Root and stalk rot of Maize

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Degree of disease development

Pathogen

Environment

Host
Life cycle vs. disease cycle

Stenocarpella maydis
Life cycle vs. disease cycle

- Life cycle = the stage or successive stages in the growth and development of an organism that occur between the appearance and reappearance of the same stage (e.g.) of an organism

**Diagram:**
- Mycelia
- Stenocarpella maydis
- Pycnidia
- Spores
Life cycle

Stenocarpella maydis

Mycelia

Pycnidia

Spores

Stenocarpella maydis
Disease cycle: Diplodia cob rot

Mycelia

Ears most susceptible 3 weeks after silking

Fungus overwinters on debris

Grows on silks and tassels, infecting kernels and ear shank

Conidia

Dry early season followed by rain during silking

Pycnidia imbedded in debris
Disease cycle: Diplodia stalk rot

Wet early season followed by drought conditions or heat stress
Introduction

Root rot is a problematic disease:

- Complex of fungi, nematodes, bacteria etc.
- Soil type
- Tillage systems
- Crop rotation systems
- Locality
- Sampling date
Introduction

Quantification of yield impact difficult

1.81 t ha\(^{-1}\) yield decline per unit increase\(^{-1}\) of disease severity

Due to complexity and unpredictability of root rot, ultimate goal would be the development of cultivation practices that would result in or contribute to healthier root systems.
Root rot

Foto – S. Lamprecht

Foto – S. Lamprecht
Crown rot
### Isolated fungi

<table>
<thead>
<tr>
<th>Isolated fungi</th>
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<th>Isolated fungi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acremonium cf guilematii</td>
<td>F. equiseti</td>
<td>N. vasinfecta</td>
</tr>
<tr>
<td>Alternatia spp.</td>
<td>F. globosum</td>
<td>Nigrospora spp.</td>
</tr>
<tr>
<td>Aspergillus spp.</td>
<td>F. graminearum</td>
<td>Paecilomyces spp.</td>
</tr>
<tr>
<td>Bipolaris spp.</td>
<td>F. oxysporum</td>
<td>Papulaspora spp.</td>
</tr>
<tr>
<td>Botrytis spp.</td>
<td>F. polyphialdicum</td>
<td>Penicillium spp.</td>
</tr>
<tr>
<td>Cheatomium spp.</td>
<td>F. proliferatum</td>
<td>Phoma spp.</td>
</tr>
<tr>
<td>Clamydosporum spp.</td>
<td>F. sambucinum</td>
<td>Phytophtora spp.</td>
</tr>
<tr>
<td>Clonostachys spp.</td>
<td>F. scirpi</td>
<td>Ramichloridium spp.</td>
</tr>
<tr>
<td>Curvularia spp.</td>
<td>F. semitectum</td>
<td>Rhizoctonia spp.</td>
</tr>
<tr>
<td>Epicoccum nigrum</td>
<td>F. solani</td>
<td>Talaromyces spp.</td>
</tr>
<tr>
<td>Exserohilum spp.</td>
<td>F. subglutinans</td>
<td>Thielavia terricola</td>
</tr>
<tr>
<td>F. clamydosporum</td>
<td>F. verticillioides</td>
<td>Torulomyces spp.</td>
</tr>
<tr>
<td>F. compactum</td>
<td>Geotrichum spp.</td>
<td>Trichoderma spp.</td>
</tr>
<tr>
<td>F. crookwellense</td>
<td>M. phaseolina</td>
<td>Sterile Hyphomycetes</td>
</tr>
<tr>
<td>F. culmorum</td>
<td>Morteriella spp.</td>
<td>Verticillium spp.</td>
</tr>
</tbody>
</table>
Root rot
## CA trial: Ventersdorp

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>P1 T4.2 Babala</td>
<td>P2 T1 Maize</td>
<td>P3 T4.3 Sunf/Cowp</td>
<td>P4 T4.1 Maize</td>
</tr>
<tr>
<td>2</td>
<td>P8 T2 Maize</td>
<td>P9 T3.1 Maize</td>
<td>P10 T4.2 Babala</td>
<td>P11 T1 Maize</td>
</tr>
<tr>
<td>3</td>
<td>P15 T4.3 Sunf/Cowp</td>
<td>P16 T3.2 Sunf/Cowp</td>
<td>P17 T3.1 Maize</td>
<td>P18 T2 Maize</td>
</tr>
<tr>
<td>4</td>
<td>P22 T2 Maize</td>
<td>P23 T4.1 Maize</td>
<td>P24 T4.3 Sunf/Cowp</td>
<td>P25 T4.2 Babala</td>
</tr>
</tbody>
</table>

This table shows the different treatments and crops for the CA trial at Ventersdorp. Each row represents a different plot, with columns indicating the treatment number and type of crop planted.
CA trial: Rep 1
CA trial: Rep 1
CA trial: Root rot
CA trial: crown rot
Stalk rots

- First symptoms observed - wilting

- Within days leaves turn grey, cobs drop and bottom nodes turn brown.
Stalk rots

- Diplodia stalk rot
- Gibberella stalk rot
- Fusarium stalk rot
- Charcoal rot
- Bacterial stalk rot
Diplodia stalk rot

Foto: Kloppers
Gibberella stalk rot
Fusarium stalk rot
Charcoal rot

Hot dry environments (drought conditions), soil temperature 32 - 42ºC

Foto: S. Tweer
Stalk rot: Control

**Resistance (?)**
- Vary for specific hybrids over seasons and localities
- Plant well adapted hybrids
- Resistance against leaf diseases, good stability and high yield potential

