



MAIN CEREAL RUSTS **IN TUNISIA**



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Why this presentation?

FAO Warning: Surveillance of Cereal Rusts in 2017

Because in 2016:

- **Generalized propagation of Stripe Rust in all Mediterranean countries,**
- **Worrying new expansion of Stem Rust in Sicily, Italy,**
- **Cereal rusts are in an extension phase.**

Why this presentation?

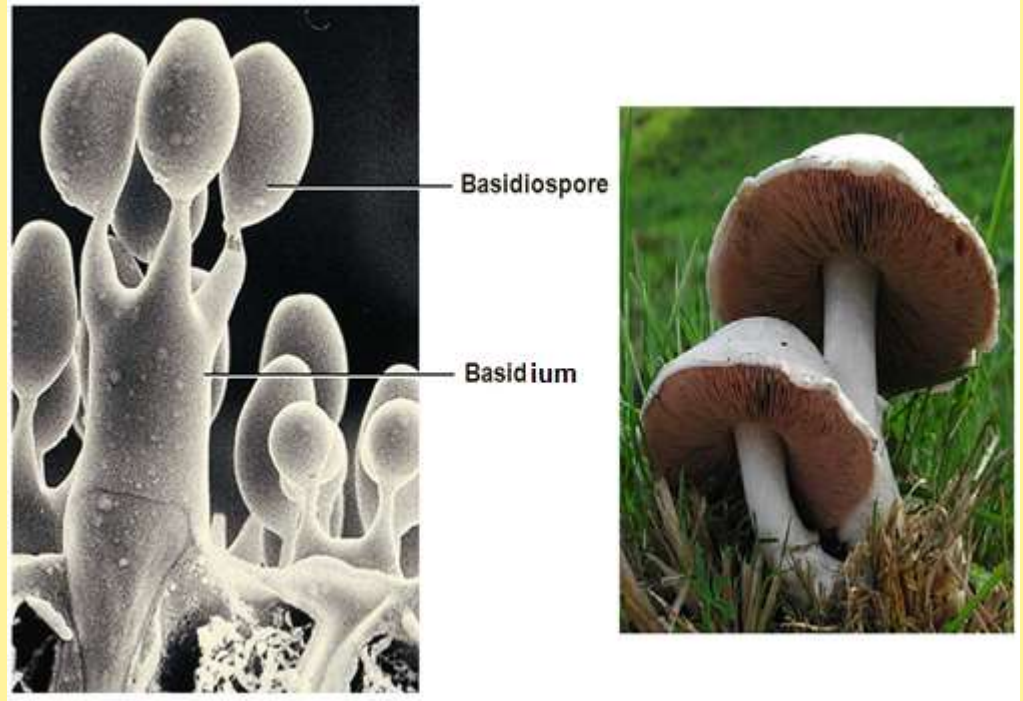
- **Reminding and updating the knowledge on the cereal rusts (specially Stem and Stripe Rusts),**
- **To be ready for an eventual battle against epidemic of Cereal Rusts in Tunisia 2017.**

Rust Agents

Basidiomycota (Basidiomycetes)



