# Integrated Innovation: Plant Breeding at the Crop Development Centre

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Director and Distinguished Professor

CROP DEVELOPMENT CENTRE
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ISTA
ANNUAL MEETING
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Calgary, Canada

June 22nd, 2026

University of Saskatchewan

# Crop Development Centre

Est. 1971

## Our Mission

Develop new crop varieties through the development and application of scientific knowledge and technologies, in partnership with stakeholders across the agriculture value chain.

University of Saskatchewan

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| 100+ | $27M+ | 210 | 600+ | 48% | 22:1 |
|---|---|---|---|---|---|
| Grad Students | Funding | Staff | Varieties | Market Share | Return On Investment |

UNIVERSITY OF SASKATCHEWAN

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# CURRENT CDC BREEDERS AND PLANT PATHOLOGISTS

**Aaron Beattie**

Ministry of Agriculture Strategic Research Program (SRP) Chair in Barley and Oat Breeding and Genetics

**Bill Biligetu**

Ministry of Agriculture Strategic Research Program (SRP) Chair in Forage Crop Breeding

**Adam Carter**

Ministry of Agriculture Strategic Research Program (SRP) Chair in CWRS Wheat, Specialty Wheats, and Canaryseed Breeding and Genetics

**Curtis Pozniak**

Ministry of Agriculture Strategic Research Program (SRP) Chair in Durum and High-Yield Wheat Breeding and Genetics

**H. Randy Kutcher**

Ministry of Agriculture Strategic Research Program (SRP) Chair in Cereal and Flax Crop Pathology

**Kirstin E. Bett**
**PLSC – Affiliated**

Dry Bean Breeder

**Bunyamin Tar'an**

Ministry of Agriculture Strategic Research Program (SRP) Chair in Chickpea and Flax Breeding and Genetics

**Tom Warkentin**

Ministry of Agriculture Strategic Research Program (SRP) Chair in Pulse Crop Breeding and Genetics

**Sabine Banniza**

Ministry of Agriculture Strategic Research Program (SRP) Chair in Pulse Crop Pathology

**Ana Vargas**

Agri-Food Innovation Fund Chair in Lentil and Faba bean breeding

**Valentyna Klymiuk**

Saskatchewan Wheat Development Commission Applied Genomics and Pre-breeding Chair

**Anže Švara**
**PLSC- Affiliated**

Assistant Professor, Fruit Genetics and Improvement

# THE PILLARS OF CROP IMPROVEMENT

## PROFITABILITY

- YIELD
- AGRONOMIC TRAITS
- LODGING
- TIME TO HARVEST

## RELIABILITY

- BIOTIC STRESSES (20-40% of losses)
- ABIOTIC STRESSES (60-80% of losses)

## SUSTAINABILITY

- WUE
- NUE
- PESTICIDES
- PHYSIOLOGICAL ADAPTATION

## MARKETABILITY

- QUALITY
- FUNCTIONALITY
- NUTRITION
- CUSTOMERS
- MARKETS

**Breeding is often a compromise, balancing priorities and inter-trait relationships**

# THE HUBs OF OUR SUCCESS

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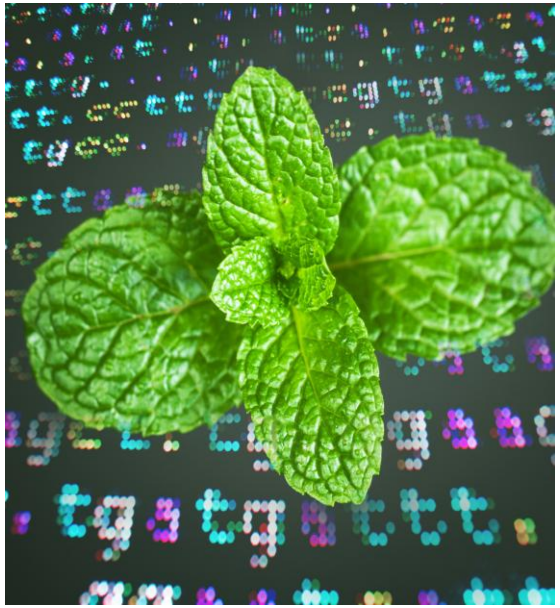
# INNOVATIONS IN BREEDING

