Does Zymoseptoria tritici accelerate leaf apical senescence in winter wheat plants cv. Soissons grown under contrasted nitrogen conditions?

Pierre Bancal, Rym Ben Slimane, Marie-Odile Bancal

To cite this version:

Pierre Bancal, Rym Ben Slimane, Marie-Odile Bancal. Does Zymoseptoria tritici accelerate leaf apical senescence in winter wheat plants cv. Soissons grown under contrasted nitrogen conditions?. 9th International Symposium on Septoria Diseases of Cereals, Sep 2016, Paris, France. hal-02947495

HAL Id: hal-02947495
https://hal.inrae.fr/hal-02947495
Submitted on 24 Sep 2020

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L’archive ouverte pluridisciplinaire HAL, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d’enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.
Does Zymoseptoria *tritici* accelerate leaf apical senescence in winter wheat plants cv. Soissons grown under contrasted nitrogen conditions?

Bancal P, BenSlimane R, Bancal MO.
Context

* **Quantitative losses** were previously well related to green leaf area losses (e.g. Robert et al., 2004; Bancal et al., 2007; 2015)

* **Qualitative losses also** in relation to decrease in both late N uptake and N remobilisation to grains (e.g. Bancal et al., 2008)

* Once green leaf area losses are taken into account, main damages also are (Robert et al., 2004)

Understand and simulate damages = understand and simulate GLA losses
Context: GLA losses in diseased leaves have 2 components.

\[ \text{Green Leaf Area} = \text{Leaf Area} - \text{Apical Necrosis} \]

\[ \text{GLA} = \text{LA} - [\text{Symptomatic Areas} + \text{Apical Necrosis}] \]

Local senescence of symptomatic areas induced by Zt development:

- Necrotic areas with pycnidia
- Necrotic areas around sporulating zones
- Under different genetic controls

Is apical necrosis (i.e. whole plant functioning) modified in the presence of Zt?

- Faster N remobilization due to N blockage in dead tissues?
- N diverted for fungal growth?
- Obturated vessels unable to feed tips?
A 1st experiment used cultivar resistance and isolate virulence to create variations in the setting of disease

<table>
<thead>
<tr>
<th>Isolate</th>
<th>Apache</th>
<th>Caphorn</th>
<th>Koréli</th>
<th>Soissons</th>
</tr>
</thead>
<tbody>
<tr>
<td>i1</td>
<td>++++</td>
<td>++++</td>
<td>+</td>
<td>++++</td>
</tr>
<tr>
<td>i2</td>
<td>++++</td>
<td>++++</td>
<td>+</td>
<td>++++</td>
</tr>
<tr>
<td>i3</td>
<td>+++</td>
<td>-</td>
<td>-</td>
<td>++++</td>
</tr>
<tr>
<td>i4</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
</tbody>
</table>

Inoculation was localized close to leaf ligulae to follow as far as possible apical senescence progression

Paintbrush inoculation by Zt: Symptom appearance and extension

Apical necrosis with acropetal progression

Acceleration of apical senescence was never observed

*Ben Slimane et al, 2012*
Objectives

→ Under a wider range of disease and senescence dynamics, does Zymoseptoria *tritici* accelerate or not apical senescence in winter wheat leaves?

Means

• Inoculating 1/3 (I5) and 2/3 (I10) of leaf area

  Paintbrush inoculation by Zt:
  Symptom appearance and extension

  Apical necrosis with acropetal progression

• Under varying nitrogen nutrition post-inoculation

  → to vary apical senescence dynamics

  → to vary symptom dynamics

• Using a unique compatible susceptible cultivar (*Soissons*) x aggressive isolate (*IPO323*) interaction
Material and Methods

Taking sequential numerical photos: two times a week, symptoms evolution (Ssep and Pycnidia Like Symptoms: PLS) as well as apical senescence (Sapi) up to the time they merged were estimated from image analysis. Non inoculated control leaves were measured as well.

As described in BenSlimane et al, 2012
Results

1- Impacts of N nutrition on apical senescence

As expected, a large range of apical senescence dynamics was created by the means of late nitrogen nutrition.
Results

2- Impacts of N nutrition on symptoms development

Necrotic symptomatic surface

Rate of symptom development

Nb of Pycnidia like structures

Apparition in 2 phases

Ssep appeared earlier and at a higher rate in I10 vs I5 leaves

Local necrotic area was increased as early as 300°CdI under N0 by 1.25 times but stopped at lower values

Symptom development followed a bi-exponential law, the switch being between 250 and 300°CdI.

Only early rates of Ssep were significantly increased under N0 by 1.7 times in I5 leaves

Pycnidia followed the same 2-phases dynamics as Ssep

But either the rate or the final PLS number per leaf was lower under N0

A large range of Septoria tritici blotch dynamics was created and the response to leaf nitrogen characterized
Results

2- Impacts of N nutrition on symptoms development

Necrotic symptomatic surface

Rate of symptom development

Nb of Pycnidia like structure

A large range of Septoria tritici blotch dynamics was created and the response to leaf nitrogen characterized.
Results

3- Impacts of symptom development on apical senescence

Apical senescence was not increased at all by localized inoculation up to 2/3 of leaf area.

The relative rate of apical senescence remained unchanged after large localized inoculations.

Residual N content in apical zone was not significantly modified by localized inoculation.

Neither leaf apical senescence area or rate was modified by large localized inoculations with Septoria tritici blotch.
4- Impacts of nitrogen on relative GLA losses

AUC Sapi (relative to HAD of healthy control) of N1 or N0 treatments

AUC Ssep (relative to HAD of healthy control) of N1 or N0 treatments

No impact at all of nitrogen nutrition on both AUDPCs of diseased leaves:
Relative non-GLA are the same, so the damages are the same
Discussion

1- Apical senescence is never accelerated by STB

- In a range of large inoculation areas
- In a range of Sapi dynamics via variation in N nutrition
→ Residual N content in non-inoculated apex zone remains unchanged

It confirms and extends previous results

2- Late N nutrition interacted with Zt dynamics

- Low N increased necrosis extent
- Late N increased the number of Pycnidia per leaf conversely to necrosis
→ Pycnidia density is increased by high N nutrition
Conclusion: in a modelling perspective of damages

3- Whatever late N nutrition, relative GLA losses are the same

- Even with the large range of Sapi and Ssep created, once HAD of control leaves is taken into account, overall damages relative to control leaves are the same

Conclusion: in a modelling perspective of damages

- Understanding and modelling Sapi in healthy leaves is sufficient to predict Sapi in diseased leaves

- Necrotic area depends on leaf N nutrition, even lately varied: quantitative relationships have to be established thoroughly and may depend on isolate x cultivar interaction

- Final pycnidia number was increased by late N nutrition: so far, its relationship to damages was not established and may also depend on isolate x cultivar interaction
Acknowledgements

INRA ECOSYS UMR AGROPARISTECH

Thanks for your attention!