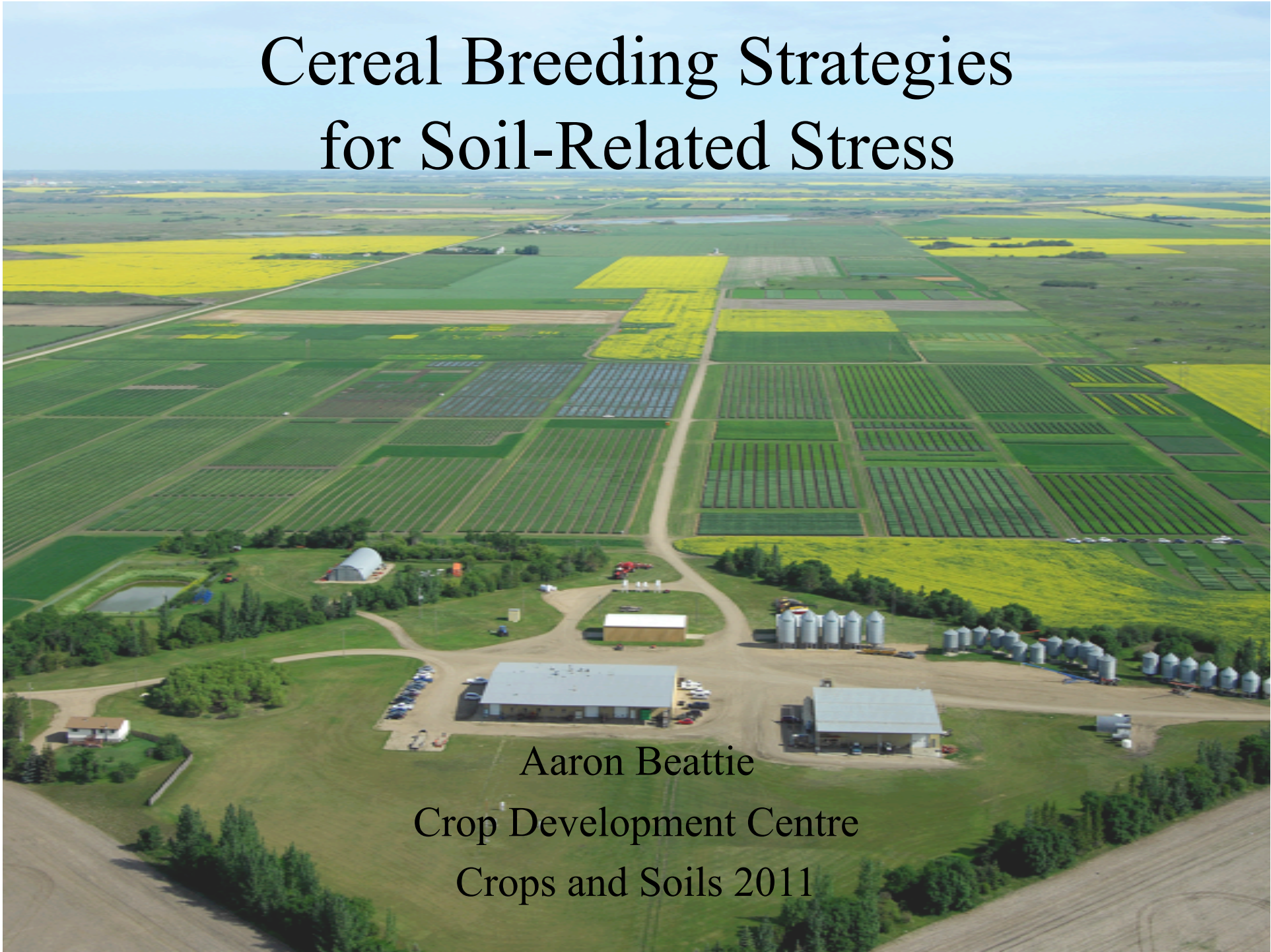


Cereal Breeding Strategies for Soil-Related Stress

Aaron Beattie

Crop Development Centre

Crops and Soils 2011



Outline

- Plant Breeding 101
 - What is it?
 - Three Important Activities
- Soil-related Stress
 - What is it?
 - Breeding strategies to improve tolerance

