FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

"A Novel Root-Knot Nematode Resistance QTL in Cowpea Accession FN-2-9-04 From Mozambique"

Arsenio Ndeve
Phil Roberts lab

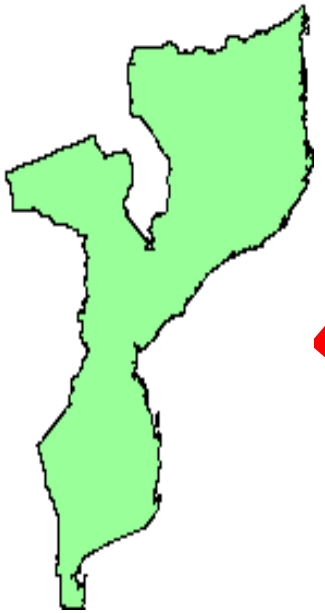
Burkina Faso - August, 2017

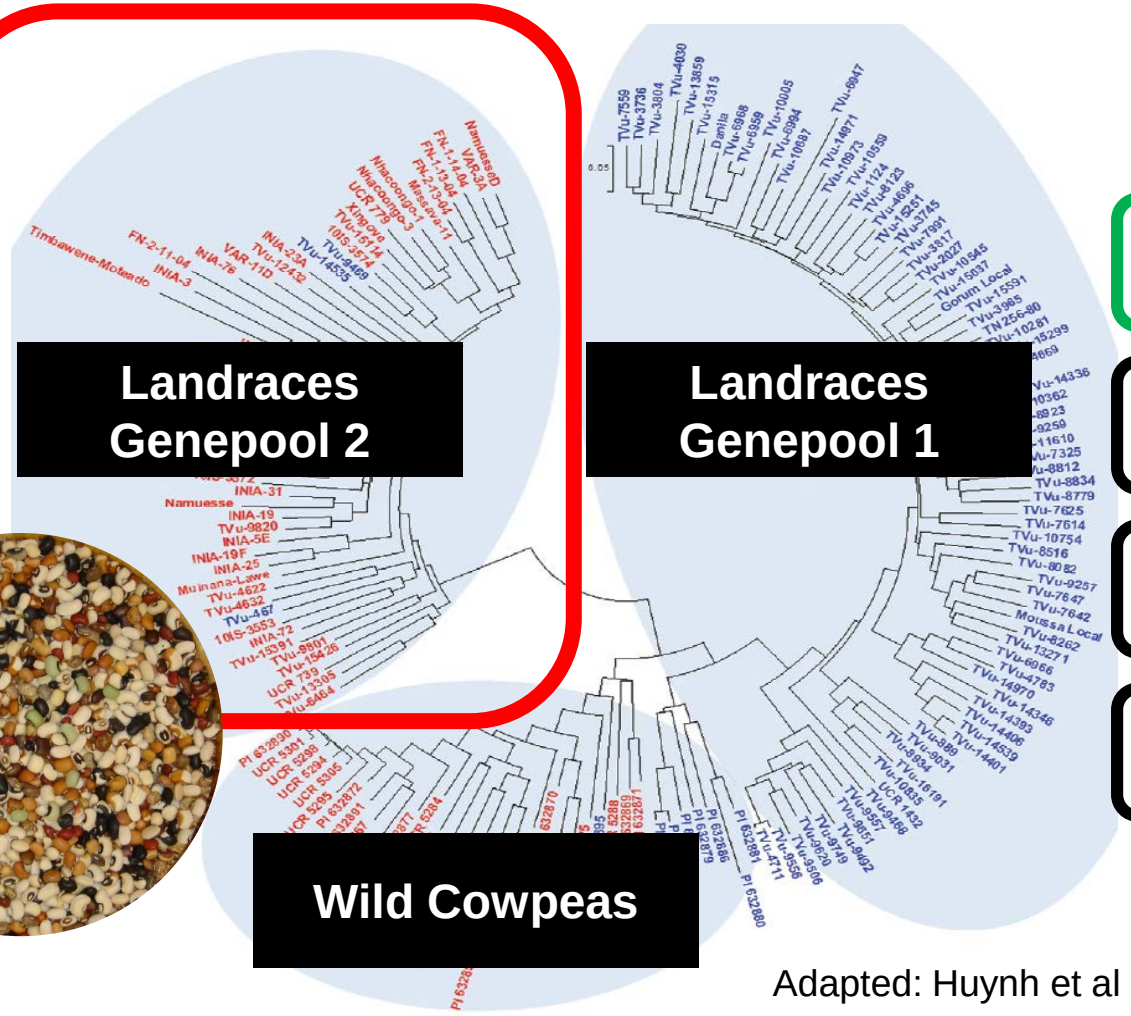
Legume Innovation Lab

Feed the Future Innovation Lab for Collaborative Research on Grain Legumes

USAID
FROM THE AMERICAN PEOPLE

Novel Sources of Resistance to Biotic Stresses





Traits

- Root-Knot Nematode
- Fusarium Wilt
- Ashy Stem Blight
- Aphids

Adapted: Huynh et al (2013)

Research Objectives

1. Variability of Response

2. Genetic Uniqueness

X. Input to Breeding

3. Genetic Architecture

“Root-Knot Nematodes: A Global Menace to Crop Production.”