**Plant density**
- Keep with proposed/suggested density

**Pest management**
- Stalk borers
- Leaf diseases

**Balanced soil fertility**
- Balanced and continuous N availability
- Potassium (K)
Stalk rot: control

Crop rotation and soil preparation
- Diplodia – soybean
- Stubble

Irrigation schedules
- Soil moisture – pollination to physiologically mature

Monitoring
- Weekly inspection of maize from 30-40% moisture
- Test firmness of stalks just below the bottom node

Foto: Kloppers
Bacterial stalk rot
Bacterial stalk rot

- High rainfall areas
- Irrigation systems (over head)
- Flood irrigation
- 32-35°C + relative humidity
- Survives on stubble on soil
- Infects through wounds and stomata
- Not seed transmitted
- Stalk borers possible vectors

Fotos: B. Janse van Rensburg
Bacterial stalk rot: Control

- Good drainage
- Stubble removal
- Irrigation practices that avoids flooding
- Irrigation schedules
  - Irrigate during cooler periods during day
- Pest control
- Prevent mechanical damage
- Resistance not known
Questions?
Soybean diseases

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Soybean rust

- *Phakopsora pachyrhizi*
- Yield losses 31-60%
Climatic conditions

- Temperature range 12-27°C
- Leaf wetness ±6h
- Overwinters in frost free areas
- Host Kudzu vine
- East to west progression
Symptoms

- Base of plant
- Yellowing
- Premature leaf senescence
Control

Chemical control

More severe symptoms on 0.45m rows than 0.9m rows

Shorter maturity groups may be able to escape effects of disease
Soybean trap crop trials

• Protein Research Foundation
Bacterial postule
Bacterial postule

- Optimal temperature 30-33 deg C
- Seed
Sclerontina stem rot

- Estimated yield loss of 250kg/ha for every 10% disease increase

- *Sclerotinia sclerotiorum*
  - Not specialized (400 hosts)

- Climatic conditions
  - Can survive extreme conditions ($0 > ^\circ C > 70$)
  - Extended cool wet conditions
# Sclerotinia stem rot: Control

<table>
<thead>
<tr>
<th>Control Measures</th>
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<tbody>
<tr>
<td>Short season cultivars (leaf cover)</td>
</tr>
<tr>
<td>Row width</td>
</tr>
<tr>
<td>Tillage practices (&gt;5cm)</td>
</tr>
<tr>
<td>Crop rotation (5 year period)</td>
</tr>
<tr>
<td>Sanitation to limit spread</td>
</tr>
<tr>
<td>Certified seed</td>
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<tr>
<td>Weed control (cosmos, Khakibos)</td>
</tr>
<tr>
<td>Chemical control</td>
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</tbody>
</table>

![Image of Sclerotinia stem rot]

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*Excellence in Research and Development*
Sclerotinia stem rot

Resistance?

• Full resistance not available

• Cultivar differences in genotype x environment interaction
  • i.e. some cultivars more resistant under certain environmental conditions that are less suited for disease development
Charcoal rot
Charcoal rot

- Hot dry weather
- Sclerotia - >2 years on host residue
- In wet soils
  - sclerotia - 7-8 weeks
  - mycelia - 7 days.

- Control
  - Cultivar selection
  - Avoid drought stress
  - Crop rotation (Cotton)
  - Avoid high planting densities
  - Agricultural practices that conserves soil moisture
Sudden Death Syndrome

Fusarium virguliforme
Sudden Death Syndrome

- First symptoms early in reproductive phase
- Effect on yield depend on onset of disease
- Roots affected / discolored and precedes leaf symptoms
- Xylem vessels grey to white – pith tissue remains white
SDS vs. Brown Stem Rot
Brown stem rot

Phialophora gregata
Brown stem rot

- Foliar symptoms similar to SDS.
- Dead leaflets tend to remain attached to the petioles.
- Darkened pith and insignificant discoloration of the cortex.
Stem canker

Diaporthe phaseolorum
Phytophthora root rot

Phytophthora sojae
Rhizoctonia root rot

Rhizoctonia solani
Rhizoctonia root rot

- More severe on seed and young seedlings with seed rot and root rot.
- Roots and hypocotyl may have a shrunken, reddish brown lesion, which will be dry when decayed.
- On older plants, the lesion is characterized by a reddish brown dry cortical root rot extending into the base of the stem.
- The foliar symptoms include leaf yellowing.
Fusarium blight (?)

Fusarium oxysporum
Fusarium blight

- Often misdiagnosed as Phytophthora root rot/wilt
- Affected plants have a wilting of the stem tips
- Upper leaves are scorched.
- The middle and lower leaves can turn yellow or have pale (dull) yellow spots.
- In severe cases the leaves will dry up and drop prematurely leaving the petiole behind.
- No evidence of a stem lesion or external decay that goes above the soil line.
- Browning of the vascular tissue and pith.
- Confused with early-season brown stem rot.
- Red, orange or white mycelium visible.
## Control

<table>
<thead>
<tr>
<th>Planting dates</th>
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<tbody>
<tr>
<td>Maturity groups</td>
</tr>
<tr>
<td>Resistance (?)</td>
</tr>
<tr>
<td>Avoid crop stresses</td>
</tr>
<tr>
<td>• Pest management</td>
</tr>
<tr>
<td>• Soil fertility</td>
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<tr>
<td>• Nematodes</td>
</tr>
<tr>
<td>• Water availability</td>
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</tbody>
</table>
Control

- Avoid compacting of soils
- Crop rotation
- Harvest
- Seed treatments
- Certified seed
Questions ?