Puccinia

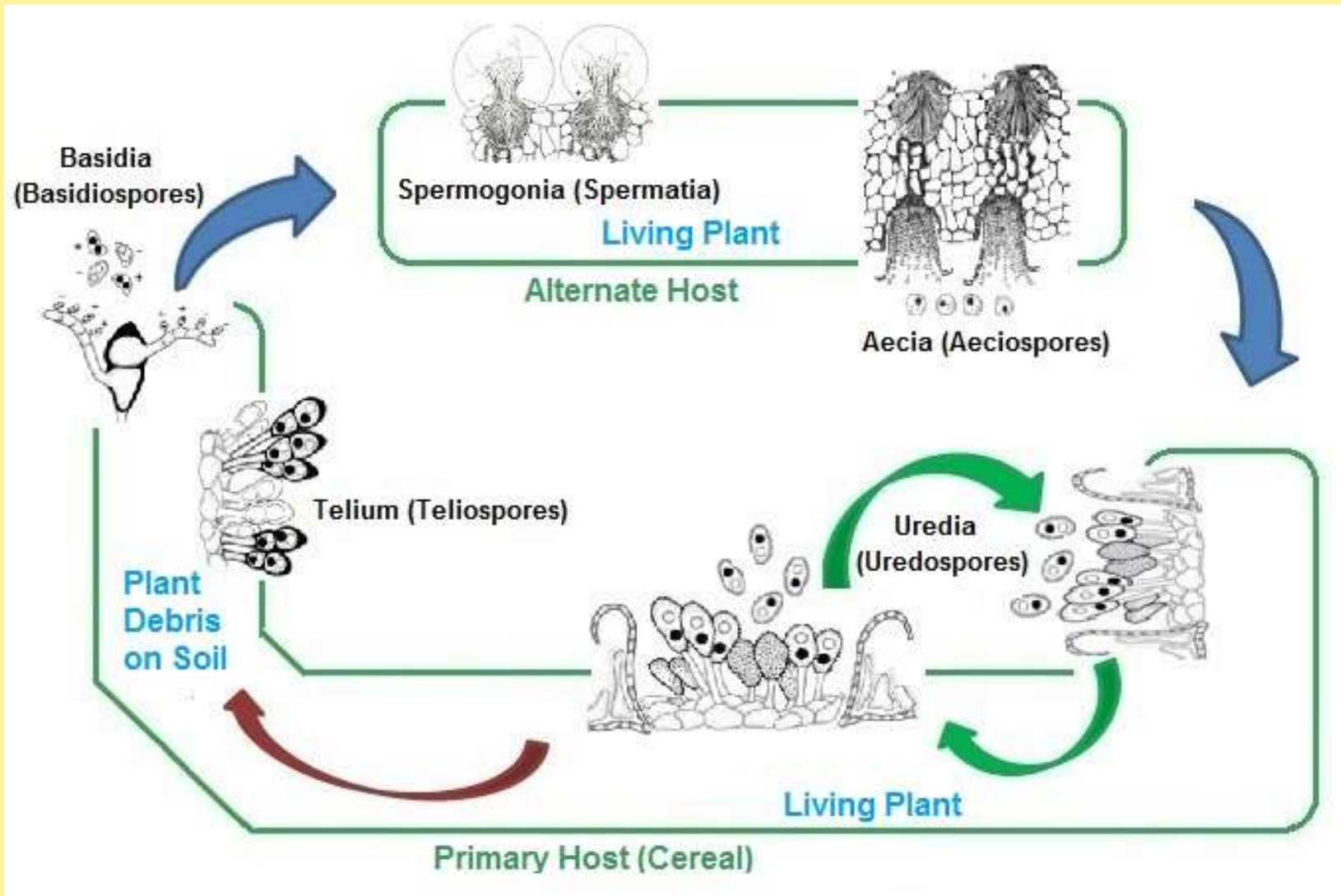


(Macroscopic fungi)

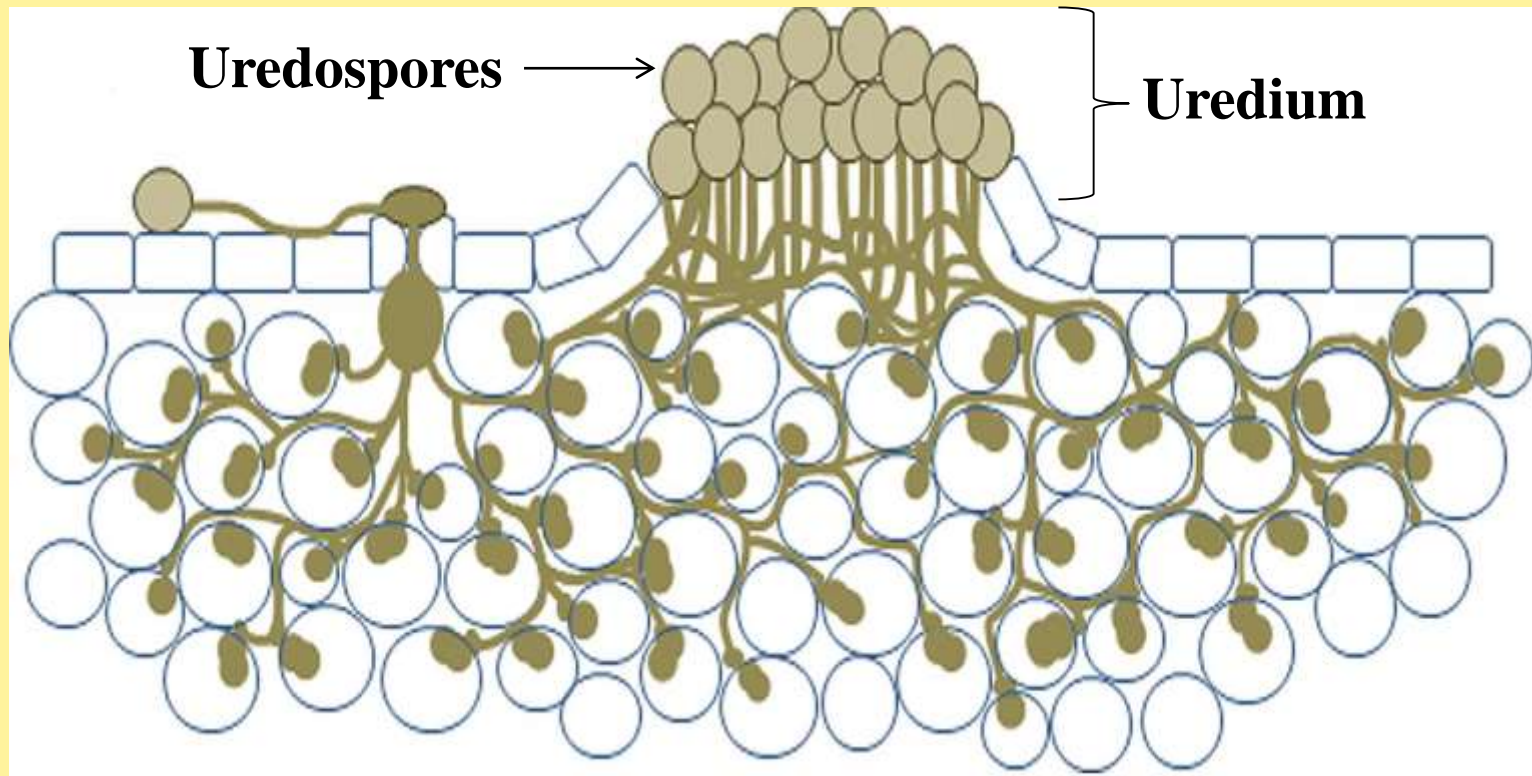
Types of Cereal Rusts

- 1- **Stem** (or Black) **Rust** of wheat: *Puccinia graminis*
- 2- **Leaf** (or Brown) **Rust** of wheat: *Puccinia recondita* (formerly *P. triticina*)
- 3- **Stripe** (or Yellow) **Rust** of wheat: *Puccinia striiformis*
- 4- **Leaf** (or Brown) **Rust** of barley: *Puccinia hordei*
- 5- **Crown Rust** of oat: *Puccinia coronata*

