

GLOBAL breeding objective

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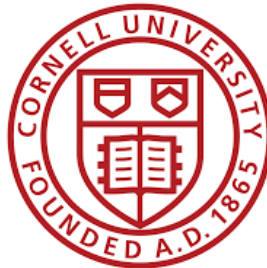
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University of Idaho

College of Agricultural
and Life Sciences

GLOBAL Advisory Board Meeting

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GLOBAL
Globodera Alliance

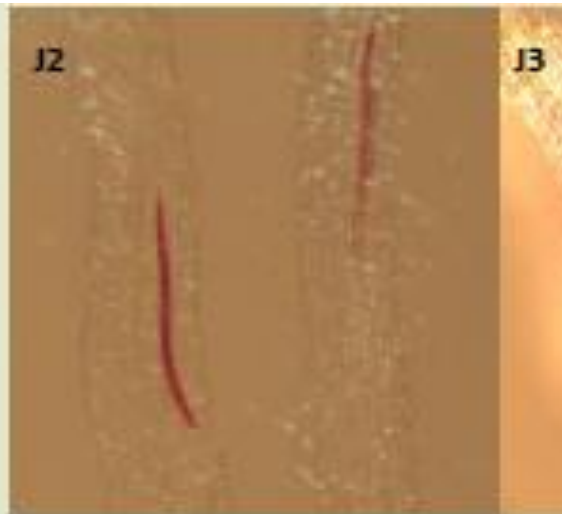
Breeding Objective

Enhance potato breeding for resistance to *Globodera*.

- 1 Development and screening of populations (Walter, Rich, Joe, Jonathan)*
- 2 Exchange and screening of parent material in US, UK, and Peru (Rich and Joe)*
- 3 Rapid mapping of QTLs and gene dosage studies (Jae and Joe)*



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



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



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



Year 1 –populations/**screening**/exchange

- Study to screen breeding lines and cultivars for 3 PCN species resistance
 - Determined cv. **Eden** had best resistance to 3 species
- Family A10915 crossed in 2010 from **Eden** x Western Russet.
- Superior x Waneta population developed to test if H1 R gene conferred resistance to *G. ellingtonae* (as well as known resistance to *G. rostochiensis*)
- Screened 1200 entries to 3 PCN species for markers and mapping

Year 2 – markers/screening/exchange

- Progeny from A10915 (Eden x Western) tested with marker indicating *G. pallida* resistance (for GPAIV_{adg})
- Progeny from Y36 (NY121 x NY115) screened for QTLs for Ro2 and *G. pallida*
 - Marker c2_50301 on chromosome 5 worked best (used in assay SPAM 5000)
- Screening continues for 3 PCN species resistance
- Idaho and New York breeding programs acquired additional European varieties with *G. pallida* resistance

Year 3 – hybridizations/**screening**/markers

- Directed hybridizations done with 10 entries
- Agronomic selection from 96 families previously hybridized for PCN resistance
- Screening continues for 2 PCN species resistance (*G. pallida* and *G. ellingtonae* since resistant to *ellingtonae* \approx *rostochiensis*)
- Marker work continues on chr 5 area for Ro2 markers and for stacking this marker with other resistance genes
- Cv. Innovator with *G. pallida* resistance being used in both NY and ID programs for hybridizations

Year 4 – hybridizations/**screening**/marker use

- Screening continues for PCN species resistance
- H1 marker correlation between *G. rostochiensis* and *G. ellingtonae* established (2 papers submitted)
- Idaho hybridizations using 52 PCN resistant entries
- Field selections for agronomic type continue
 - 224 Eden x Western progeny with 31 selected for good agronomic type
- Resistant parent material screened at ID with 3-4 PCN markers
- E x W population has $GpaIV_{adg}^S$ resistance gene, goal is to introgress $GpaV$ as well to increase resistance
- New York hybridizations with
 - Innovator x Lamoka – round whites
 - Innovator x NY160 - reds

Year 5 – hybridizations/**screening**/markers/new germplasm

- Screening continues for PCN species resistance
- Hybridizations continue
- Progeny from Eden x Western screened using marker Contig237 (for GPAIV_{adg})
 - 234 progeny with marker evaluated using SNP chip v3 for further marker development
- Progeny from NY121 x NY115 with resistant QTLs for Ro2 and *G. pallida* used to further refine marker for Ro2 on chromosome 5
- Exchange – new resistant cvs. obtained from Europe, Peru, and New Zealand w/ goal of increasing *G. pallida* resistance