**STRATEGIES TO INCREASE GENETIC GAIN AND REDUCE TIME TO COMMERCIALIZATION**

PREDICTIVE BREEDING



SPEED BREEDING

"DIGITAL" BREEDING

PRECISION BREEDING


**INTEGRATION OF THESE TECHNOLOGIES IS MODERNIZING PLANT BREEDING**

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# CDC's INNOVATION PIPELINE


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# INTEGRATION OF SEED TESTING & BREEDING

**VARIETAL ID**

- DISTINCTNESS, STABILITY
- IP PROTECTION
- CONTRACT PPRODUCTION

**PURITY**

- UNIFORMITY
- FARMER GUARANTEE
- TRAIT VERIFCATION

**SEED QUALITY**

- GENETIC COMPONENTS
- GERMINATION
- VIGOR/VIABILITY
- DISEASES/WEEDS

**MARKETS**

- GERMPLASM EXCHANGE
- SEED HEALTH
- REGULATORY
- REAL WORLD FEEDBACK

**Multiple paths for intersection along the breeding continuum, but with an emphasis on near commercialization**

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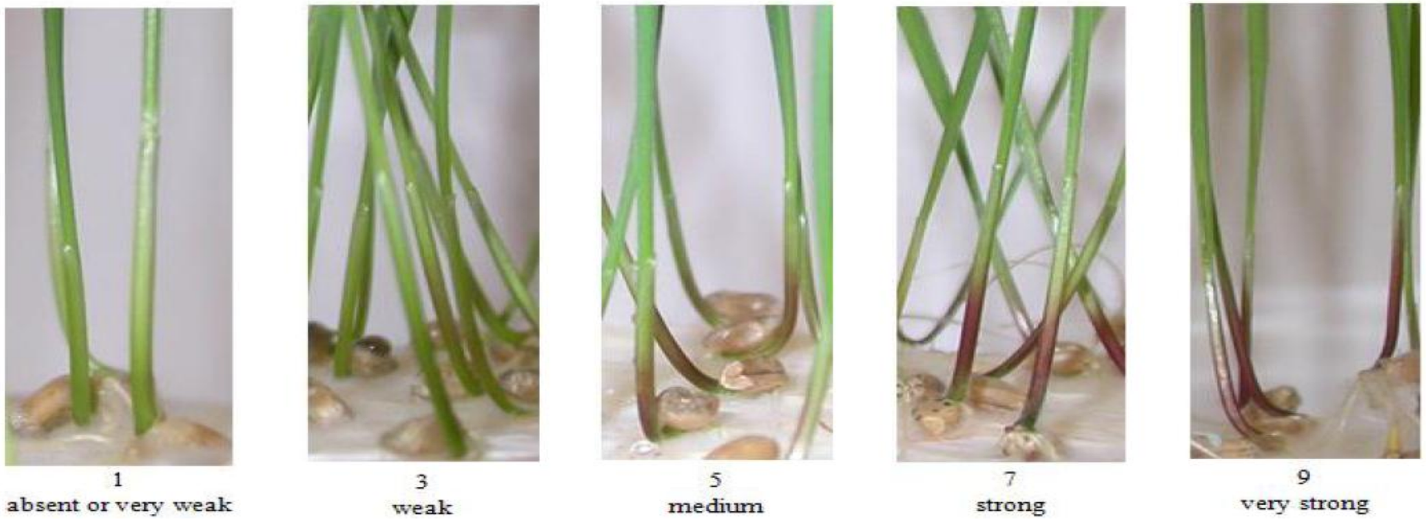
# VARIETY DISTINCTNESS AND STABILTY