General Cycle of Wheat Rusts



Uredium (Uredospores)



Infection: Cutting of an uredium

Importance of Uredospores

* Damages on Cereals: due only to

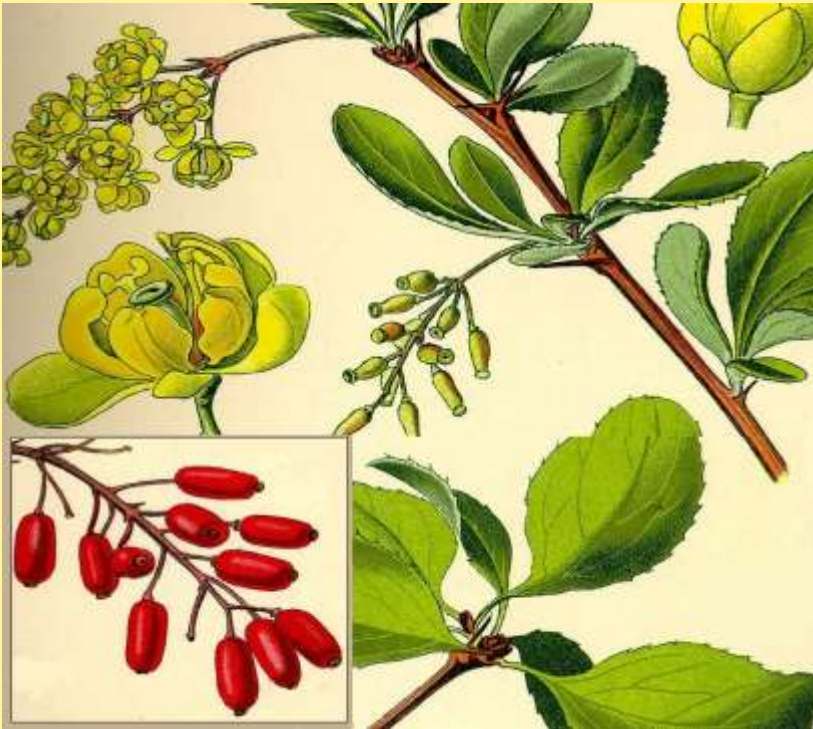
Uredospores

* Origins of uredospores (3 possibilities):

- Produced on the spot: Complete biological cycle in Tunisia (Aeciospores → Uredospores)
- Coming from Europe by crossing Mediterranean (only Uredospores)
- Maintained on living Graminae during summer on wet microclimate highlands (only Uredospores)

Alternate Host Plants

1- Stem Rust / Wheat:



Berberis



Mahonia

Alternate Host Plants

2- Leaf Rust / Wheat:



Thalictrum

Alternate Host Plants

3- Leaf Rust / Barley:



Ornithogalum [Monocot.]

Alternate Host Plants

4- Crown Rust / Oat:

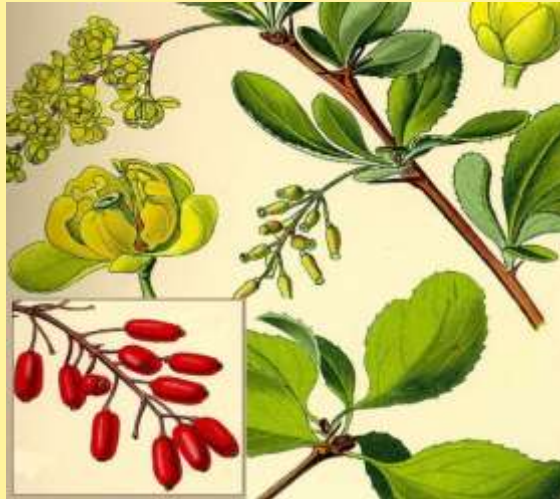


Rhamnus

Rhamnus lycioides : Species confirmed in Tunisia (INRAT)

Alternate Host Plants

5- Stripe Rust / Wheat:



Berberis



Mahonia

- Natural infections are extremely rare in the nature (observed for the 1st time in China in 2013),
- Artificial inoculation is possible (since 2010),
- Cycle seemingly limited to Uredospores in the regions of wet temperate climate → then propagation in the rest of the world.