Eden: Resistant

Western Russet:
Susceptible



Marker Summary of Selected Progeny

Total selected	<i>H1</i>	<i>Gpa1VS_{adg}</i>	BOTH
30	25	20	16



A10915-41

Both progeny had the two markers associated with resistance to PCN from Eden

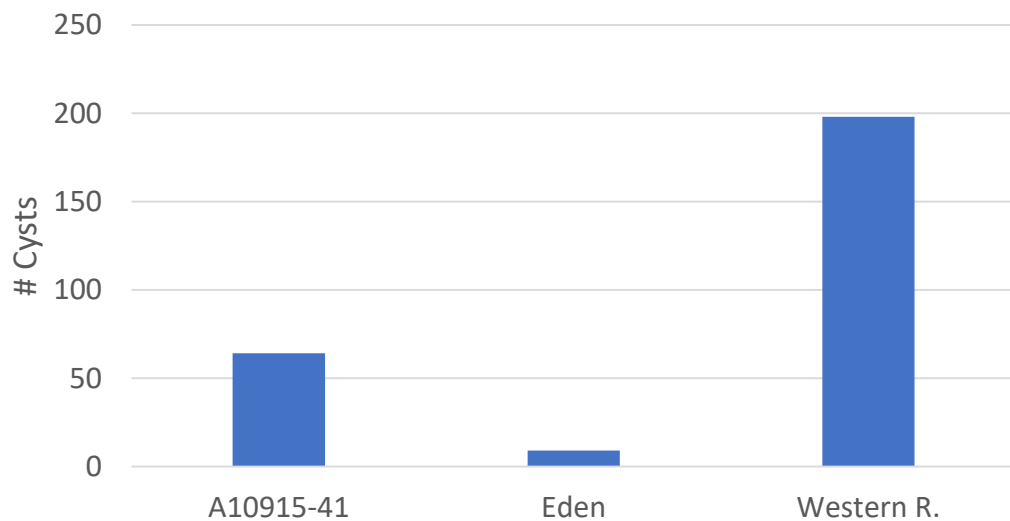


A10915-71

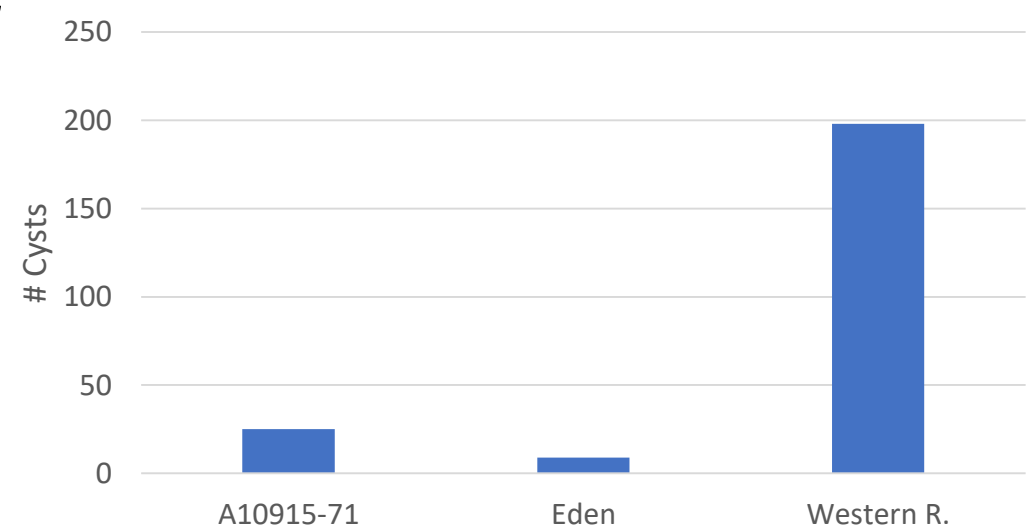
PCN Screenings by Nematologists



Resistant to *G. ellingtonae* with no cysts like Eden; whereas average of 14 cysts for Western Russet



G. pallida



Future Directions – Years 1 and 2

- Plant Protection Act request for PCN resistance breeding – start August 2020?
- Fine map Eden x Western Russet population with SNP Chip V3
 - Further define $GpaIV_{adg}^S$ locus, develop new diagnostic marker
 - Identify additional QTL for *G. pallida* resistance, develop marker(s)
- Identify progeny with $GpaIV_{adg}^S$ and $GpaV$
 - With good agronomic characteristics (and beyond year 2)
 - Evaluate with *G. pallida*
- New USDA-ARS Molecular Biologist in Aberdeen
 - Collaborate with Kuhl on PCN marker development and testing
 - Large scale screening of populations

Future Directions – Years 3 and beyond

- Incorporate additional sources of resistance (e.g. South America) into progeny with $GpaIV^{S_{adg}}$ and $GpaV$
- Continue to identify molecular markers closely linked to resistant QTL
 - Generate new mapping populations
- Bring more *G. pallida* resistant germplasm into the U.S. for hybridization
- Combine Ro2 resistance with *G. pallida* resistance in long, russet-type tubers

Future Directions: Cornell

- Breeding is a long term process (*and commitment*)
 - We'll continue to develop Ro1 and Ro2 resistant cultivars
- Explicitly considering *pallida* resistance is new for us
 - Will use HC marker to increase frequency of *pallida* resistance in our germplasm, increasing likelihood of developing *pallida*-resistant cultivars
- SPAM5000 looks like a promising marker for Ro2 (and *pallida*)
 - We'll keep testing it, and use if proves genuinely useful
- Breeding and genetic engineering would be so much easier if we had sequence of PCN resistance genes
 - Seek resources to clone a few, e.g. using RenSeq