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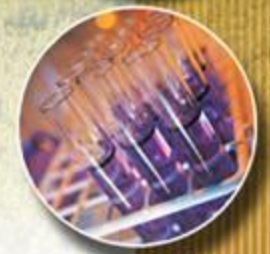

Environment and clubroot risk

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International Clubroot Workshop, Edmonton, June 20, 2013

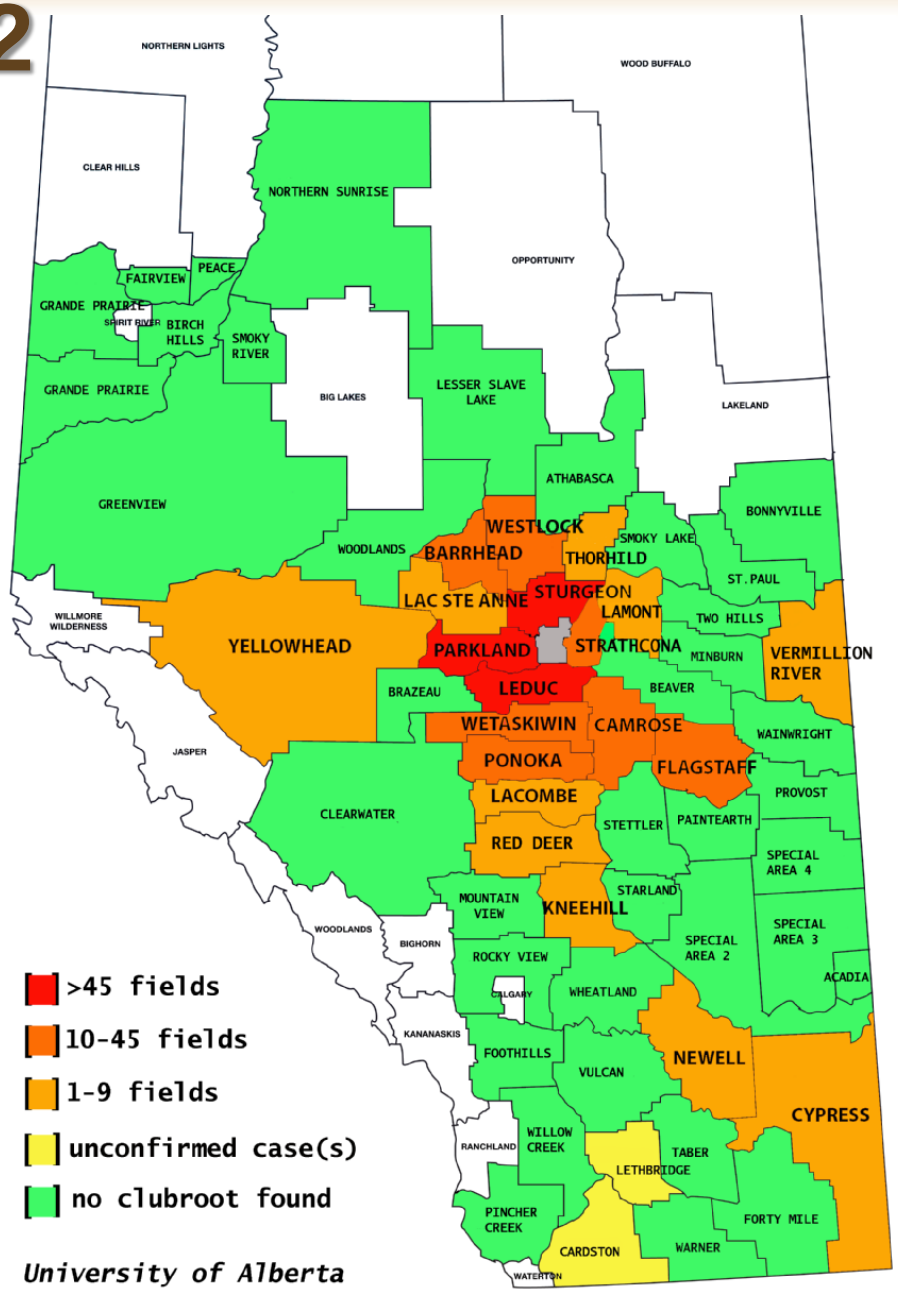
Canada

Projects to assess clubroot risk

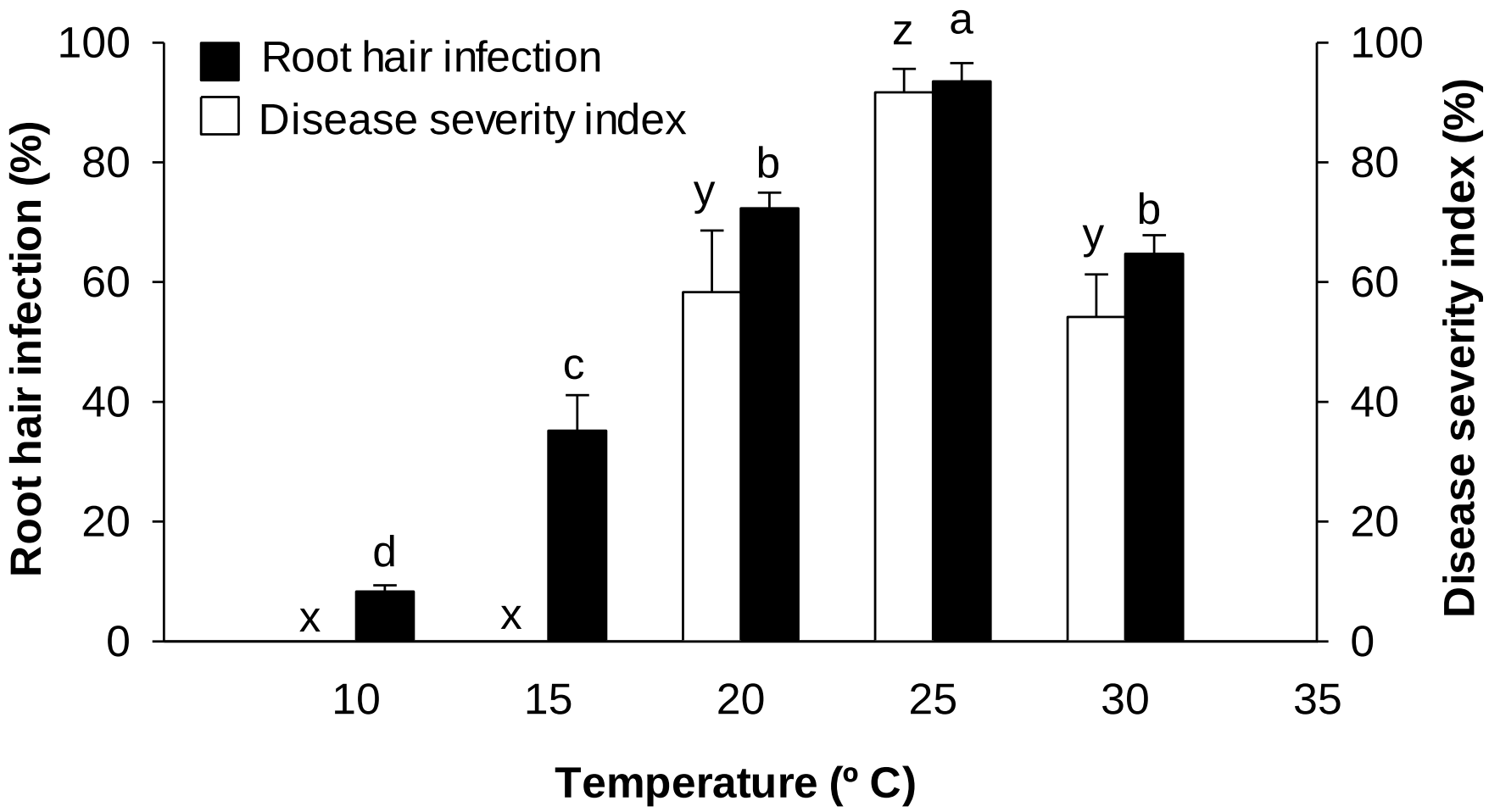
- *Strelkov et al.* – annual survey provides info on the impact of weather on clubroot severity. Also, study movement of spores by wind/water.
- *McDonald / Gossen* – assess impact of temperature, pH, soil type, etc. on clubroot.
- *Turkington / Klein-Gebbinck* – using projection (Climex) and modeling (Dymex) approaches to predict clubroot risk. N.B. Very little info available for canola!