Symptoms / Alternate Host Plants



Spermogonia (Spermatia) / Upper face

Symptoms / Alternate Host Plants



Spermogonia producing honeydew

Symptoms / Alternate Host Plants



Aecia / Lower face

Symptoms / Alternate Host Plants

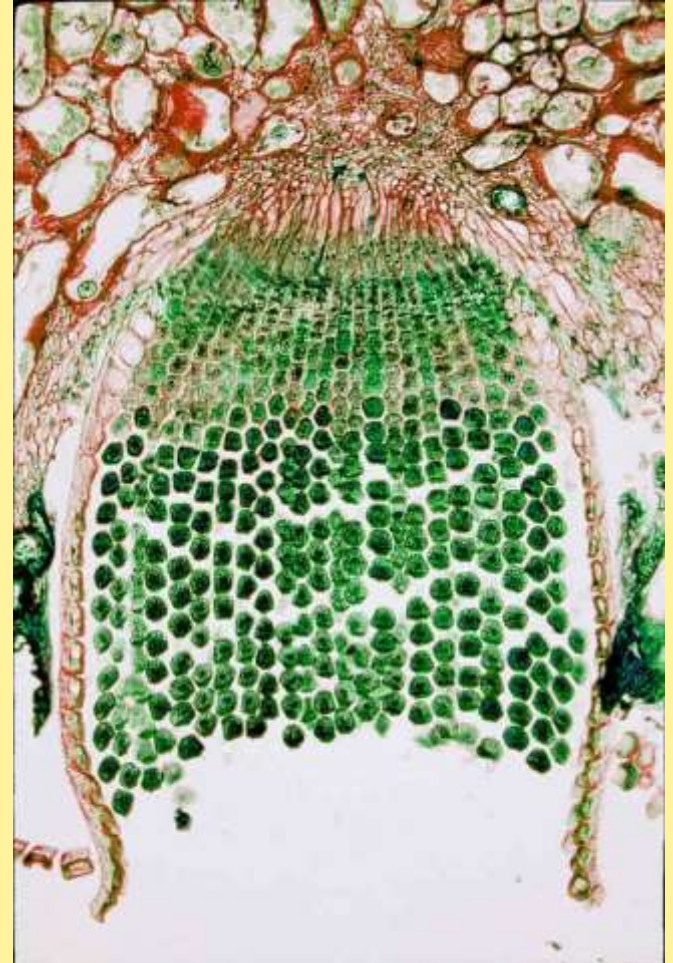


Aecia

Symptoms / Alternate Host Plants



Aecia (Aeciospores)



Symptoms / Cereals (Wheat)

Stem (or Black) Rust: It is brown



***Puccinia graminis* / Uredia (Propagation, Damages)**

Symptoms / Cereals (Wheat)

Stem (or Black) Rust: It is brown



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Symptoms / Cereals (Wheat)

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***Puccinia graminis* / Uredia (Propagation, Damages)**

Symptoms / Cereals (Wheat)

Stem (or Black) Rust



Puccinia graminis / Telia (Conservation)

Symptoms / Cereals (Wheat)

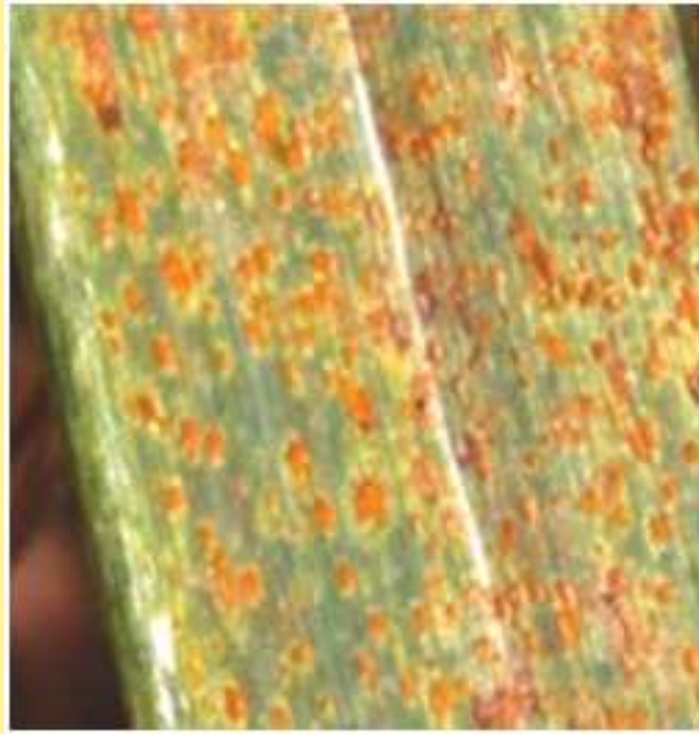
Leaf (or Brown) Rust



***Puccinia recondita* / Uredia (Propagation, Damages)**

Symptoms / Cereals (Wheat)

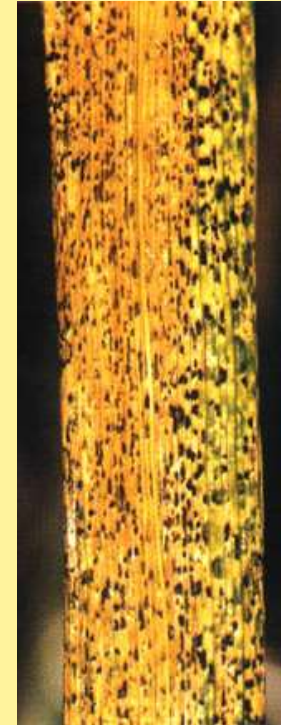
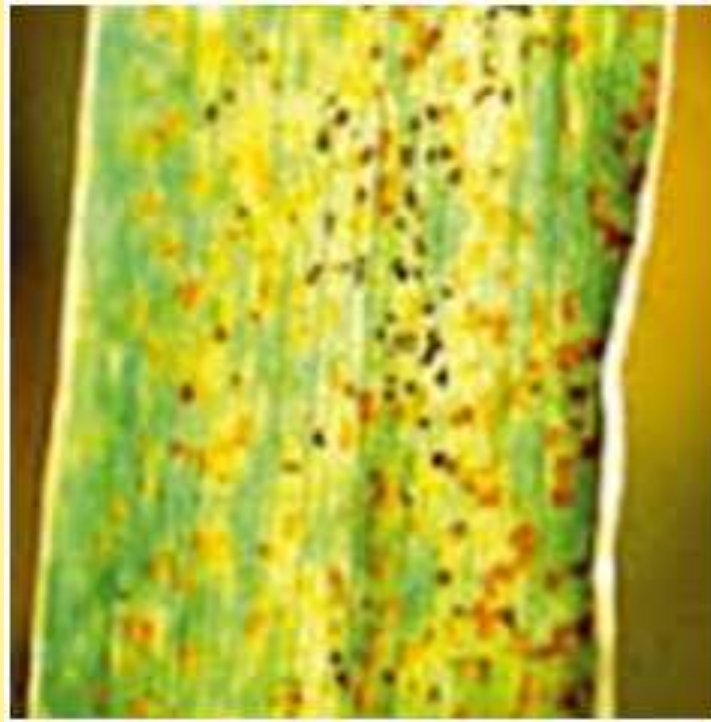
Leaf (or Brown) Rust