J. N. **Sasser. 1980.** *Plant Dis.* 64(1).

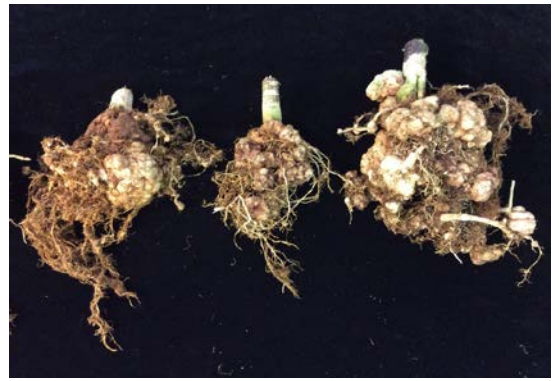
International *Meloidogyne* Project: Funded by USAID

Challenges with Root-knot Nematode

- Disease relevance;
- Pathogen host range;
- Disease complex;
- Population dynamics and shift in virulence;
- Management options;
- Genetic basis of resistance;
- Resistance spectrum;
- Availability of sources of genetic resistance.

	Cultivar			
Nematode/ Fusarium wilt	**CB3**	**CB5**	**CB46**	**CB27**
M. incognita (Avr)	**Susc.**	Res.	Res.	Res.
M. incognita (Vir)	Res.	**Susc.**	**Susc.**	**Susc.**
M. javanica	**Susc.**	**Susc.**	**Susc.**	Res.
Fusarium wilt (r3)	Res.	**Susc.**	Res.	Res.
Fusarium wilt (r4)	**Susc.**	**Susc.**	**Susc.**	Res.
Macrophomina	**Susc.**	**Susc.**	**Susc.**	**Susc.**