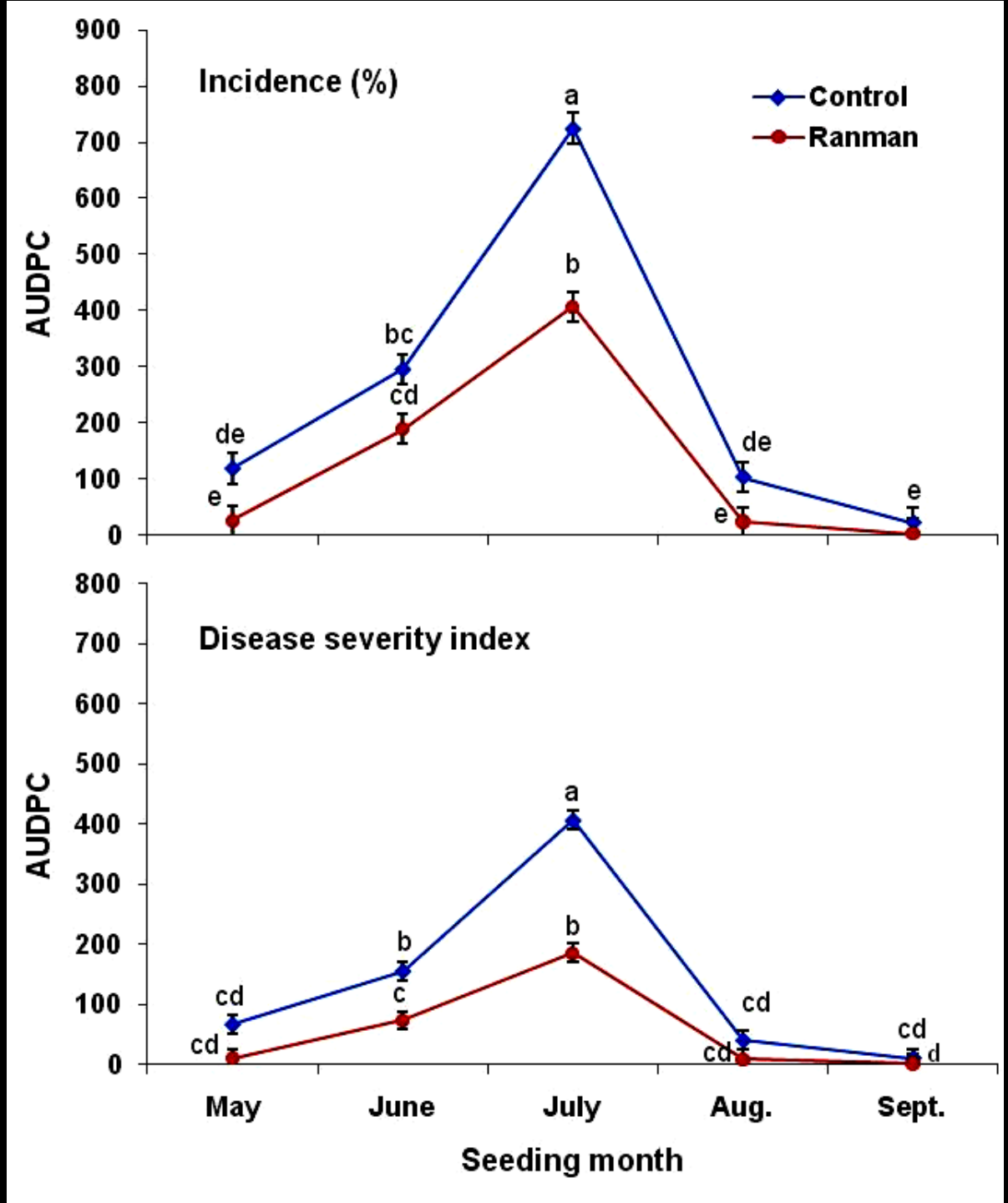
Clubroot status, 2012

- Clubroot confirmed in >1000 fields in Alberta.
- Most severe in black soil zone of central AB, on heavy, acidic soils with abundant rainfall.
- Confirmed in 2 fields in SK in 2011 and 2 fields in MB in 2012.
- **Crucial question** - What is the clubroot risk for other areas, e.g., on more alkaline or lighter soils with lower rainfall?

