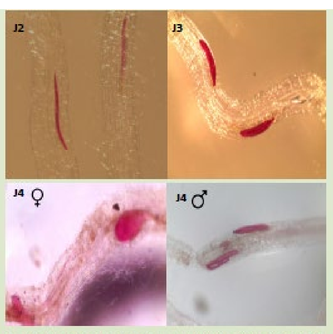
Potato Cyst Nematode Resistance: Efforts and Successes of the GLOBAL Grant Working Group

Two species of potato cyst nematode (PCN) are quarantined in North America. Host resistance in potato offers the best long-term control solution. A population of individuals from a resistant x susceptible cross was developed with progenies having high to moderate PCN-resistance and long to oblong tubers with russet skin suitable for processing being selected. PCN- resistant varieties from Europe, New Zealand, and South America have been introduced for use as parents. Genetic work using SNP markers identified quantitative trait loci associated with resistance to both golden nematode race 2 and pale cyst nematode. These results accelerate the development of new resistant varieties in the primary market classes grown in the U.S.



G. pallida in potato roots (L.M. Dandurand)

pale cyst nematode


G. rostochiensis cysts on potato roots (X. Wang)

Quarantine species golden cyst nematode

1. CHALLENGES

- Cysts can survive ~30 yrs in absence of host
- Lower resistance available for pale cyst nematode
- New race of golden cyst nematode (Ro2) needs new resistance genes
- New species (*G. ellingtonae*) discovered
- High yield reduction w/o fumigation
- Fumigation, costly, environmentally harsh


G. ellingtonae cyst on potato root (I. Zasada)

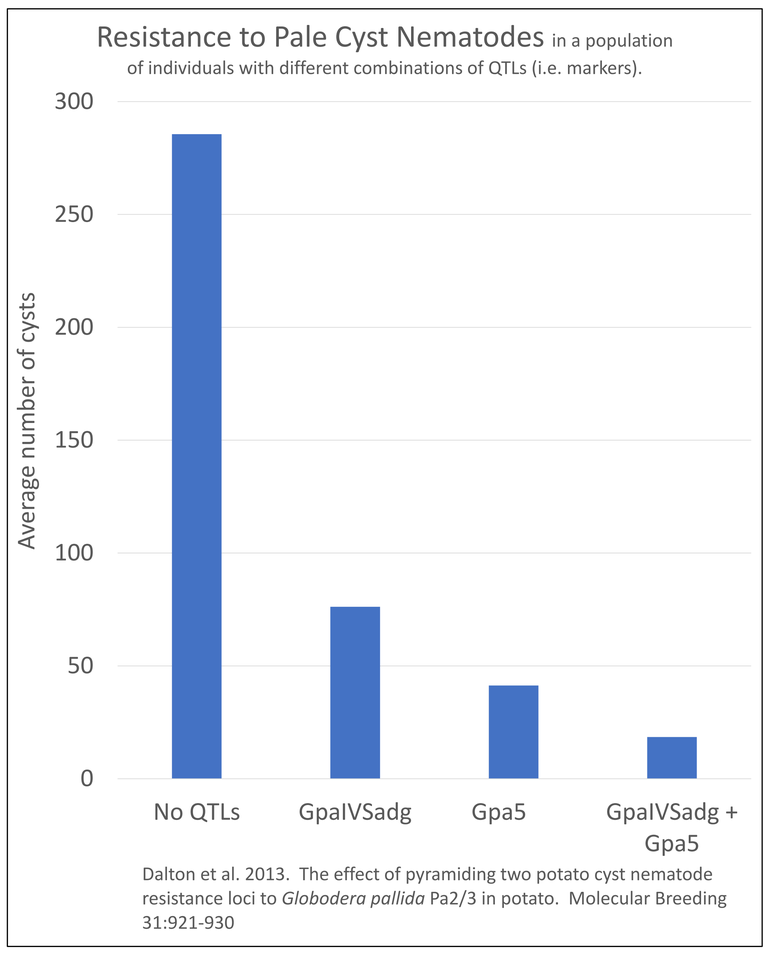
Not Quarantined, but does reproduce on potato, not yet proven to cause significant yield loss

Germplasm/ variety	Origin	Pale Cyst (*G. pallida*)	*Golden Cyst (G. Rosto-chiensis)*	Gene (Marker)				
				Pale cyst		Golden cyst		
				$GpaIV^{s}_{adg}$ (C237)	**Gpa5** (HC)	**H1** Ro1 (57R)	**Ro2_A** Ro2 (SPUD -5000)	**Ro2_A** Ro2 (TG432)
Eden	Scotland	PR*	R	+	-	+	-	-
NY121	NY	PR	R	-	-	+	+	+
A10915-41	ID	PR	na	+	-	+	na	na
A10915-71	ID	PR	na	+	na	+	na	na
Moonlight	New Zealand	PR	R	+	-	+	-	-
Karaka	New Zealand	PR	R	na	-	+	-	-
Sante	UK	PR	R	?	-/+	?	?	?
Maria Huanca	Peru	PR	?	-	+	-	+	+
Nautilus	Germany	?	?	-	-	+	?	?
Tokio	Germany	PR	?	+	+	+	+	-
Innovator	Nederlands	R	S[1]	-	+[2]	-	na	-
Alicante	Nederlands	PR	PR[3]	-	+	-	+	-
Ambassador	Nederlands	PR	PR[4]	-	+	-	+	-
Arsenal	Nederlands	PR	R[3]	-	+	-	+	+
Basin Russet	Nederlands	PR	S[3]	-	+	-	+	-
Nomade	Nederlands	PR		-	+	-	+	-
Performer	Nederlands	PR	PR[3]	-	+	-	+	+
Producent	Nederlands	PR	R[5]	-	+[2]	+	+	+

