43</td>
<td>44</td>
<td>58</td>
</tr>
<tr>
<td>B</td>
<td>20 spores/kernel</td>
<td>58</td>
<td>101</td>
<td>29</td>
</tr>
<tr>
<td>A</td>
<td>100 spores/kernel</td>
<td>29</td>
<td>58</td>
<td>187</td>
</tr>
<tr>
<td>B</td>
<td>100 spores/kernel</td>
<td>43</td>
<td>144</td>
<td>144</td>
</tr>
</tbody>
</table>

variety A = susceptible  
variety B = low susceptible
Common Bunt of wheat (*Tilletia caries*)

Infestation of the crop 2009, wheat varieties, early sowing date

 Variety A = susceptible
 Variety E = low susceptible

Markus Dressler – ISTA Seed Symposium 2010, Cologne
Common Bunt of wheat (*Tilletia caries*) – varieties

Infestation of the crop 2009, wheat varieties, early sowing date

Means with the same letter are not significantly different ($\alpha \leq 0.05$)

variety $A = $ susceptible

variety $E = $ low susceptible
Common Bunt of wheat (*Tilletia caries*)

Spore potential in soil prior to the seed 2008 and after harvest 2009, wheat varieties, early sowing date

<table>
<thead>
<tr>
<th>varieties</th>
<th>treatments</th>
<th>Bavaria</th>
<th>North Rhine-Westfalia</th>
<th>Saxony</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>spores in 10 g soil</td>
<td>spores in 10 g soil</td>
<td>spores in 10 g soil</td>
</tr>
<tr>
<td>A</td>
<td>untreated control</td>
<td>58&lt;sup&gt;a&lt;/sup&gt;</td>
<td>29&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>E</td>
<td>untreated control</td>
<td>15&lt;sup&gt;a&lt;/sup&gt;</td>
<td>58&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0&lt;sup&gt;a&lt;/sup&gt;</td>
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<td>A</td>
<td>20 spores/kernel</td>
<td>15&lt;sup&gt;a&lt;/sup&gt;</td>
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<td>29&lt;sup&gt;a&lt;/sup&gt;</td>
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<td>0&lt;sup&gt;a&lt;/sup&gt;</td>
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</tbody>
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Means with the same letter are not significantly different (α ≤ 0.05)

variety A = susceptible
variety E = low susceptible
Dwarf Bunt of wheat (*Tilletia controversa*)

- infestation is also possible at diffuse light conditions (without any snow cover or fog)
- the infestation will be high when the soil is not frozen and covered by snow for a long period during tillering
- in the case of a high infestation there is no difference between wheat and spelt wheat varieties
- at present there are no resistant varieties available for the farmers in Germany
Summary

Common Bunt of wheat (*Tilletia caries*)

- at an early sowing date the infestation will be significantly higher
- at a late sowing date the infestation will be much lower
- the infestation is strongly influenced by the weather conditions during germination
- infection from the spore potential in soil is also possible
- resistant varieties are available for the farmers
Summary

Spore potential in the soil

- the spore potential is inhomogenously distributed in the soil and depends on the site
- a high infestation level of the crop causes a high increase of the spore potential in the soil
- under favorable conditions the existing spore potential in soil increases infestation level of the crop enormously

a threshold value for the soil for Dwarf bunt of wheat should be discussed?
Acknowledgement

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- R. Hückelhoven
  Technical University Munich (TUM)

- project partners

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Infestation of the crop with Bunt spores

- 0 spores/kernel
- About 6,000 spores/kernel
- > 50,000 spores/kernel
- Very high infestation