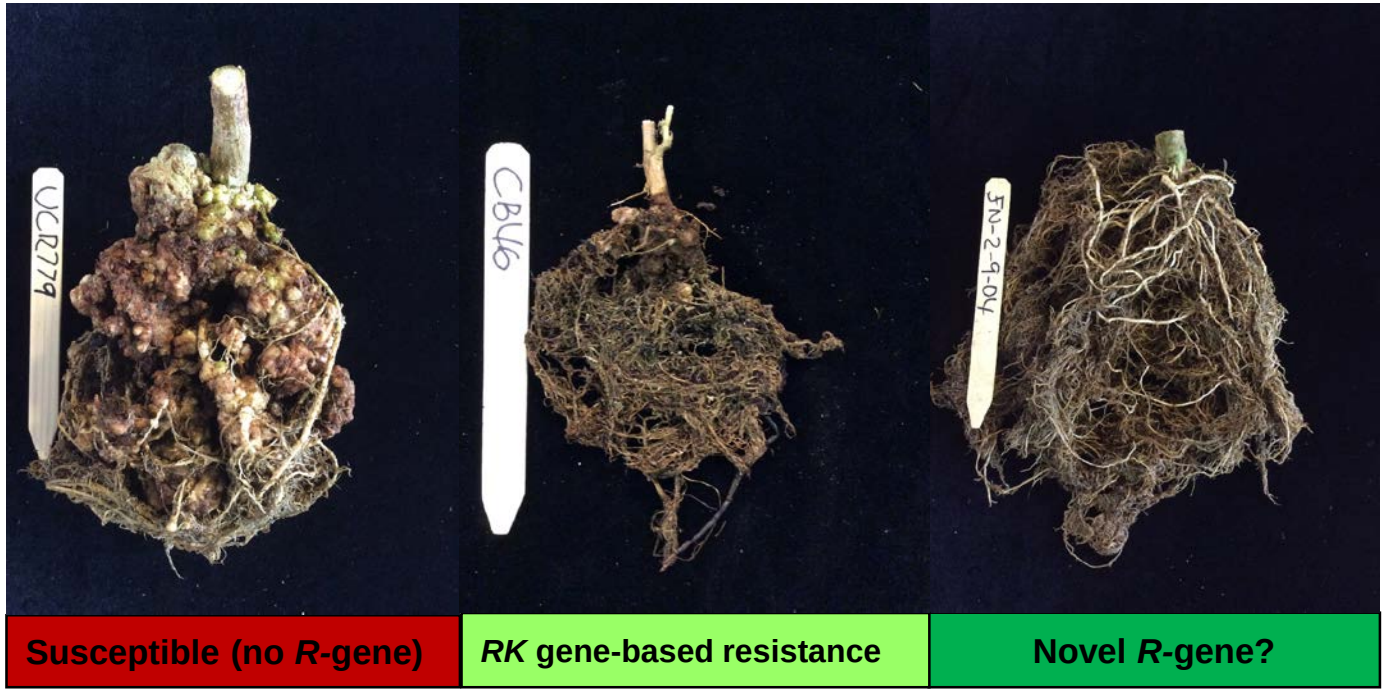
Adapted: Hall et al (1996)



Pursuing RKN Resistance for Cowpea Breeding

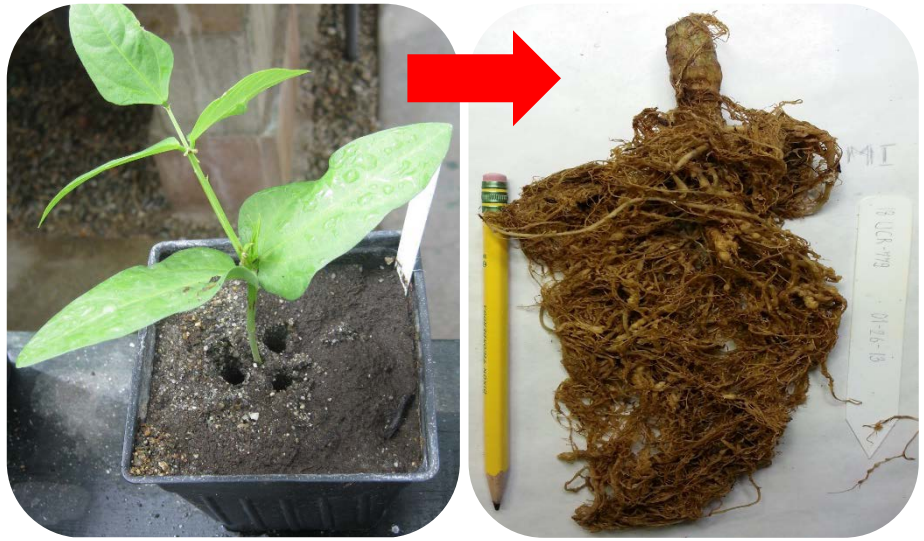
- ***Rk* gene**;
- ***Rk*^{2}**;
- ***rk*^{3}**;
- **Galling resistance gene**;