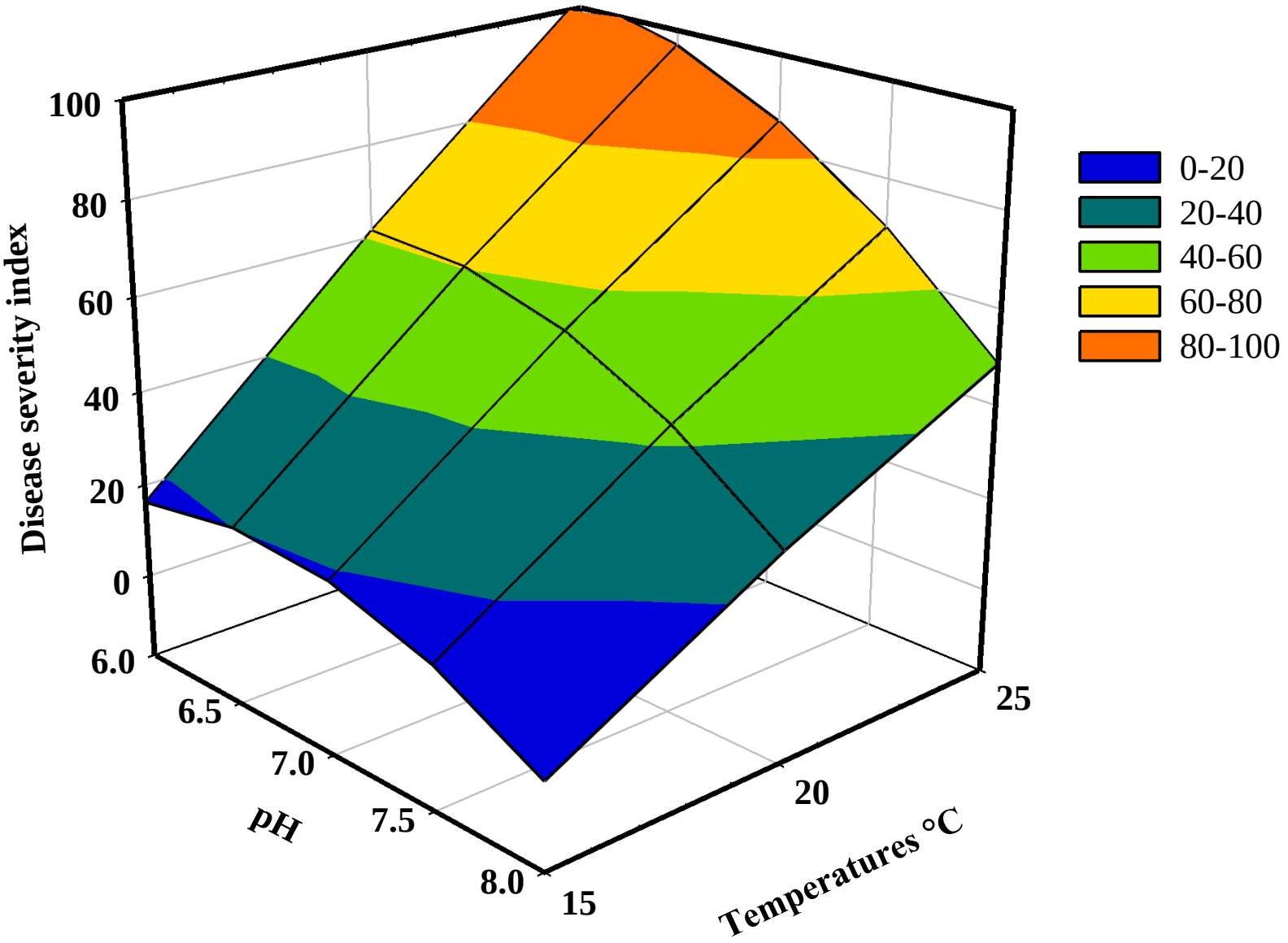


Correlation: Root hair infection vs. Severity

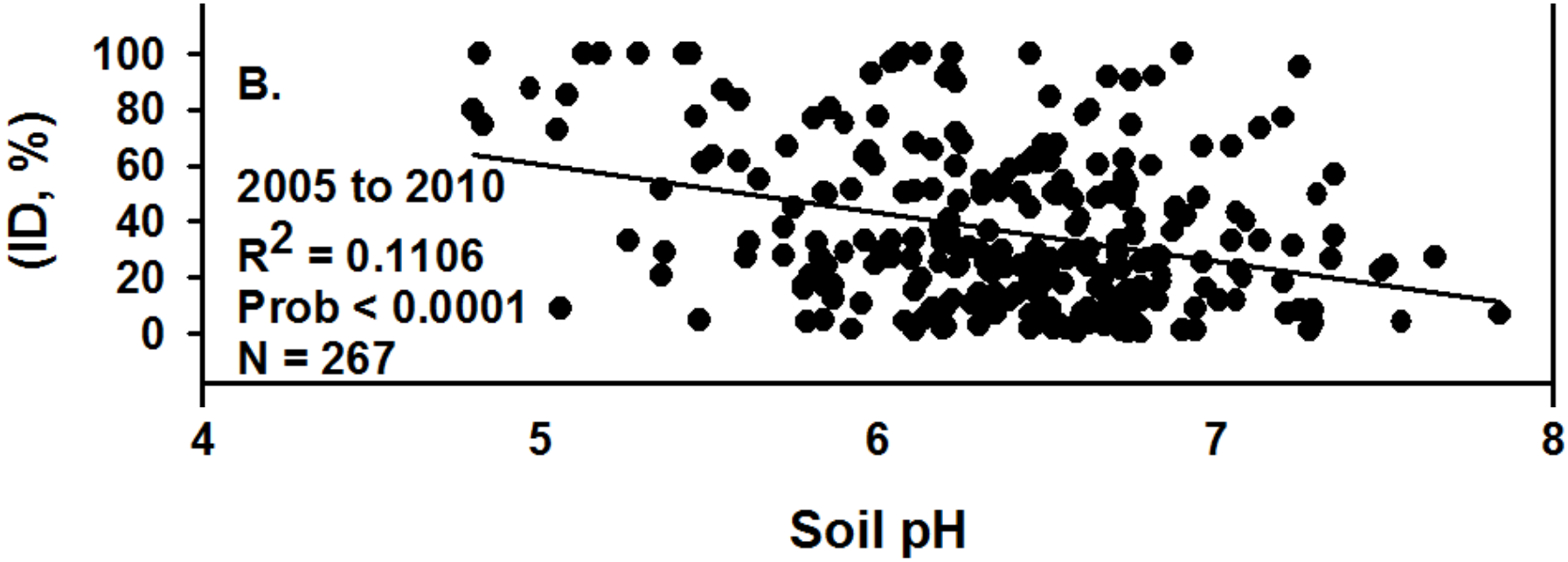



Incidence (%)
AUDPC
900
800
700
600
500
400
300
200
100
0
Control
Ranman
a
b
bc
cd
de
e
de
e
Disease severity index
AUDPC
800
700
600
500
400
300
200
100
0
a
b
b
c
cd
cd
cd
cd
cd
d
May
June
July
Aug.
Sept.
Seeding month