***Puccinia recondita* / Uredia (Propagation, Damages)**

Symptoms / Cereals (Wheat)

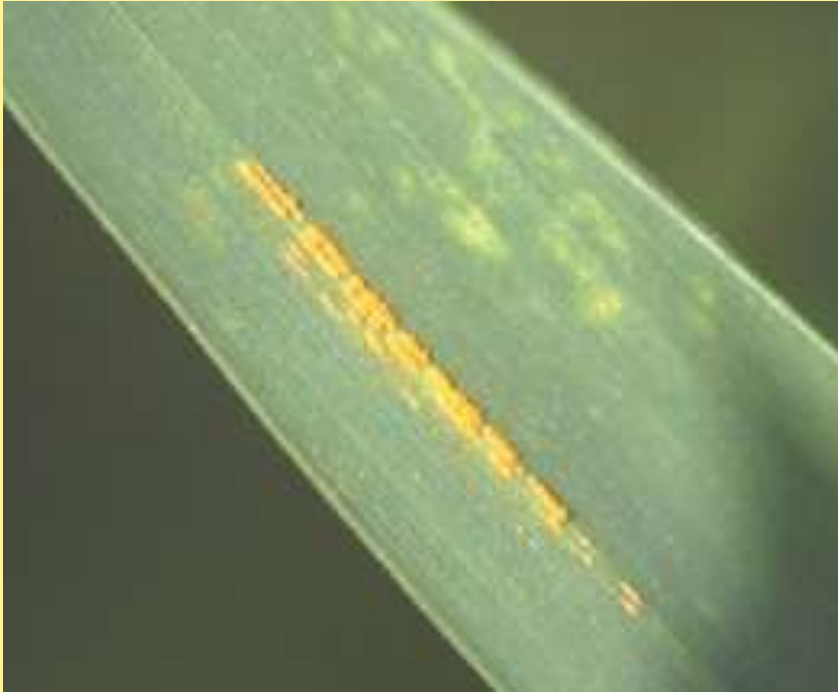
Leaf (or Brown) Rust



Puccinia recondita / Telia (Conservation)

Symptoms / Cereals (Wheat)

Stripe (or Yellow) Rust



Puccinia striiformis / Uredia (Propagation, Damages)

Symptoms / Cereals (Wheat)

Stripe (or Yellow) Rust



Puccinia striiformis / Uredia (Propagation, Damages)

Symptoms / Cereals (Wheat)

Stripe (or Yellow) Rust



Puccinia striiformis / Telia (Conservation)

Symptoms / Cereals (Wheat)

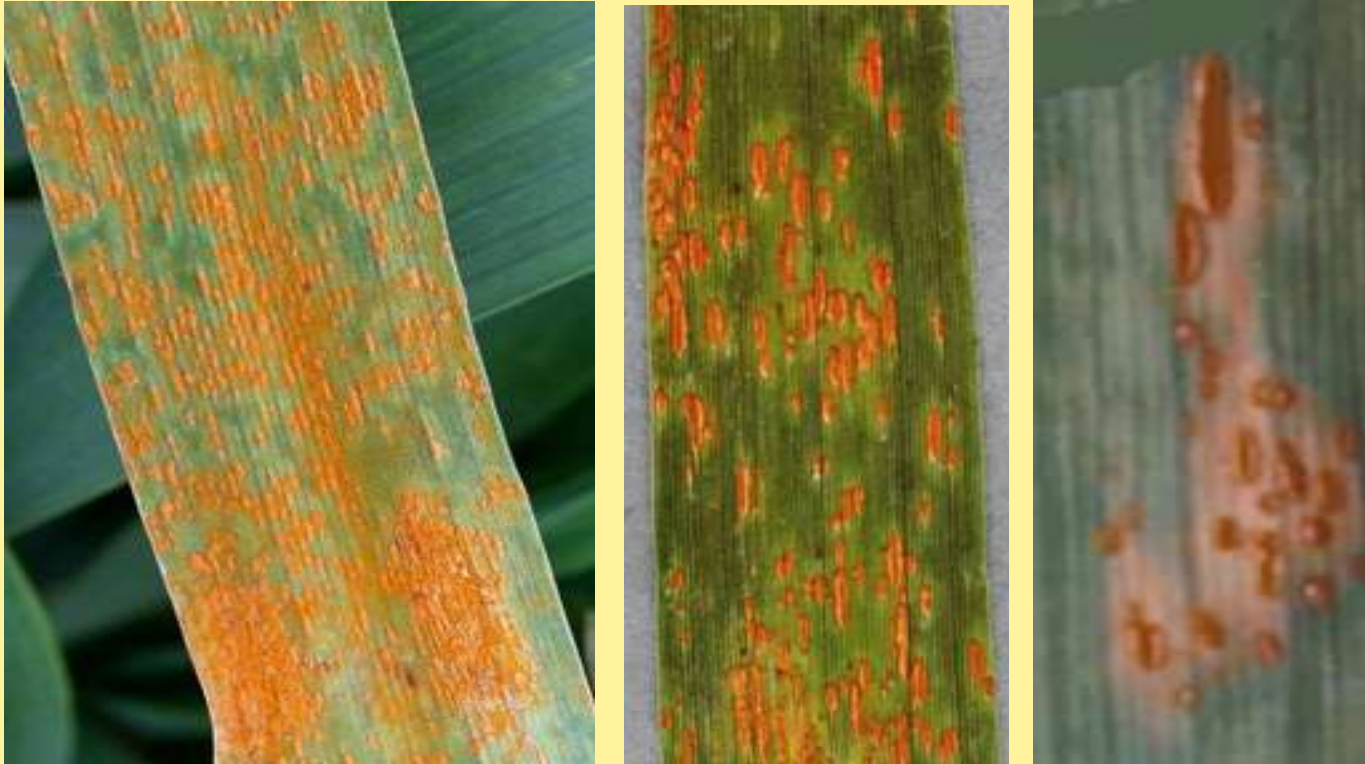
Leaf Rust + Stripe Rust



Uredia (Propagation, Damages)

