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Loss of sensitivity to strobilurin fungicides in *Mycosphaerella pinodes*

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Canada

Gossen’s Guide to Disease Management

- Disease management activities should be almost complete **BEFORE** any crop is planted.
- Plan for a diverse crop rotation
  - 3- to 4-yr, alternating cereals with dicots. Even different cultivars can be useful if they carry different sources of resistance.
- Use the best genetics for your region.
  - High yield, suitable days to harvest, good disease resistance.
- Don’t plant problems with the crop.
  - Use seed with high germination and vigour, treated & inoculated, minimal / no pathogens with seed.
- Provide isolation from last year’s heavily infected fields.
- Scout fields and apply a foliar fungicide only if required.

Disease Management – Past and Present

- Crop residue was buried.
- Windbreaks, pastures, and headlands for diversity.
- Crop rotation largely for weed management.
  - Provided interval for residue breakdown.
  - Also provided natural biological control.
- Improved herbicides facilitate short rotations, reduced tillage, few windbreaks / pastures.
- Disease management increasingly reliant on major gene resistance and fungicides.

Fungicide Usage on the Canadian Prairies

Province	Production area (M ha)	Fungicide applied (%)			↑Δ (%)
		2006	2011	2016	
Alberta	7.0	7	15	22	214%
Saskatchewan	10.9	7	21	33	374%
Manitoba	3.5	23	47	51	122%
Total	21.3	11	23	32	191%
Ontario	2.4	11	17	34	209%

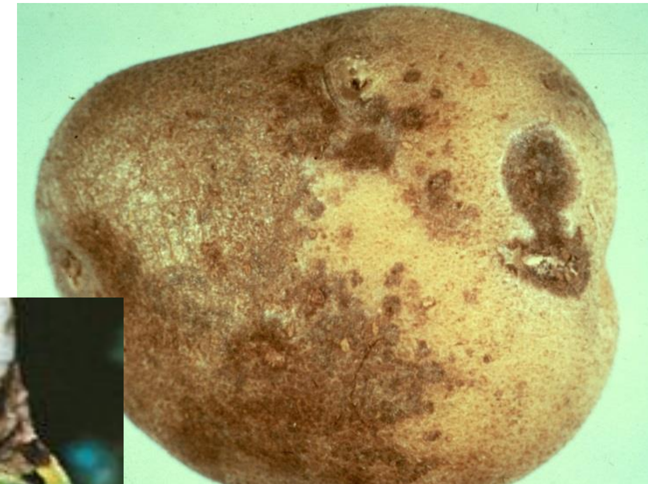
History of Fungicide Usage

- Initially, persistent actives with multi-site modes of action, e.g., copper, heavy metals.
- Shift to focus on reduced-risk actives (usually non-persistent, single-site modes of action).
- Reduced sensitivity usually detected first under high selection pressure.
- Viticulture, golf courses, orchards > hort crops > intensive field crops > extensive field crops

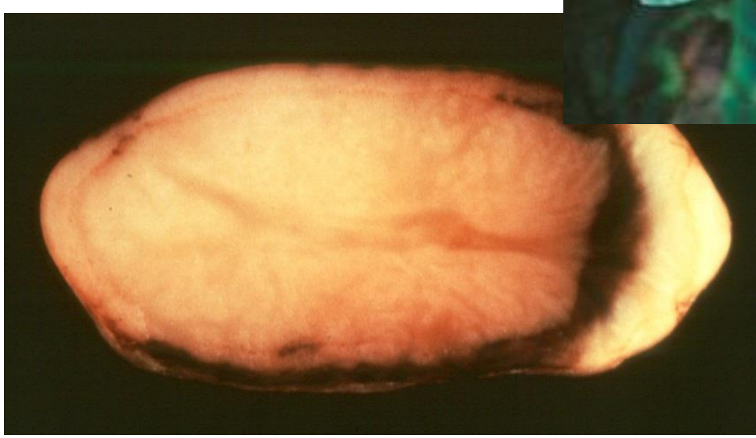
Loss of Efficacy From Fungicide Insensitivity

