ITLUS Conference 1<sup>st</sup> December 2011

# Protecting against fungal disease – the challenges

Dr. Tom McCabe, School of Agriculture, UCD

# **Topics Covered**

• Unique Factors in Ireland - weather and key crop diseases

• Recent Experiences - 2011



Areas of intense Septoria tritici infection surrounded by crop which at this time was almost disease free



### 2002 – Fungicide failure in the field

The emergence of Septoria tritici resistance to strobilurin fungicides was stunning and dramatic

- 2002 was the highest disease pressure year in at least a decade
- Disease control on wheat started very well and finished very variably
- High spend on strobilurin-based fungicide programmes with over 90% of crops getting strob at T2
- Uneven control of Septoria across fields e.g. disease build-up in a very unusual spatial pattern
- Unexplained differences in efficacy of disease control between fields, farms, localities and regions



### Fungal Disease Stress Points Recent History

Period	Problem
1985	Septoria on wheat
Late 1980's	Blight on Potatoes / Yellow rust on wheat
1993	Septoria on wheat
1997 / 1998	Rhynco / Blotch on barley
2002/03	Strobs and Septoria control on wheat
2007 / 2008	Fusarium / Septoria on wheat
2011	Septoria control on wheat

#### Untreated

#### Treated



# Potato Blight Trial cv. Rooster (2002)

Location : Co. Meath

Treatment	% Blight	Total Yield (t/ha)	Saleable Yield (t/ha)		
Untreated	100.0	13.5	3.9		
Fluazinam	21.6	35.1	32.4		
Infinito	12.1	<b>41.o</b>	34.3		

#### EU Blight Workshop Blight fungicide ratings (2005)

	Effectiveness				Mode of	action	Rain-	Plant		
	Leaf blight	Stem blight	Tuber New blight growing point		Protectant	Curativ e	Anti- sporulant	fastness	mobility	
Fluopicolide + Propamocarb	+++	++	++(+)	++	+++	++	++(+)	++(+)	Translaminar + systemic	
benthiavalicarb- isopropyl + mancozeb	+++	+(+) L	+(+)	?	+++	+(+)	+	++(+)	Translaminar + contact	
cymoxanil + mancozeb	++(+)	+(+)	-	?	++	++	+	++	Translaminar + contact	
dimethomorph + mancozeb	++(+)	+(+)	++	?	++(+)	+	++	++(+)	Translaminar + contact	
cyazofamid	+++	+	+++	?	+++	-	-	+++	Contact	
fluazinam	+++	+	++(+)	?	+++	-	-	++(+)	Contact	
zoxamide + mancozeb	bstance in t	the list is N + L	Dased on the Dased	e of its regis	tration status e	either in the	EU or elsewh	ere in Europe. ++(+)	Contact + contact	

### Winter Oilseed Rape – Disease Issues : PHOMA control



### **Topics Covered**

**Unique Factors in Ireland - weather and key crop diseases** 

**Recent Experiences - 2011** 

#### Rainfall (mm/day) UCD LYONS - Eastern Ireland -Summer 2011



#### Rainfall (mm/day) UCD LYONS - Eastern Ireland -Summer 2011





#### **Cordiale Seedtech – Untreated Flag Leaves 27/5/11**





#### •Sensitivity Studies with New Irish Strains in 2009 1. Tebuconazole

pyrosequencing of cyp51 mutations in selected Irish strains



strain IRE4 belong to class TriR8 as the reference strain

#### Data: Bayer CropScience

### Assessing triazole insensitivity







Microtitre plate tests with active ingredient vs. individual isolates =  $ED_{50}$ 

Molecular studies to identify genetic markers for resistance = CYP51 mutations e.g. I381V / 136 / **S524T** 

Spray tests on artificially inoculated plants in controlled environments = reliability of ED<sub>50</sub>

Outdoor replicated spray trials in natural conditions with field populations = field performance



Winter Wheat 2011 - Data from 15 trials in Eastern Ireland















# **Review of 2011 season in Ireland**

- Septoria population widespread emergence of 524-linked mutation in field crops -- a dynamic situation
- Weather cold winter, dry spring
- South very wet May with intense disease infection and reduced fungicide efficacy with high treated disease levels
- East 'normal' rainfall in summer months giving moderate disease pressure, excellent SDHI performance (all a.i.s), mixed / variable efficacy from triazoles
- Excellent grain fill , very high yield levels, untreated yields of 9-10 + t/ha, treated yields + 1.0 -2.5 t/ha (in east )