What is Plant Breeding

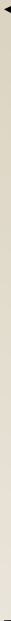
- A bit of Darwin with a lot of Mendel (and Watson & Crick)
 - directed and quantified evolution
 - if you don't know the genes controlling a trait, set up conditions to identify their expression

Breeding Program Activities



Breeding Program Activities

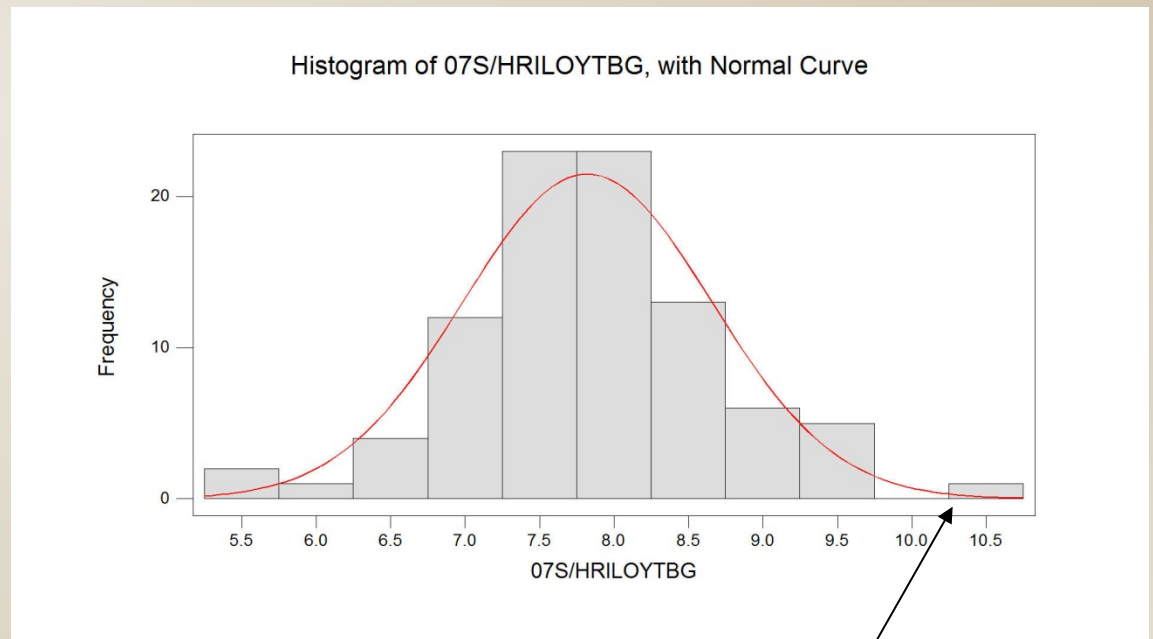
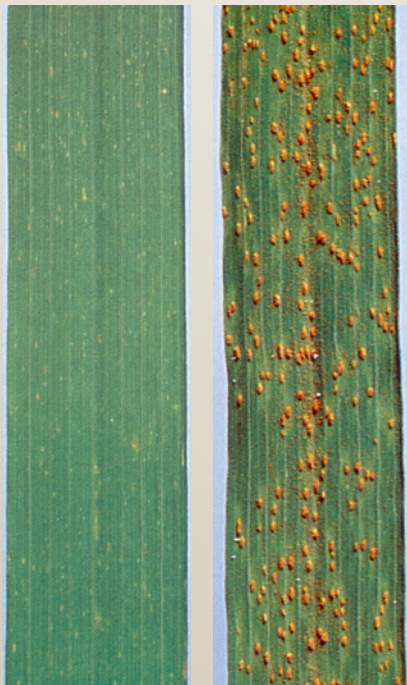
F7	Preliminary Yield Trial - 2 reps @ 2 locations - select based on agronomics / quality	2016
F8	Standard Yield Trial - 3 reps @ 6 locations - select based on agronomics / quality	2017
F9	1 st year Coop - 2 or 3 entries - 3 reps @ 17-20 locations	2018
F10	2 nd year Coop - 1 or 2 entries - 150-225 paired hills for breeder seed	2019
F11	- 150-200 Breeder Rows (from hills)	2020



Evaluation and Selection
(cont.)