Fusarium dry rot

Early blight



Silver scurf

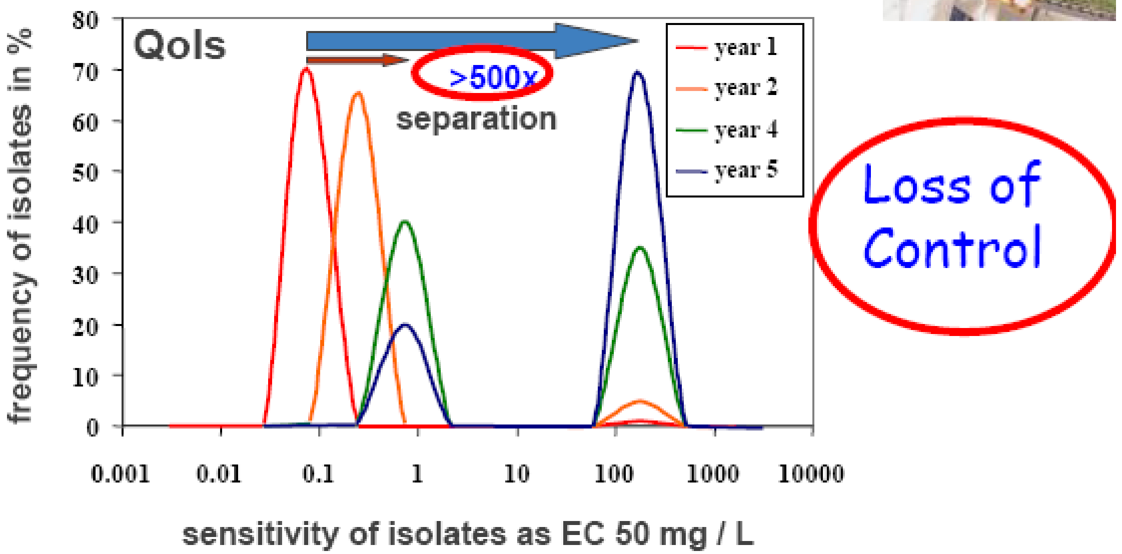


Pink rot

Late blight

Fungicide resistance development: Selection models for QoI and DMI fungicides

monogenic, single allelic resistance at target site, disruptive selection, **high risk**