Symptoms / Cereals (Oat)

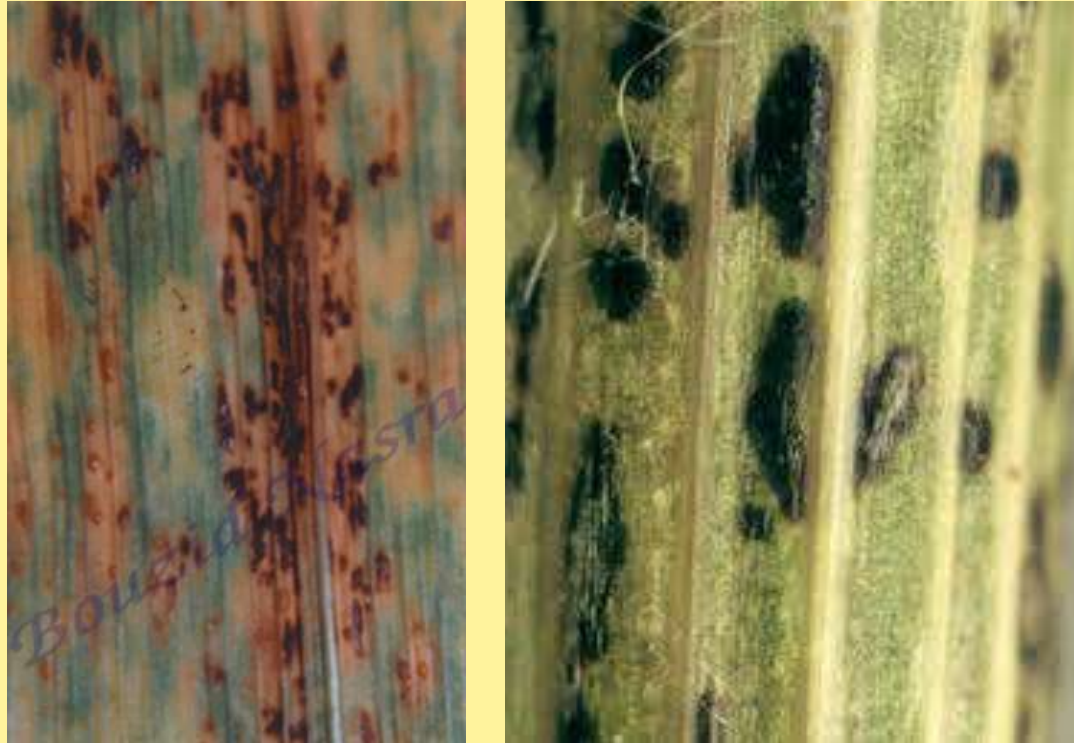
Crown Rust



***Puccinia coronata* / Uredia (Propagation, Damages)**

Symptoms / Cereals (Oat)

Crown Rust



Puccinia coronata / Telia (Conservation)

Symptoms / Cereals (Barley)

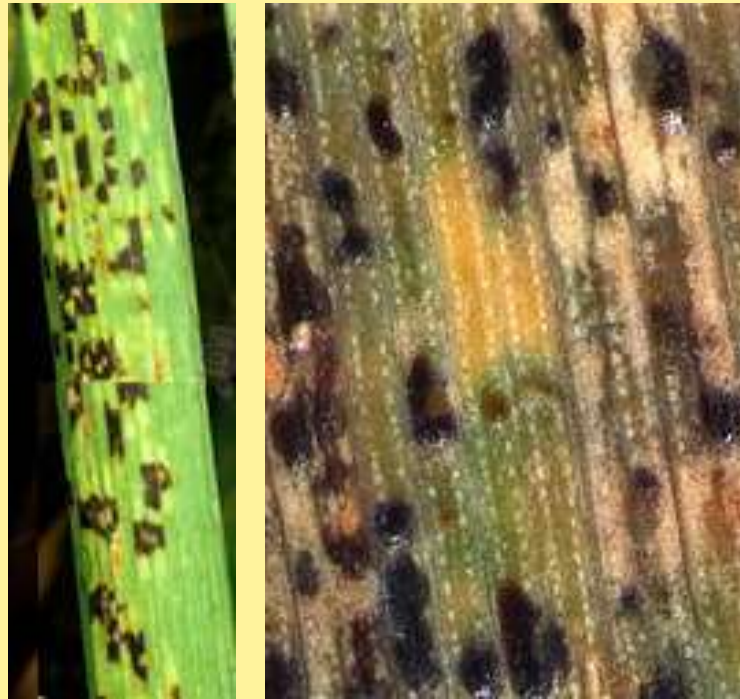
Leaf (or Brown) Rust



Puccinia hordei / Uredia (Propagation, Damages)

Symptoms / Cereals (Barley)