Selection for Two Types of Traits

- Qualitative
 - Discrete phenotypic classes, single or simple genetic inheritance
 - E.g. some diseases, hulled/hulless
- Quantitative
 - Continuous range of expression, complex or multi-genic inheritance
 - E.g. beta-glucan content, abiotic stress, FHB resistance



Plant breeders are interested in finding the needle
in the haystack

Soil-Related Stress

- Abiotic
 - Water-logging or drought
 - Salinity
 - pH
 - Temperature
- Biotic
 - Common root rot (*Cochliobolus sativus*, *Fusarium* spp.)
 - Browning root rot (*Pythium* spp.)

Soil-Related Stress

- impacts germination, emergence and ultimately crop stand

Breeding Strategies

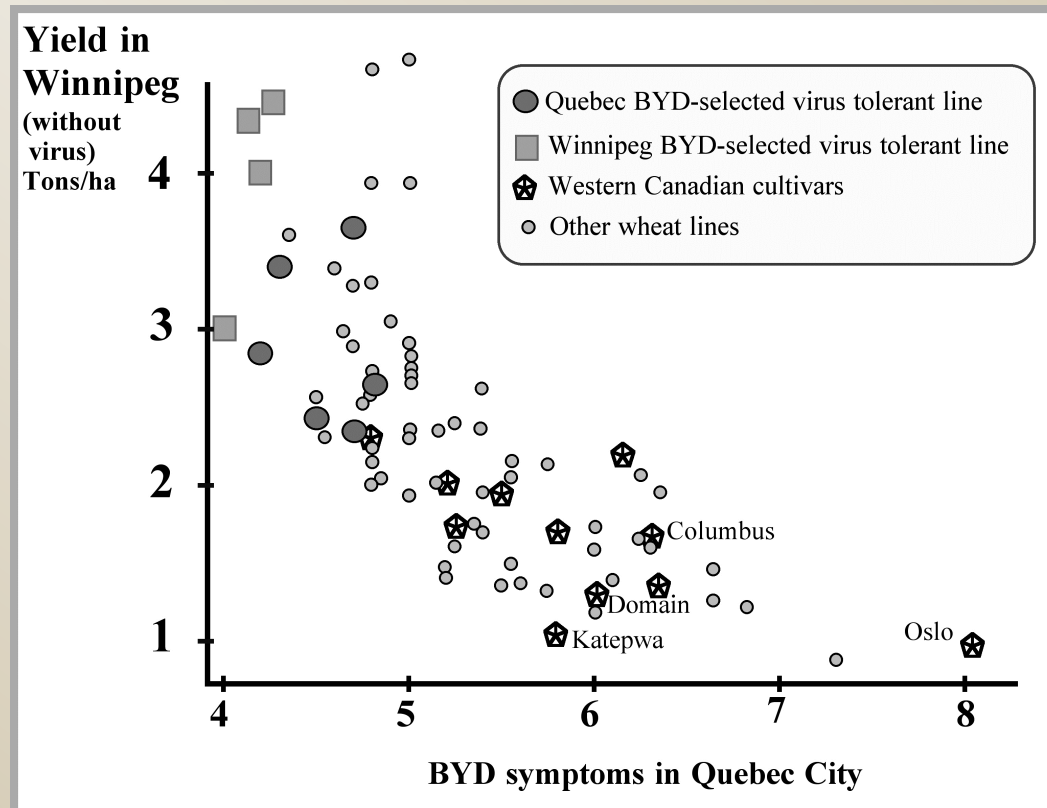
- Basis for effective selection is a level playing field for all genotypes
 - ideally each genotype is planted using seed with the same germination potential under “perfect” conditions
 - then genetic potential to soil stress can be observed

Breeding Strategies

- Natural selection
 - Growing plots in the presence of the stress
 - E.g. root rot pathogens are endemic
 - “opportunistic selection” – selecting when the conditions present themselves
- Forced selection
 - Root disease nurseries
 - E.g. BYDV nurseries

Breeding Strategies

- BYDV inhibits phloem function
 - Photosynthate movement is limited
 - Roots suffer the most
- BYDV can be used as a representative of other soil stresses
- BYDV tolerance is associated with more efficient roots
 - In wheat this is also associated with tolerance to water-logging, root rots and poor soil (Comeau et al. 2005)
 - Ultimately this impacts yield



Cool and wet spring planting in 1994 at Winnipeg.

Thanks