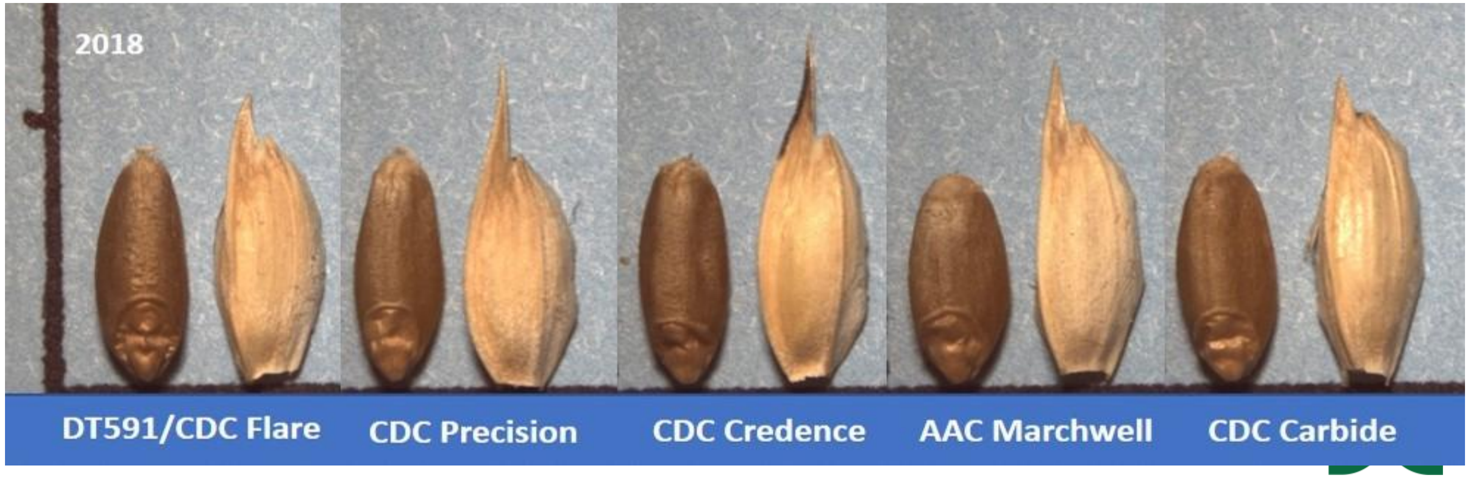
Morphological assessment

Observable **(qualitative**)

Measurable (**quantitative**)

Stable over successive generations



# LIMITATIONS OF MORPHOLOGICAL TRAITS

Inconsistencies due to environment

G X E, repeatability, reliability

Time consuming, skill/experience, subjective

More varieties, reduced genetic diversity = reduced combinatorial space

Intra-population variation in outcrossing species

Linkages of morphological traits to each other (and potentially to performance traits)

NBTs – small changes in genome, no morphological differences, yet performance differences

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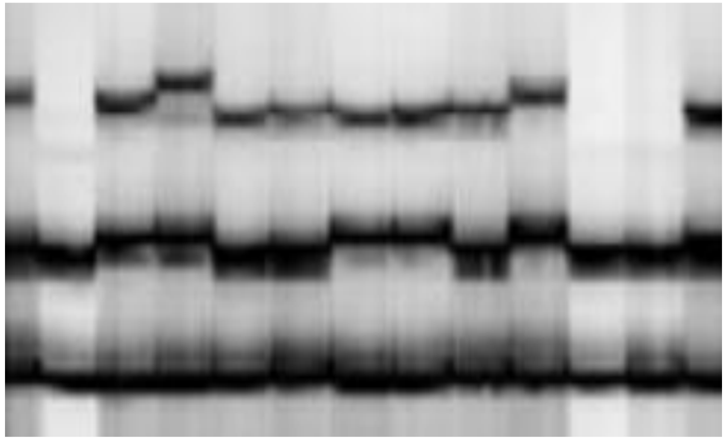
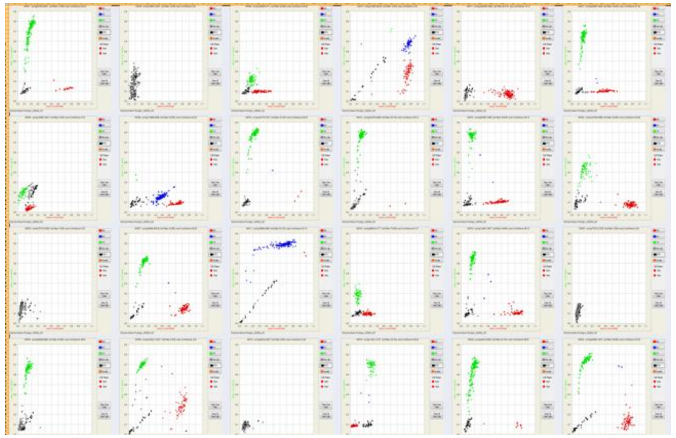
# ASSESSMENT OF DISTINCTNESS – DNA TECHNOLOGIES