Temperature x pH

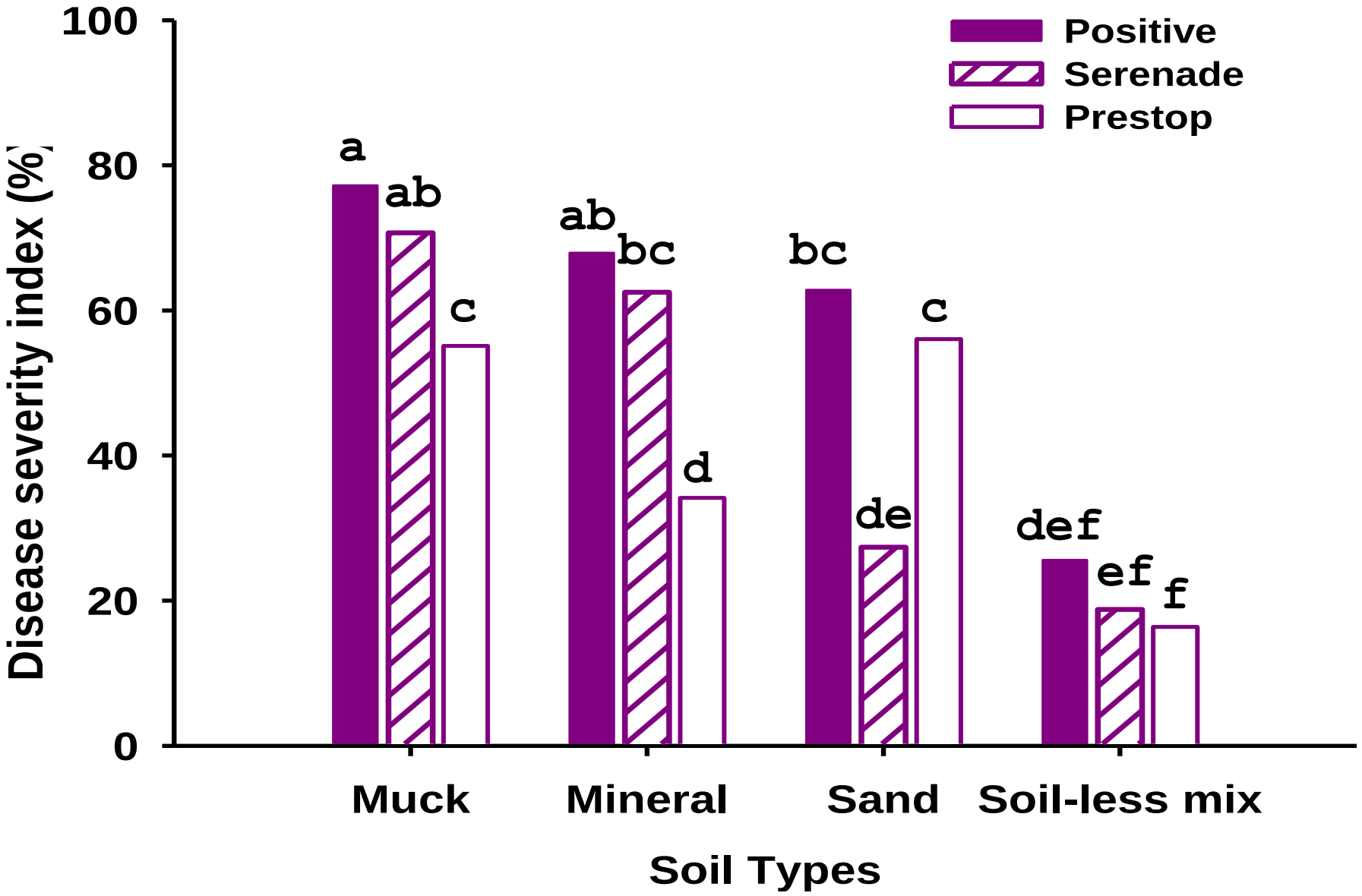


Does moderate pH reduce clubroot?