syngenta

Factors Affecting Risk of Insensitivity

Pathogen

No. of generations

Spore production

Spore dispersal

Occurrence of disease

History of resistance

Overall Resistance Risk

Agronomic

Alternation/Combination

No. of different MOAs

No. of applications

Resistant cultivars

Cropping system

Residue management

Fungicide

Single/multi-site

Persistence

Intrinsic activity

Resistance factors

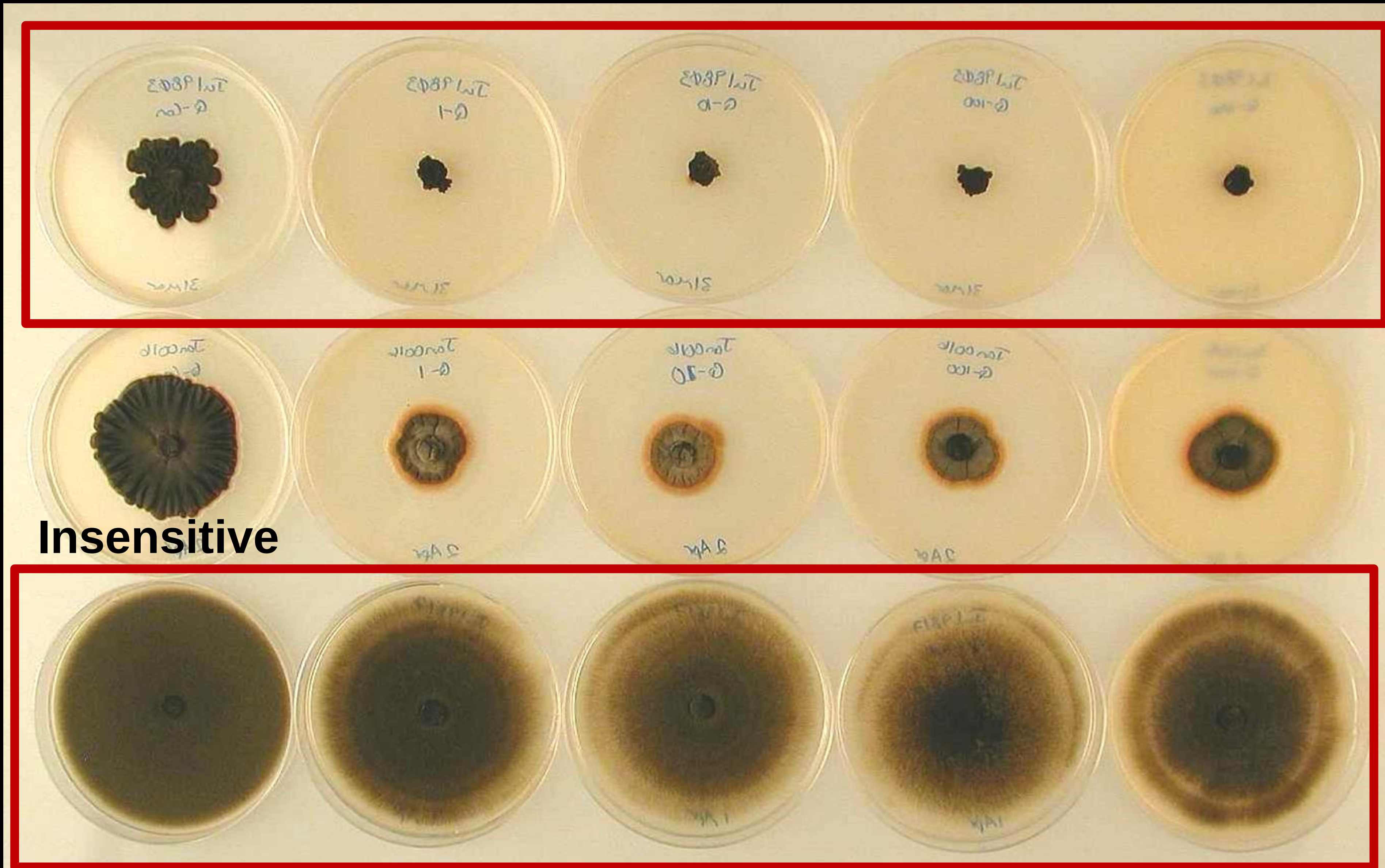
Source: K. Polziehn, BASF

Strobilurin Insensitivity in *Ascochyta rabiei*

Risk of insensitivity to strobilurins was high:

- Genetically diverse pathogen.
- Air-borne sexual spores.
- Several fungicide appl. / yr.
- Insensitivity in related fungi.

Sensitive



0 ppm 1 10 100 1000

Increase of Insensitive Isolates in SK

- **2004–2005** — **Insensitive (%)**
  - Headline 53 isolates Susc — 0%
  - Quadris 4 R, 49 S — 8%
- **2006**
  - Headline 20 R, 17 S — 50%
  - Quadris 23 R, 14 S — 68%
  - Control failures
    - 6 of 7 fields — 100%
    - 1 field — 0%
- **2007** 132 R, 4 S — 97%
- **2008** 74 R, 7 S — 92%

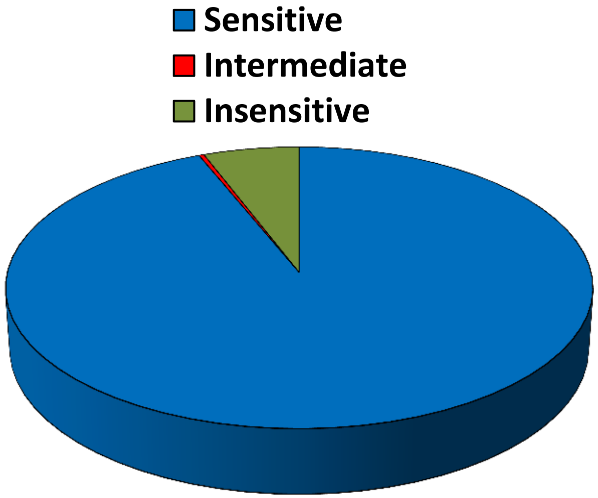
Conclusions

- Rapid increase in insensitivity in SK, AB, and across the Northern Great Plains in 2007.
- Cross-resistance within the strobilurin group.
- Insensitivity resulted in loss of control.
- Industry moved quickly to inform producers and minimize potential for losses.
- No evidence of reduced fitness in insensitive isolates – likely to persist.

Mycosphaerella pinodes from field pea

- Pathogen at high risk of loss of sensitivity to strobilurins.
- Baseline isolates from before 2003.
- Assessed > 300 isolates collected in 2010–2011.