**Genomic era – marker technology is evolving – Speed, cost, information**

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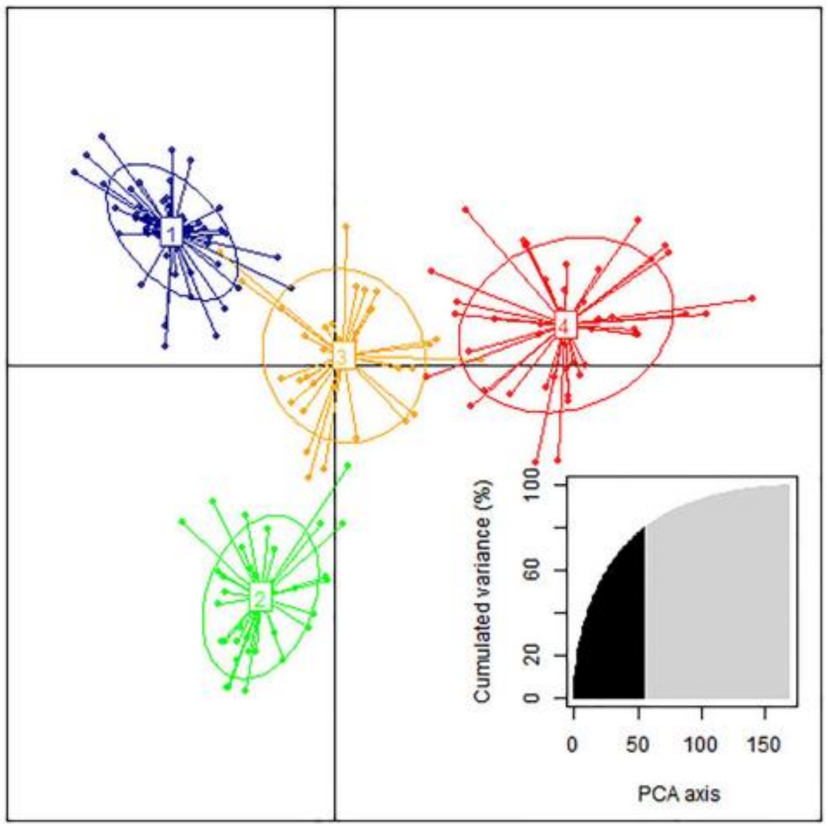
# ASSESSMENT OF DISTINCTNESS

Evidence from the literature supports DNA markers are more precise at defining **Identity** and **distinctness**

General consensus is that **not many DNA markers are required** to adequately define distinctness (dependent on marker type)*

Some concern that a "limitless" number of markers could be used to find differences that do not necessarily relate to phenotypic distinctness

Testing of varieties (and establishing a database) is required to established a threshold of pairwise inter-cultivar similarity




*Jamali et al. 2019; Theor Appl Genet 132: 1911*

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# IMPLEMENTATION CONSIDERATIONS

What marker platform should we use? – crop specific, information vs cost (cost not really an issue)

How many markers?  Genome size, relatedness, ascertainment bias

Changing marker technologies – data cross talk

Database management, who is the "keeper"?

Public availability of marker sets is a prerequisite – level playing field

IP related - Ownership?

Define the minimum required distance for distinction – how close is too close

**WHO DECIDES?**

**The solution (technology) can not be a barrier….**

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# MANAGING SEED UNIFORMITY

## CDC STRATEGY:  Starts with Breeder Seed

Define the variety with a molecular fingerprint (together with partners)

Ensure purity of the variety phenotypically but also for molecular fingerprint

Utility of molecular fingerprint to support seed certification – assess purity and/or to support forensic  follow up to mitigate production issues

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# EXPERIENCES WITH SEED PURITY – CDC VANTTA


| | AX-158583314 | AX-158583166 | AX-89390139 | RFL_Contig4881_137 | wsnp_Ex_c6739_11646407 | AX-158583204 | IAAV2271 | wsnp_Ex_c30695_39579408 | AX-89451517 | Kukri_c52413_282 | AX-89747834 | IWB72442 | AX-158542362 | Tdurum_contig64772_417 | BS00010925_51 | Tdurum_contig51688_681 | AVRIG25675 | TG0010b | TGWA25K-TG0010 | AX-94685096 | AX-158538731 | Tdurum_contig94674_207 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CDC Vantta** | A | G | T | A | T | T | T | C | G | A | A | A | A | C | C | A | A | T | T | T | A | G |

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# TRAIT VERIFICATION – AN EXAMPLE

## RESISTANCE TO THE ORANGE WHEAT BLOSSOM MIDGE IN WHEAT


Resistance is provided by a **single resistance gene** – *Sm1*

Seed is sold as a **varietal blend**, with 90% made up of a midge tolerant variety and the remaining 10% midge susceptible.