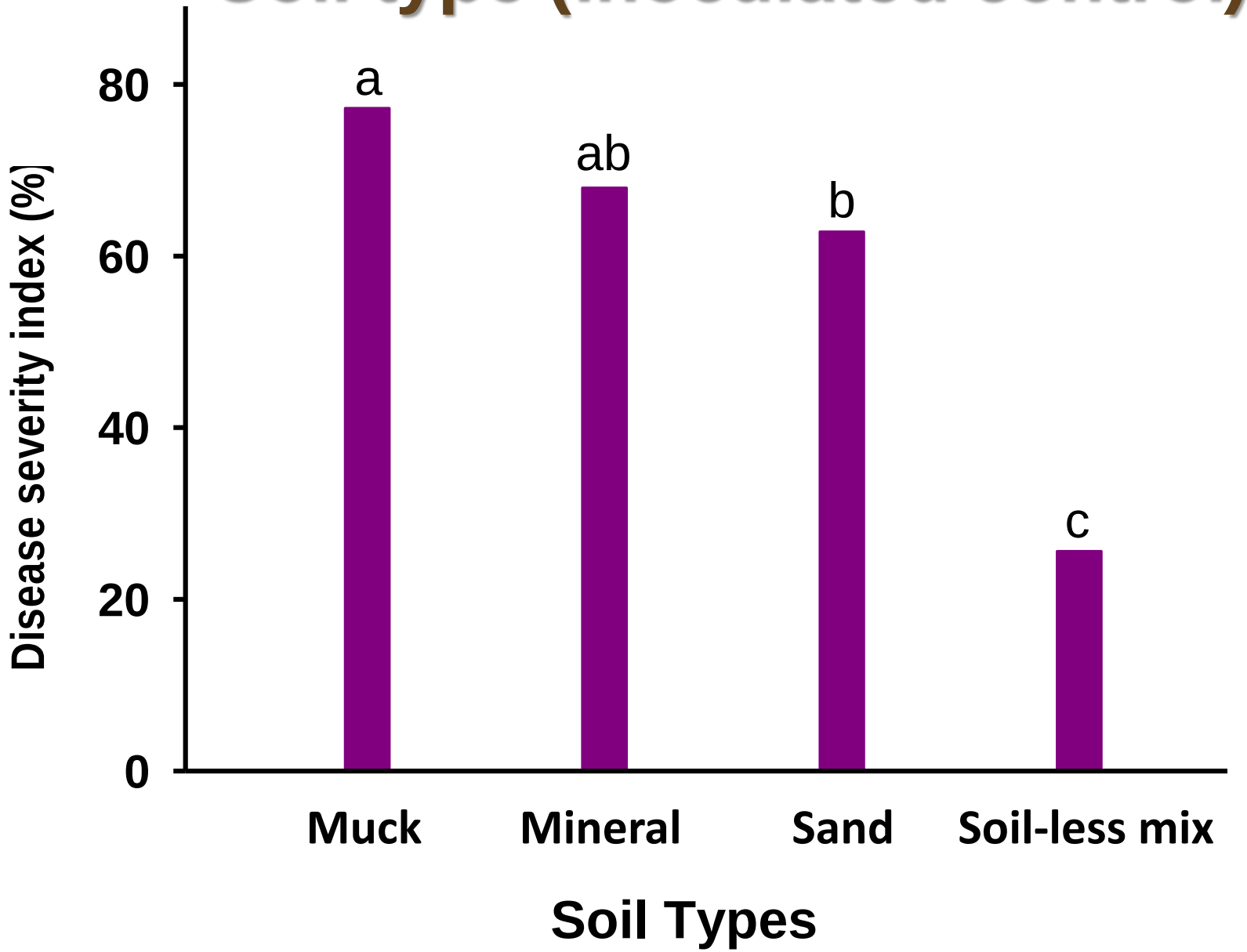


Field assessments support the observations under controlled conditions; pH above 7.5 reduces clubroot, but otherwise the relationship is quite weak

Does soil type affect clubroot?

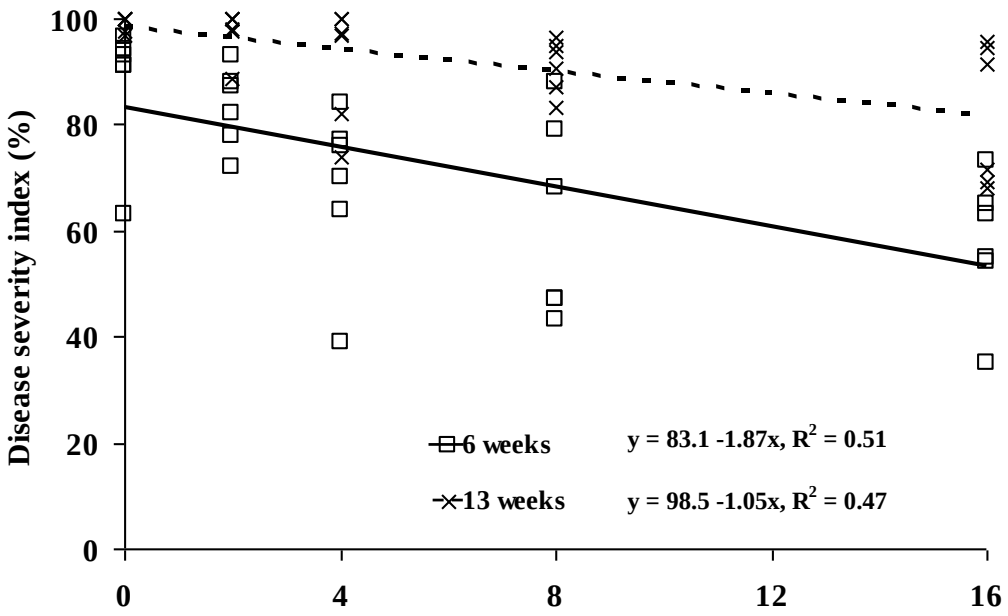


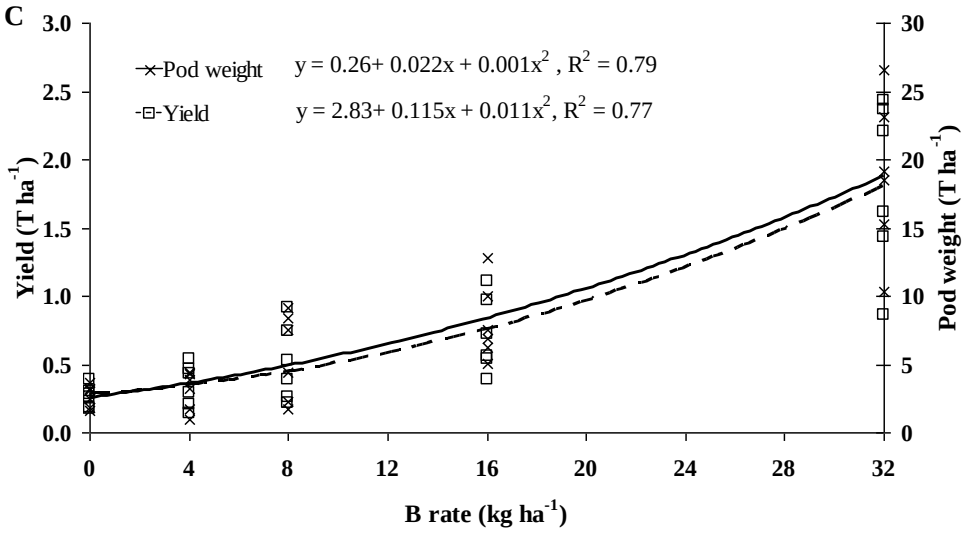
Soil type (inoculated control)



Effect of B & Ca on Clubroot

- Ca levels high in most prairie soils. Likely closely inter-twined with pH.
- B levels in prairie soils as generally low to moderate.
- High rates of B slightly delayed clubroot development and increased yield on organic soils.
- Almost no effect on mineral soils (lower organic matter).