- **Novel *R* genes and biological spectrum among Mozambique germplasm?**

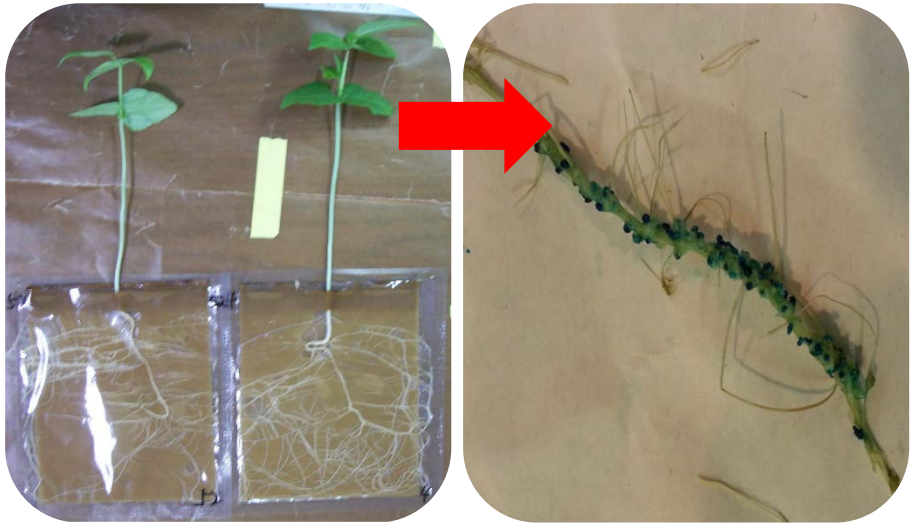


Phenotyping Protocols for RKN Resistance