Inclusion of the 10% ensures that the wheat midge population will **not evolve** to overcome the *Sm1* resistance

Pedigreed seed must be **certified** to be in the correct blend


midgetolerantwheat.ca

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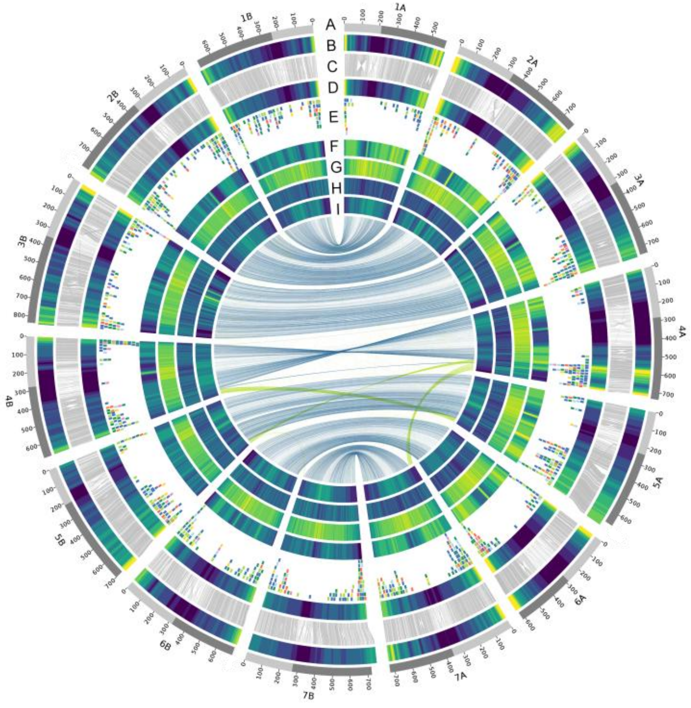
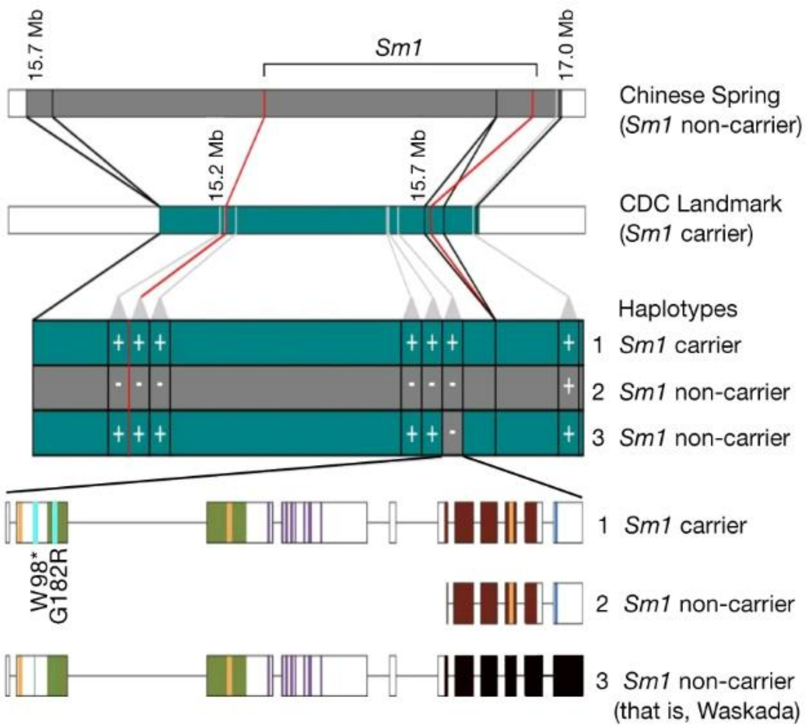
# AN INDUSTRY NEED – *Sm1* CERTIFICATION