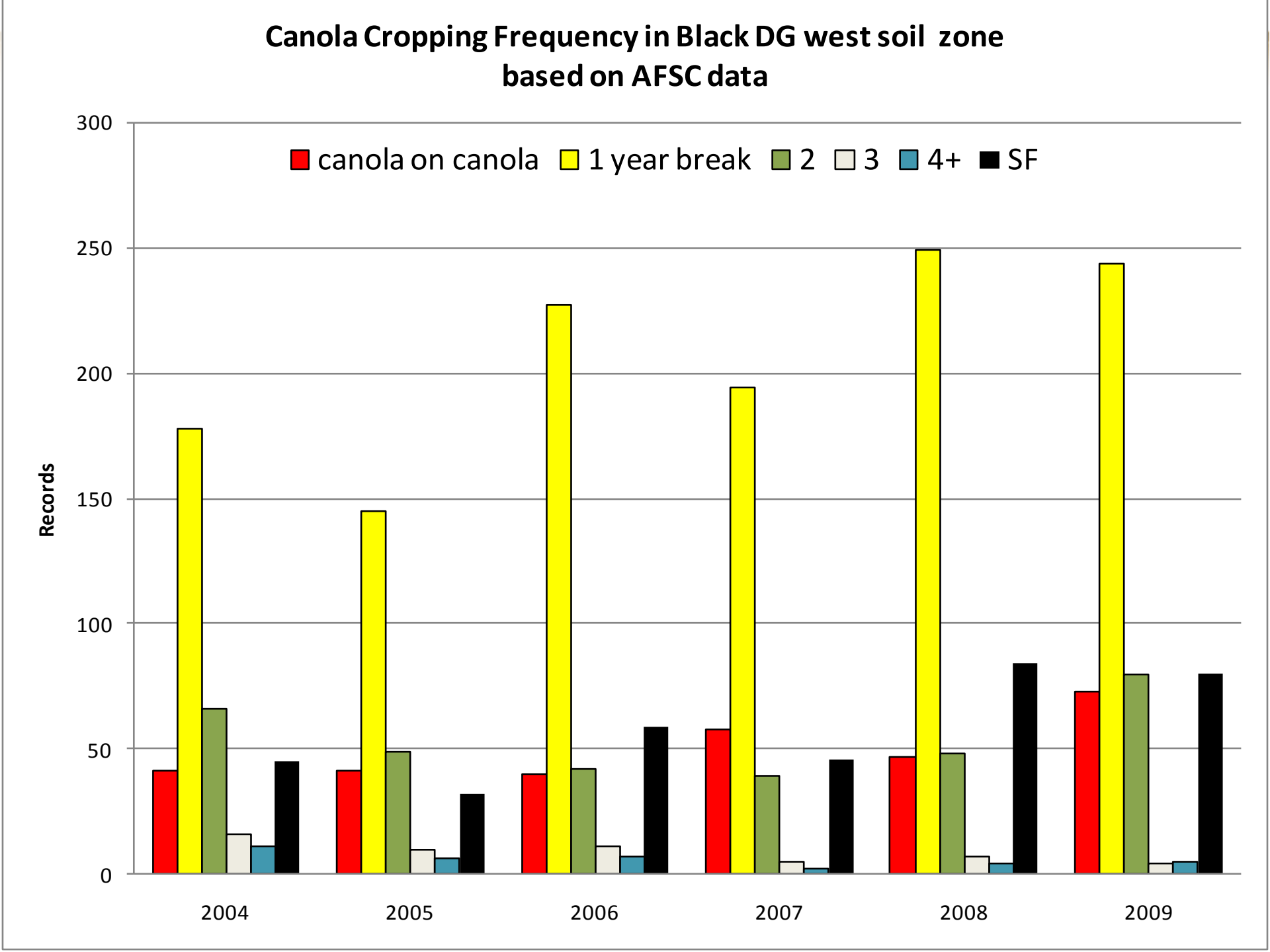


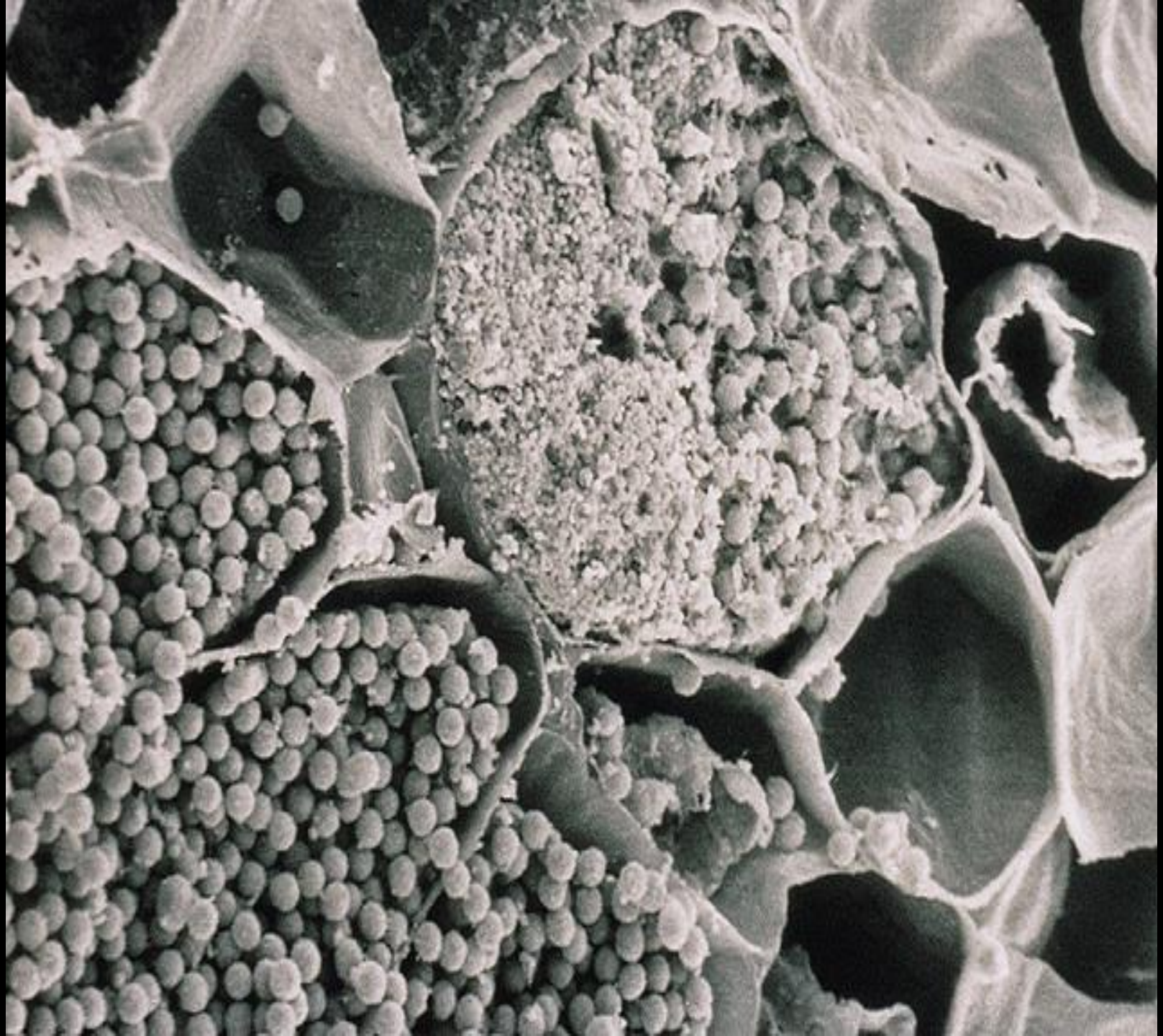
Do dry conditions reduce clubroot?

- Dry conditions resulted in reduced severity in ON, 2010.
- Clubroot was severe after drought delayed crop emergence in AB, 2009.
- Consistent effect of moisture (esp. after seeding) on epidemic development (2 recent studies).
- Conclusion – Low mean rainfall may make it more difficult for clubroot to establish. Once established, severity could still be high in wet years.