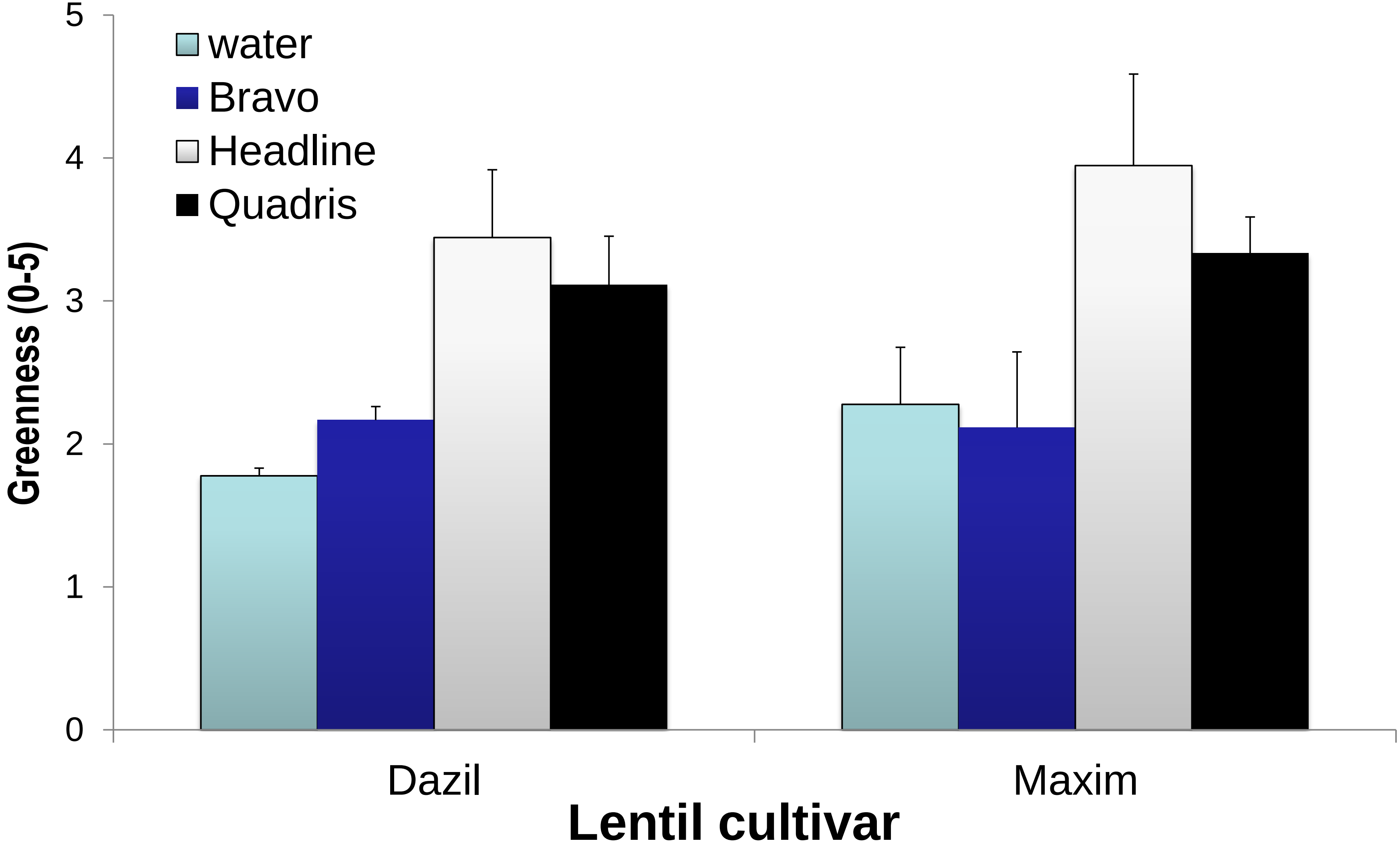
- 8% of isolates from SK & AB insensitive, 0% from ND & WA.
- Populations in SK & AB at risk of loss of efficacy using strobilurins.



Fungicide insensitivity in SK 2013–2016

- 72% (46/64) isolates of *M. pinodes* insensitive.
  - Strobilurins likely no longer effective in the field.
- Crop health benefit assessment
  - No benefit on pea or chickpea.
  - Early season benefit at one site-yr on lentil.
- 24% (13/54) isolates of *A. lentis* from lentil insensitive.
  - Levels only slightly higher than baseline from 10 yr ago.
- 10% (2/22) isolates of *Colletotrichum lentis* from lentil insensitive (baseline).
- 25% (2 of 8) isolates of *A. rabiei* insensitivie

Crop health, lentil cultivars, Guelph 2014



Solutions

- Alternate fungicides with different MOA.
- Tank mix high-resistance risk products with a multi-site partner or different MOA.
- **N.B.** Most of the multi-site actives will be removed / limited this year!!!
- Research to identify pathogen systems at risk.
- Develop cheap, rapid screening methods for high-risk pathogens, for use in local labs.

Conclusion

- Mycosphaerella blight on pea and ascochyta blight on lentil ARE at risk of failure.
- Most field crops are NOT at immediate risk of management failures due to insensitivity.
  - Crop rotation provides adequate disease reduction.
  - Multi-site actives effective (old / cheap, no insensitivity).
  - Pathogens with no air-borne phase, so spread is slow.
  - Pathogens with low genetic diversity.
- Actives will last longer if used less frequently.

Acknowledgements

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Questions?