Leaf (or Brown) Rust

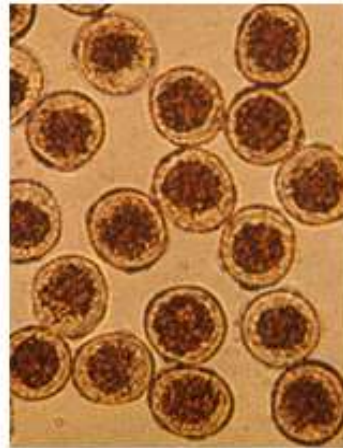


Puccinia hordei / Telia (Conservation)

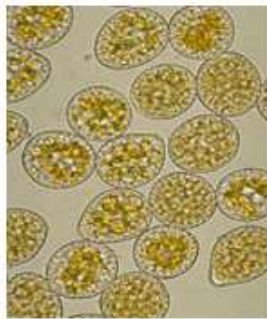
Rusts / Cereals



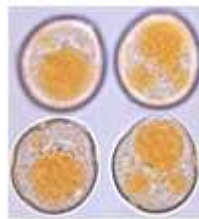
Puccinia graminis



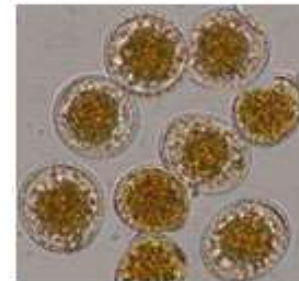
Puccinia recondita



Puccinia striiformis



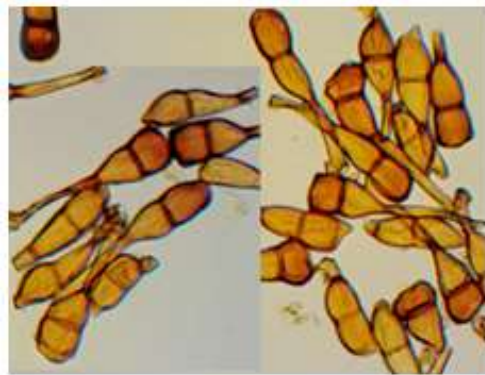
Puccinia hordei



Puccinia coronata

Uredospores (monocellular)