# **Carboxamide (SDHI) Chemistry**

- Boscalid / Bixafen / IZM / LEM / Xemium
- A lot of products coming to the market
- Boscalid: (+EPZ ) Venture Good persistence / colour
- Bixafen: (+PTZ) Aviator & Siltra Very good formulation / spectrum
- IZM: (+CYP) Bontima / (+EPZ) Seguris Good GLA / yield
- LEM: LEM+CTL / LEM+CYPZE Good persistence / flexible
- Xemium: (+EPZ) <u>Adexar</u> (+ EPZ+F500) Very curative / strongly active

#### Winter Wheat Trials 2010

2-Spray Fungicide on Septoria on cv. Cordiale Duleek



#### **Resistance management principles**

Different modes of action but must be significantly active on the same part of the life cycle



#### **Ranking the Evolutionary Risk of Plant Pathogens (Celeste Linde)**

<b>Mixed</b> "epidemic" genetic structure	H i g h (3)	Phytophthora sojae	7 6 5	Rhynchosporium secalis Mycosphaerella graminicola Phaeosphaeria nodorum	8 7 6	Blumeria graminis Phytophthora infestans- new populations Puccinia graminis f. sp. tritici – pre 1930's	9 8 7	- (3) - (2) - (1)	Effectiv
Outcrossing Sexual high genotype diversity Inbreeding	M e d i u m (2)	Pratylenchus Heterodera Armillaria <b>mellea</b>	6 5 4	Sporisorium reilianum	7 6 5	Ustilago hordei, maydis Tilletia Sclerotinia sclerotiorum	8 7 6	- (3) - (2) - (1)	e populat
<b>Asexual</b> low genotype diversity	L o w (1)	Fusarium oxysporum f. sp. melonis, lycopersici, cubense Soil-borne viruses Meloidogyne incognita	<mark>5</mark> 4 3	Colletotrichum graminicola Insect-dispersed viruses	6 5 4	Magnaporthe grisea P. graminis f. sp. tritici, avenae Human-dispersed viruses	7 6 5	- (3) - (2) - (1)	I O N S i Z e
Reproduction/, mating system		Low (1)		Medium (2)		High (3)			
		Propagules soilborne, difficult to disperse ~ 5 meter total dispersal	Propagules waterborne, moderate dispersal ~100 m – within field		Propagules airborne, easily dispersed ~10 – 1000 km				
flow	уре	Man-aided dispersal may modify risk McDonald and Linde 2002							

Mycosphaerella graminicola (aka Septoria tritici) is a highly sexual, very mobile pathogen that evolves rapidly in farmers' fields (and in laboratories and greenhouses and experimental plots)

#### Bruce McDonald – leading scientist

- ~80% of world genetic diversity is present within 1 m<sup>2</sup> area of any farmer's field
- 2. ~92% is within 8 m<sup>2</sup> of a farmer's field



# **Topics Covered**

- Unique Factors in Ireland weather and key crop diseases
- Recent Experiences 2002 / 2011

- New Fungal Disease Strains (mutations) and Fungicide Resistance
- Cultural practices and Genetic (Varietal) control
- ICM / IPM / Decision Support Systems / Expert Systems
- Fungicide chemistry and cereal disease control
- Future prospects Wheat / Barley / Other crops

# cv Cordiale – Untreated



### **Cultural Practices – very important**

- Rotation / crop diversity / spring and winter cropping
- Sowing date / seedrate
- Management practices N timing

# **Genetic / Varietal Resistance**

- A cornerstone of disease management for all field crops in Ireland
- Single gene / multi-gene resistance challenges, time lag with new disease strains / fungicide 'shocks' / novel diseases
- Hybrids (WB), GM technology (potatoes), Molecular techniques
- Ups and downs with individual varieties in specific crops -
  - Yellow Rust and Slepjner/Robigus/Oakley, Blotch on Cooper
  - Septoria on Riband/Consort/Tanker etc, Net Blotch on Lux/Wicket,
  - Rhyncho on Saffron, Mildew on Barra, Blight on Rooster
- Successful Varietal Performance Yield and Quality in recent decades