COMPARATIVE GENOMICS

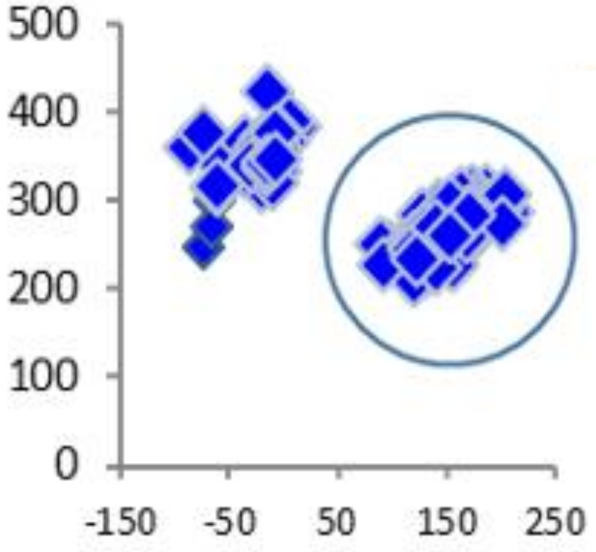



GENE IDENTIFICATION




MOLECULAR DIAGNOSIS

SGS

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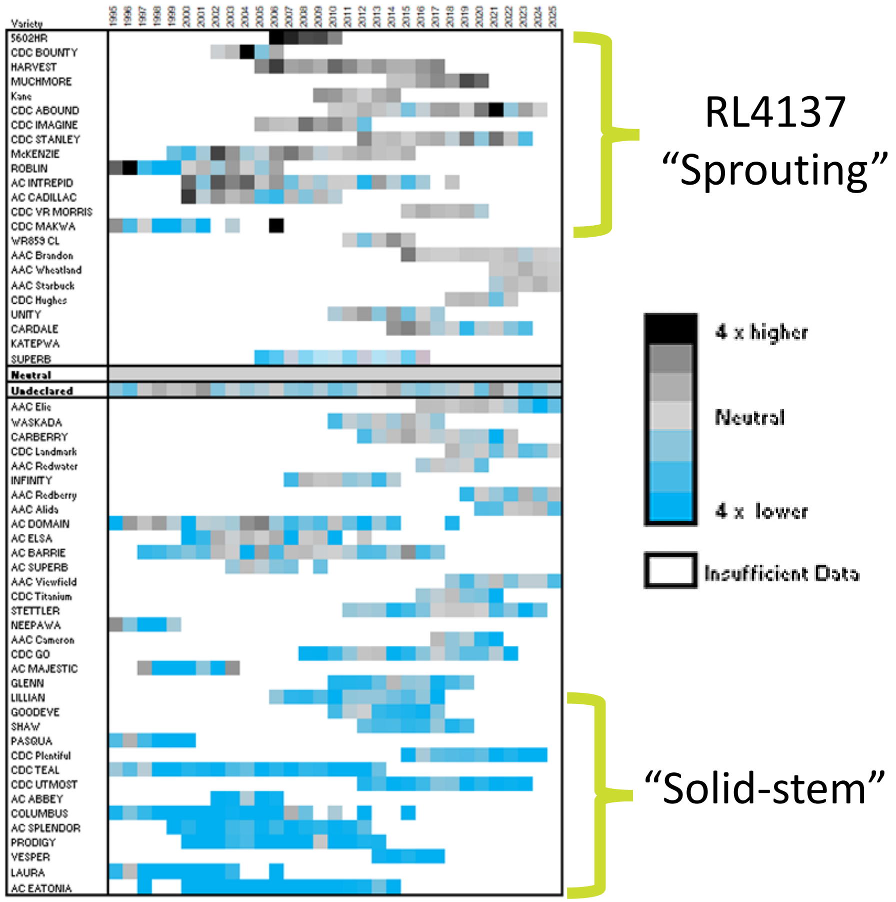
# “REAL-WORLD” SEED QUALITY INSIGHTS

**Feed-back loop**: Seed testing can provide **early insights** into seed-trait related issues –diseases, seed vigor and viability issues

Example – **CGC Harvest Survey Program** provides insights on **disease prevalence** and **genetic insights** – both can guide breeder decisions


Canadian Grain Commission
Commission canadienne des grains

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# INTEGRATION OF SEED TESTING & BREEDING

VARIETAL ID

PURITY

SEED QUALITY

MARKETS

**METHOD DEVELOPMENT, ID/TRAIT TESTING, REAL-WORLD SIGNALS**
**DIGITAL/COMPUTATIONAL DEVELOPMENT**
**COMMON ANALYTICAL PLATFORMS – FROM BREEDING TO SEED**

# Thank You

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