Rusts / Cereals



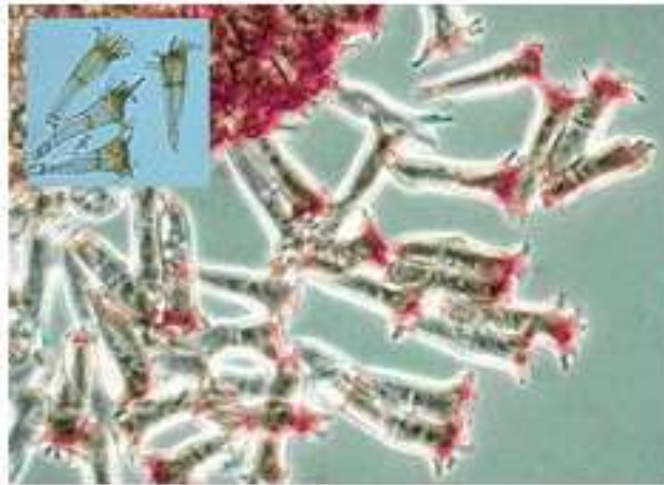
Puccinia graminis



Puccinia recondita



Puccinia striiformis



Puccinia coronata

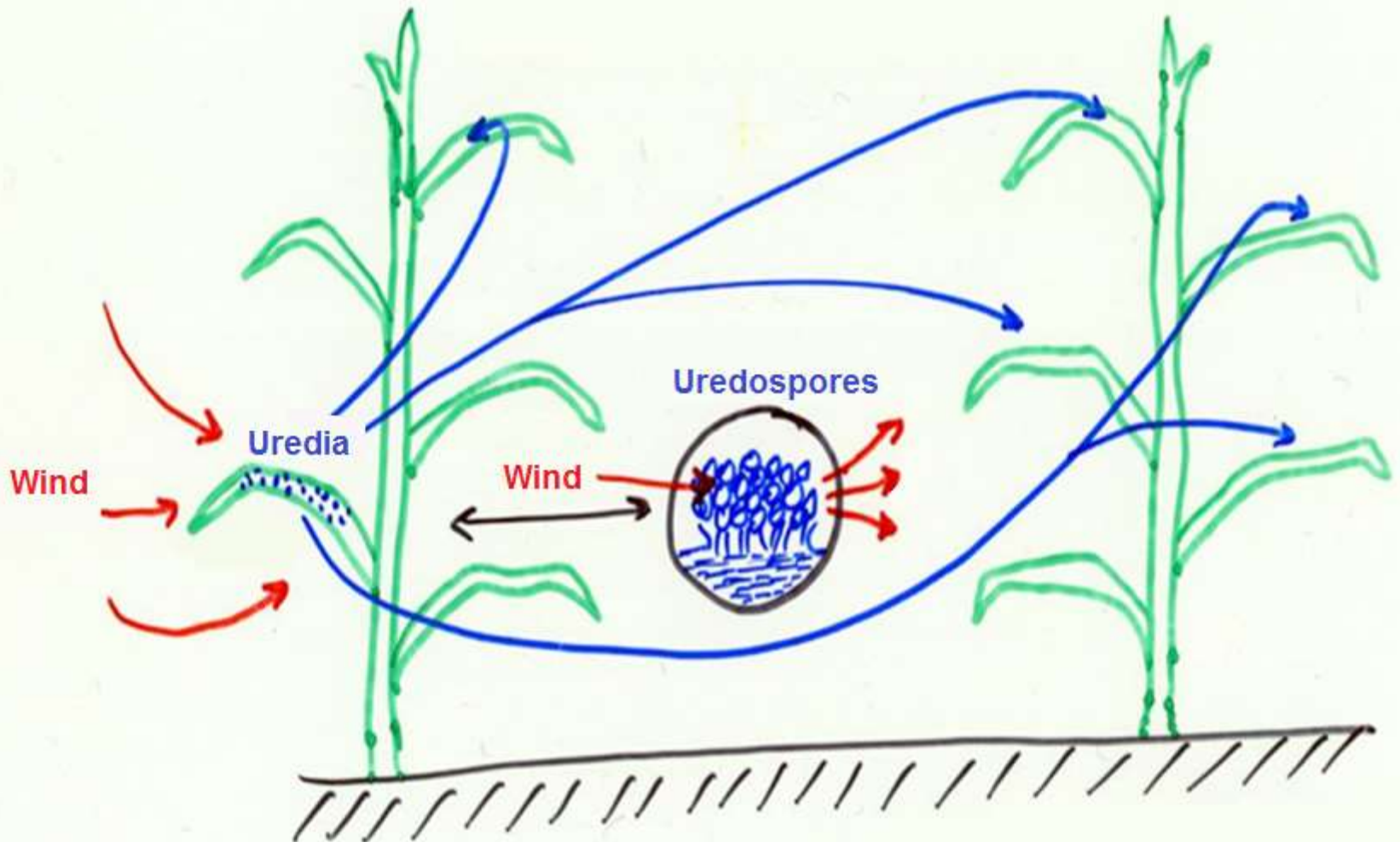


Puccinia hordei

Teliospores (bicellular, except *P. hordei*)

Rusts / Cereals

Propagation of Rusts on Cereals



Biology of Cereal Rusts

* All rusts of cereals are:

- Heteroecic: 2 host plants (I & II)
- Macrocytic: 5 spore stages

* Transmission:

- *Uredospores* coming from far infected plants (hundreds Km),
- Infected debris (Teliospores), Basidiospores, Aeciospores, *Uredospores* (if the cycle is complete),
- Not transmitted by seeds.

* Favorable conditions : High humidity (Rainy spring)

Cereal infected Organs

- 1- **Stem** (or Black) **Rust** of wheat: Stems and other organs
- 2- **Leaf** (or Brown) **Rust** of wheat: Leaves
- 3- **Stripe** (or Yellow) **Rust** of wheat/triticales: All organs
- 4- **Leaf** (or Brown) **Rust** of barley: Leaves
- 5- **Crown Rust** of oat: All organs

Favorable Temperatures

3- **Stripe** (or Yellow) **Rust** of wheat/triticale: 10-20°C

2- **Leaf** (or Brown) **Rust** of wheat: 15-25°C

5- **Crown Rust** of oat: 15-25°C

1- **Stem** (or Black) **Rust** of wheat: 20-30°C

4- **Leaf** (or Brown) **Rust** of barley: 20-30°C

How to combat Cereal Rusts

*** Two essential components:**

1- Chemical control using Fungicides,

2- Genetic control by selecting resistant varieties.

*** Other means of control are little efficient.**

Chemical Control of Cereal Rusts

- One first treatment as soon as symptoms appear (Uredia, Uredospores) on cereals,
- A second treatment one month later if conditions stay favorable to the disease.

Registered Fungicides against Cereal Rusts in Tunisia (2016)

- Azoxystrobin**
- Azoxystrobin + Propiconazole**
- Boscalid + Epoxiconazole**
- Chlorothalonil + Propiconazole + Cyproconazole**
- Cyproconazole + Azoxystrobin**
- Cyproconazole + Propiconazole**
- Epoxiconazole**
- Epoxiconazole + Kresoxim-Methyl**
- Epoxiconazole + Thiophanate-Methyl**
- Fenpropimorph**
- Fenpropimorph + Epoxiconazole + Metrafenone**
- Fenpropimorph + Propiconazole**
- Fluoxastrobin + Tebuconazole**
- Flusilazole + Carbendazim**

Registered Fungicides against Cereal Rusts in Tunisia (2016)

- Flutriafol**
- Flutriafol + Thiabendazole**
- Mancozeb**
- Prochloraz + Tebuconazole**
- Propiconazole + Cyproconazole**
- Propiconazole + Trifloxystrobin**
- Prothioconazole + Tebuconazole**
- Pyraclostrobin + Epoxiconazole**
- Pyraclostrobin + Epoxiconazole + Fluxapyroxad**
- Tebuconazole**
- Tebuconazole + Prochloraz**
- Tebuconazole + Trifloxystrobin**
- Triadimenol + Spiroxamine + Tebuconazole**

Choice of Fungicides

Fungicides inhibiting the biosynthesis of ergosterol (FRAC 3)

Triazoles (3)

- Cyproconazole
- Epoxiconazole
- Flusilazole
- Flutriafol
- Propiconazole
- Prothioconazole
- Tebuconazole
- Triadimenol

Imidazoles (3)

- Prochloraz

Choice of Fungicides

Fungicides inhibiting the respiratory chain (FRAC 11)

Strobilurins (11)

- Azoxystrobin
- Fluoxastrobin
- Kresoxim-Méthyl
- Pyraclostrobin
- Trifloxystrobin

Fungicides inhibiting the tubulin polymerization (FRAC 1)

Benzimidazoles (1)

- Carbendazim
- Thiabendazole
- Thiophanate-Methyl

Choice of Fungicides

Diverse FRAC:

- Boscalid / Carboxamides (7)
- Fluxapyroxade / Pyrazoles (7)
- Fenpropimorph / Hydroxyanilides (5)

- Chlorothalonil / Chloronitriles (M5)
- Mancozeb / Dithiocarbamates (M3)
- Metrafenone / Benzophenones (U8)



Thank You