#### Variety Trial 27/5/11. Septoria susceptible

![](_page_35_Picture_1.jpeg)

### **Integrated Disease Control Practices**

- ICM / IPM good integrated disease control practices
  - Winter Wheat v Spring Wheat ?
  - Cultivar (disease resistance ratings)
  - Rotation / Sowing date / Seedrate /
  - N nutrition
- Decision Support Systems have potential but show limited success in unpredictable climate (rainfall)
  - Often based on one disease only / 'idealistic' / based on premise of using less often in a wet climate you need to use more
  - Expert systems probably more a research-based tool

#### Much favoured by Legislators / EU Pesticide Directive

![](_page_37_Picture_0.jpeg)

**Fungicide Use, Economics and Profitability of Crop Production** 

- Are Fungicides expensive ?
  - Cost:benefit analysis
  - High grain prices mean the high usage level in Ireland is bearable
  - Low grain prices mean the moderate-high usage is unbearable
  - Pricing is for key European markets FR / GER / UK
- Part of a competitive disadvantage?
  - High diseases and excess rainfall
  - Rainfall delivers higher yields
- Low Grain Prices a very difficult scenario
  - Limited scope to reduce fungicide inputs but big pressure on agronomists (surprisingly price inelastic on both grain prices (UK stg£55/tonne) and fungicide prices)

*Trial – Coole – Opus + Bravo* T1 timing sprayed on 09/05/2011 and all received cover spray of 0.75 Opus on 30/06/11.

![](_page_39_Picture_1.jpeg)

**Coole – Opus + Bravo + SDHI** - T1 timing sprayed on 09/05/2011 and all received cover spray of 0.75 Opus on 30/06/11.

![](_page_40_Picture_1.jpeg)

![](_page_41_Picture_0.jpeg)

# **Strategy for 2012 season in Ireland**

- Crops sown relatively early followed by good growth in a very mild autumn indicating high disease inoculum next spring
- Big switch to SDHI expected, already 30% of wheat choice (boscalid/bixafen),
   SDHI x2 sprays in 2012
- SDHI as key treatment at T1 and T2 expected
- IZM (Seguris) and Boscalid (Tracker) at T1
- BIX (Aviator), Xemium (Adexar) and IZM (Seguris) at T2
- Triazoles prothio and epoxi showing similar reduced efficacy
- Focus on mixtures prothio+teb / epoxi+metcon\*\*
- Clear concern over the gap in triazole / SDHI efficacy (30% +)
- Chlorothalonil x3 expected the anchor treatment and will be recommended to be used with all SDHI combinations

### **Carboxamide (SDHI) Chemistry in barley**

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![](_page_44_Picture_0.jpeg)

### RAMULARIA Leaf Spotting

### **NET BLOTCH**

![](_page_44_Picture_3.jpeg)

![](_page_45_Picture_0.jpeg)

### Site 1. Athy % Ramularia Leaf 2 on 15th July (29 daa)

![](_page_46_Figure_1.jpeg)

% Infection

#### Winter Barley Trials 2009 T1 + T2 Fungicide on **Foliar Disease** on cv. Saffron

![](_page_47_Figure_1.jpeg)

#### UCD Lyons - cv. Centurion in 2009 : Treated on 16<sup>th</sup> June % Rhynco on Two Dates

![](_page_48_Figure_1.jpeg)

% BRACKLING (Breakdown) - 2010 Spring Barley cv Centurion

![](_page_49_Figure_1.jpeg)

#### And then there is the uncertainty of fusarium ear blight control!

![](_page_50_Picture_1.jpeg)

# **Future Prospects**

- Potatoes the ultimate fungal disease test.
  - Huge challenge ongoing
  - Aggressive blight strains -- but good chemistry pipeline
- Barley (& Oats) optimistic outlook but cautious probably the best set of chemistry and genetics
- Wheat Concern
  - Strobs nearly obsolete
  - Triazoles under sustained pressure, reducing efficacy and disappointing field performance
  - SDHI (carboxamides) more preventative, excellent in 2011, single site so will have their problems in time
  - Thank God for chlorothalonil