Greenhouse inoculation

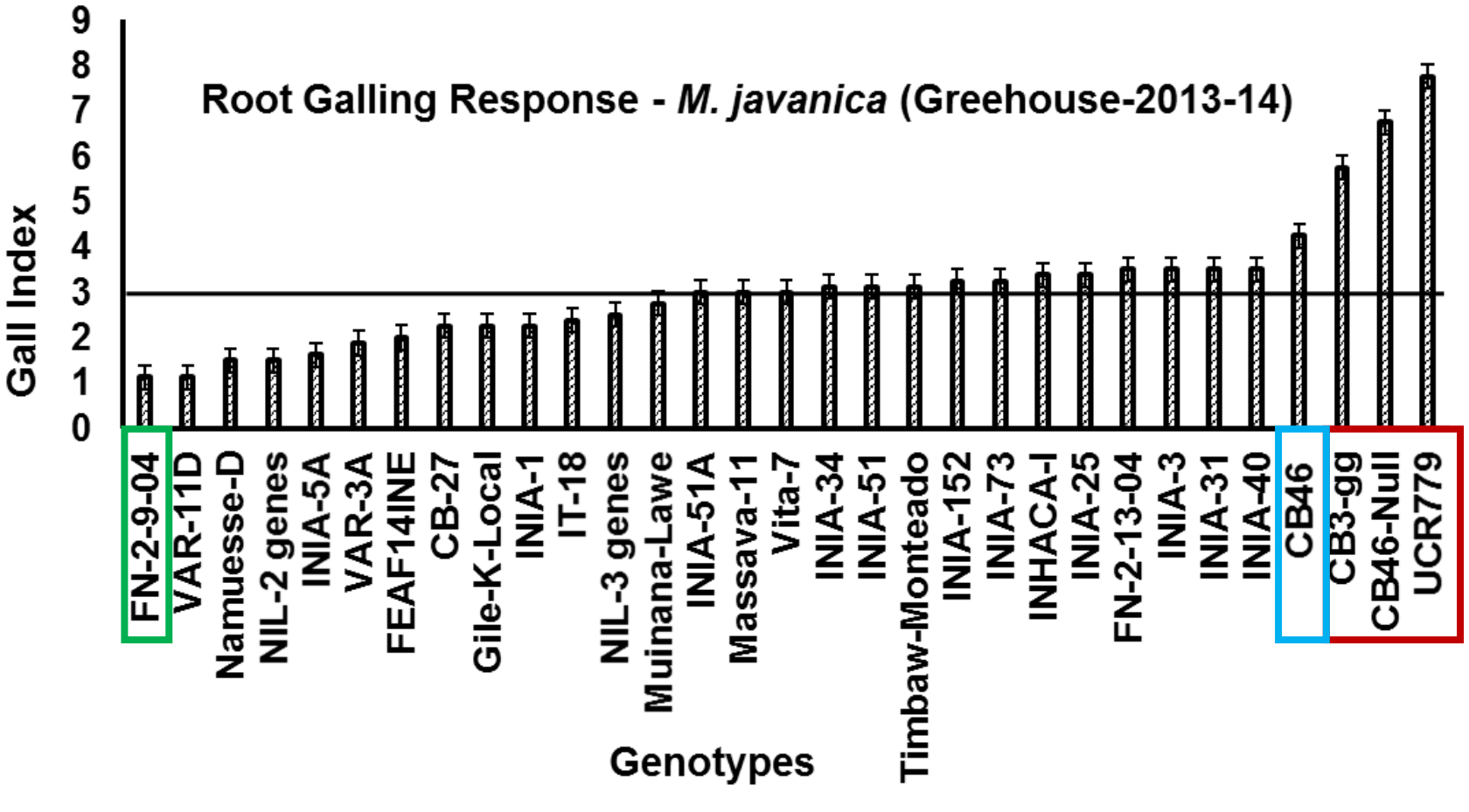


Seedling growth pouch inoculation

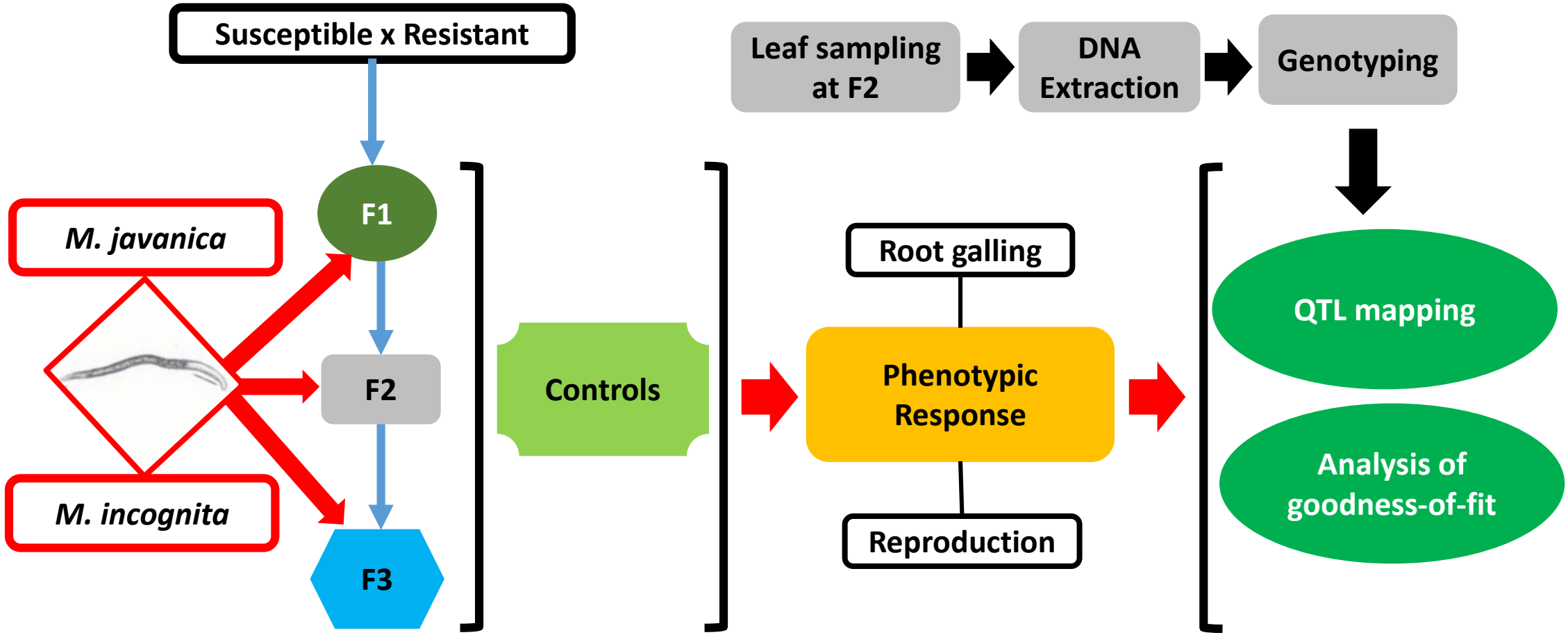