Factors Affecting Spread of Clubroot

- The spread of clubroot from the initial focus of infection was unexpectedly rapid relative to spread from site to site in vegetable production.
- Highly susceptible crop.
- Large, contiguous fields & short crop rotations results in trillions of spores in infested fields.
- Susc. crop produced on > 8M ha each year, but susc. weeds also present across region.

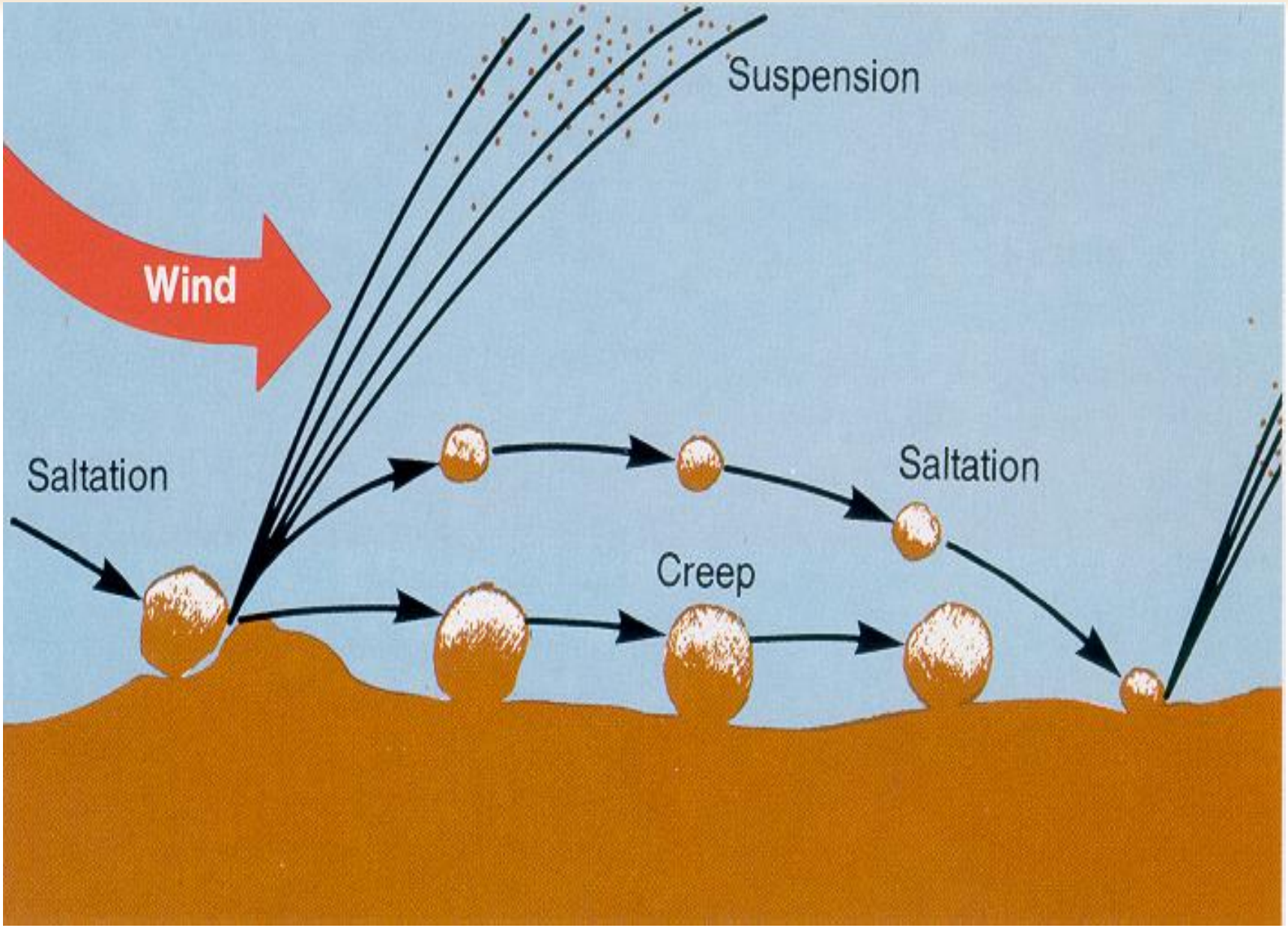

Canola Cropping Frequency in Black DG west soil zone based on AFSC data
canola on canola
1 year break
2
3
4+
SF
Records
300
250
200
150
100
50
0
2004
2005
2006
2007
2008
2009