* S=susceptible; PR=partially resistant, R= resistant
[1] from Schultz et al. 2012
[2] also agrees with Sattarzadeh et al. 2006.
[3] from Agrico, UK
[4] from AHDB, UK (rating 4 from scale of 1-9, 9=high resistance)
[5] from European Cultivated Potato Database

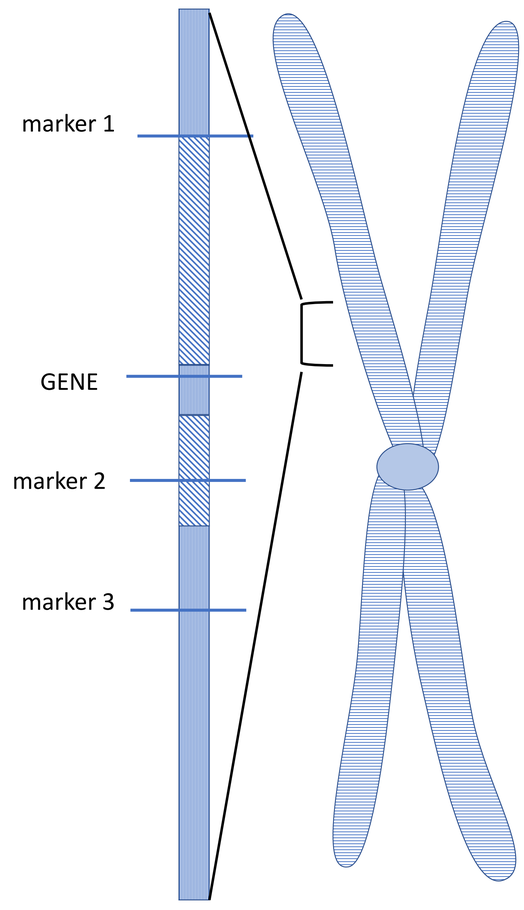
2. RESOURCES

- Working populations of nematode species at Idaho and New York
- Pyramiding genes to get higher resistance
- Genetic tools – molecular markers
- Germplasm/Varieties



Dalton et al. 2013. The effect of pyramiding two potato cyst nematode resistance loci to *Globodera pallida* Pa2/3 in potato. Molecular Breeding 31:921-930

Example of a gene and associated markers on an arm of a potato chromosome.



3. SUCCESSES

- Collaboration of nematologists and breeders for screening and breeding

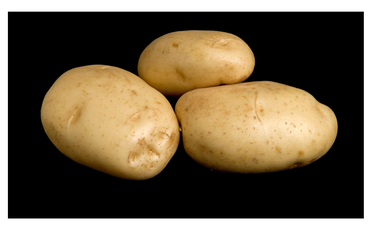
Golden Cyst Nematode

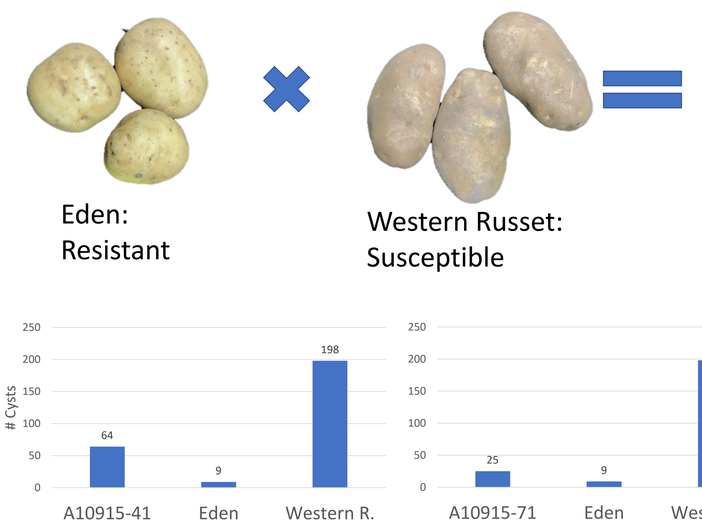
- New varieties with Golden Nematode Ro2 resistance; Brodie and Upstate Abundance
- New markers for selecting Ro2 resistance

Pale Cyst Nematode

- Eden x Western progeny with markers and agronomics
- Acquisition of new sources for stacking nematode resistance to increase resistance levels and increase durability of resistance


Upstate Abundance, high setting variety, golf ball size with Ro1 AND Ro2 resistance


Brodie, full season maturity, large oblong with excellent chip color from cold storage



4. FUTURE WORK

- Continued steady efforts to combine resistance with market type (oblong russets for fries, round whites for chips, tablestock in both oblong and round types)
- Coordinated work with researchers and industry to accelerate breeding efforts.
- Use of Tokio variety for crossing to incorporate higher pale cyst and both races of golden cyst resistance

Jonathan Whitworth[1], Richard Novy[1], Joseph Kuhl[2], Walter De Jong[3], Glenn Bryan[4], Inga Zasada[5], Xiaohong Wang[6], Louise-Marie Dandurand[2]

1 USDA-Agricultural Research Service, Aberdeen
2 University of Idaho, Moscow, Idaho, USA
3 Cornell University, Ithaca, New York, USA
4 James Hutton Institute, Dundee, Scotland, UK
5 USDA-Agricultural Research Service, Corvallis, Oregon, USA
6 USDA-Agricultural Research Service, Ithaca, New York, USA
* Corresponding author jonathan.whitworth@ars.usda.gov

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For further information see
www.globodera.org
Contacts:
Louise-Marie Dandurand
lmd@uidaho.edu
Inga Zasada
Inga.Zasada@usda.gov