Soil on Cultivator Wheel

Soil Scraped from Shank/Shovel

Trash on Combine Header


Suspension
Wind
Saltation
Saltation
Creep

Dispersal studies

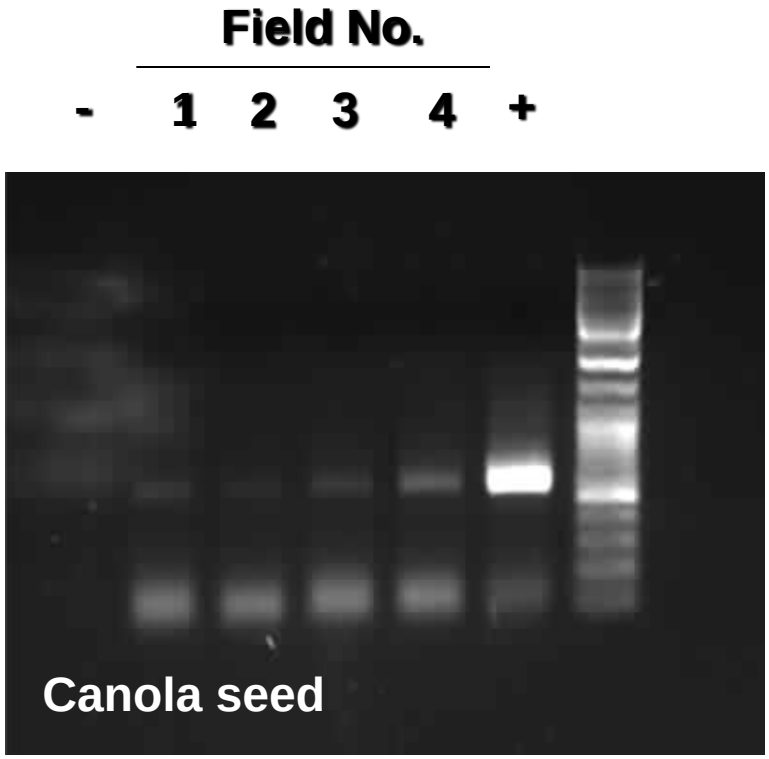
Wind erosion potential

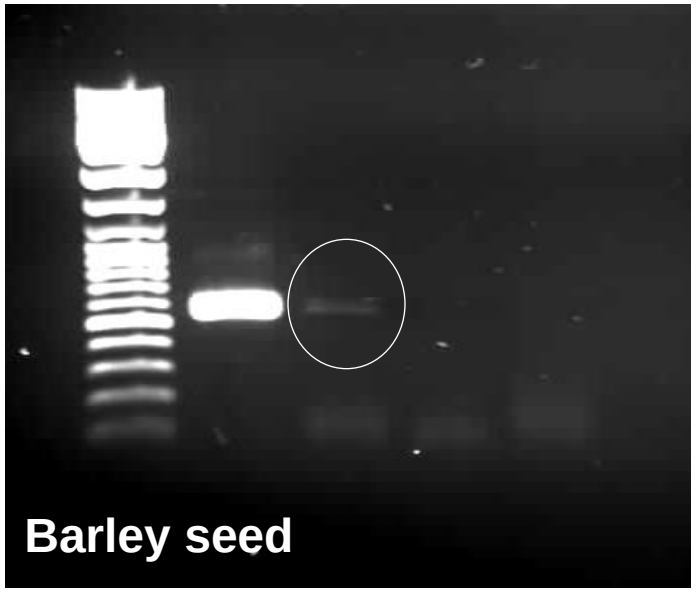
- BSNE dust samplers set up in commercial fields
- Two locations
- PCR test for clubroot pathogen

Water erosion potential

- Collection of soil samples
- qPCR gradients

Seed Transmission?





- PCR tests - pathogen DNA is present on seed.
- No evidence of seed-to-seedling transmission in trials in 2009 or 2010 (site in Ontario).
- One clubroot-infected plant in 2011.

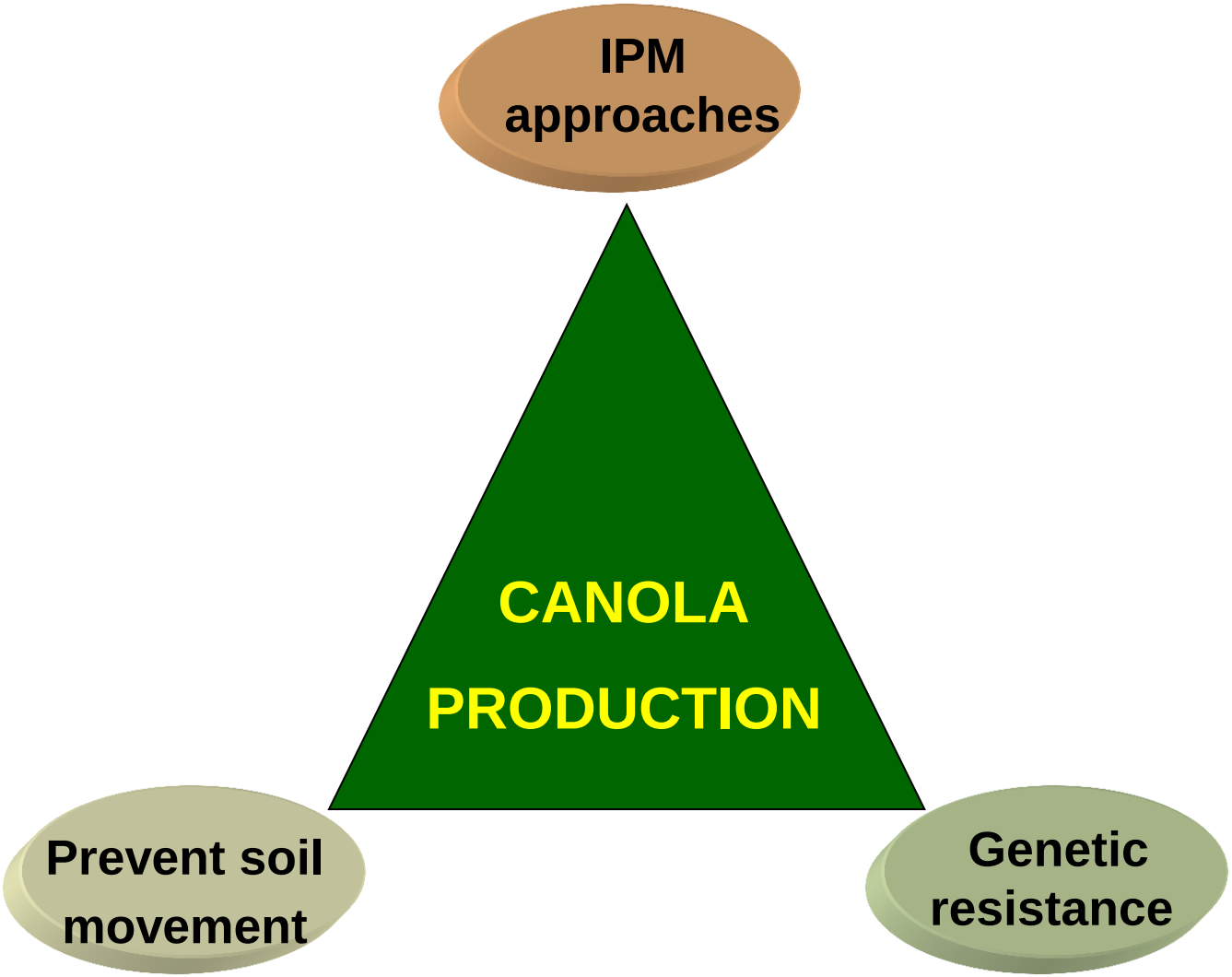
Interaction of environment with dispersal mechanism & inoculum load

- Temperature, soil pH, and nutrient levels in soil can reduce or delay, but not eliminate infection.
- Soil moisture is critical for infection, but even dry regions experience occasional wet seasons.
- Infection can result from single spores, but generally requires at least 1000 spores g^{-1}.
- Seed transmission could theoretically result in long-distance transmission when conditions are ideal, but seed cleaning and routine seed treatment would eliminate that risk.

Interaction (cont'd)

- Infested fields represent a source of trillions of spores for dispersal by wind each spring. This is likely an important mechanism of short-distance movement, and may occasionally result in long-distance transmission when conditions are ideal.
- Movement of infested soil on machinery places large quantities of inoculum in the field. Once established in a field, becomes a focus for spread.
- Many regions of the Canadian prairies (esp. northern SK and all of MB) are at risk of clubroot epidemics if resting spores are distributed by human activities, wind, or water.

Sustainable Clubroot Management



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