Infested field screening

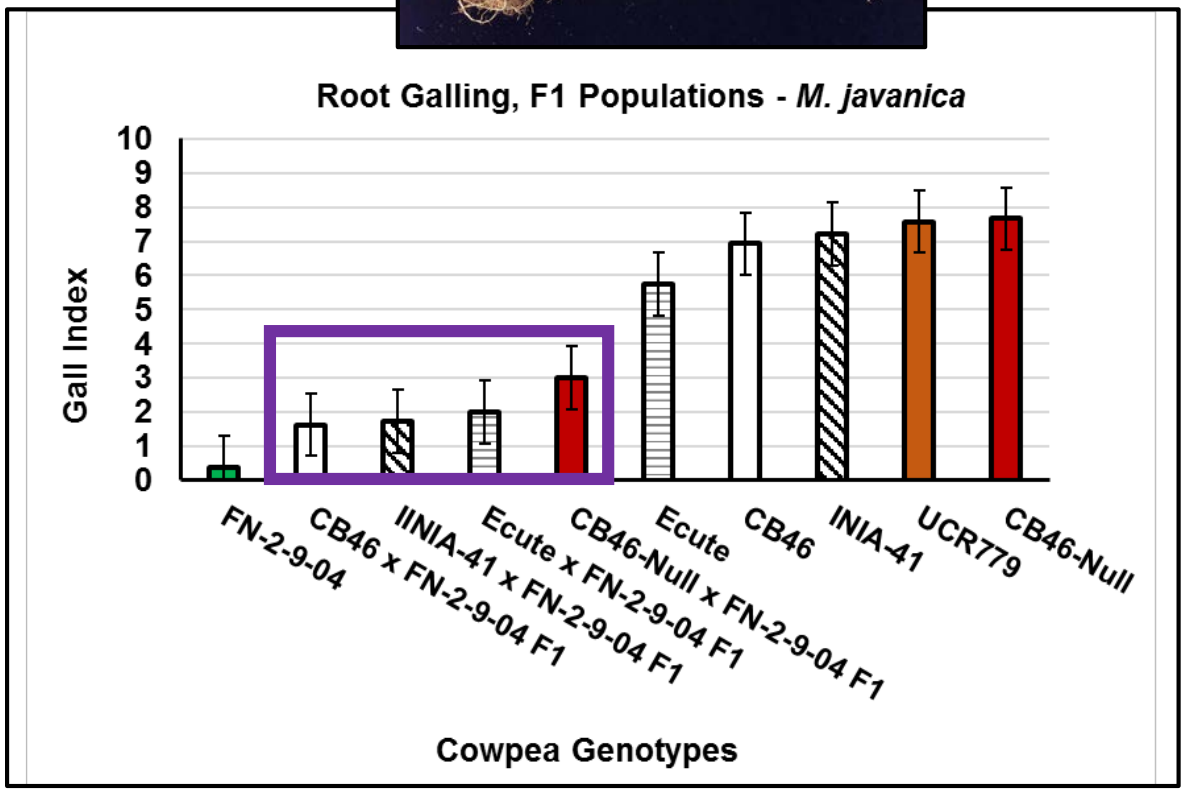
Novel Sources of Broad-Based RKN Resistance

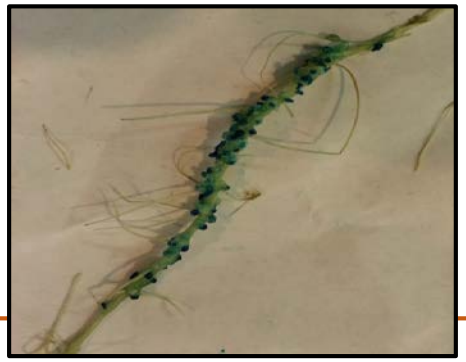


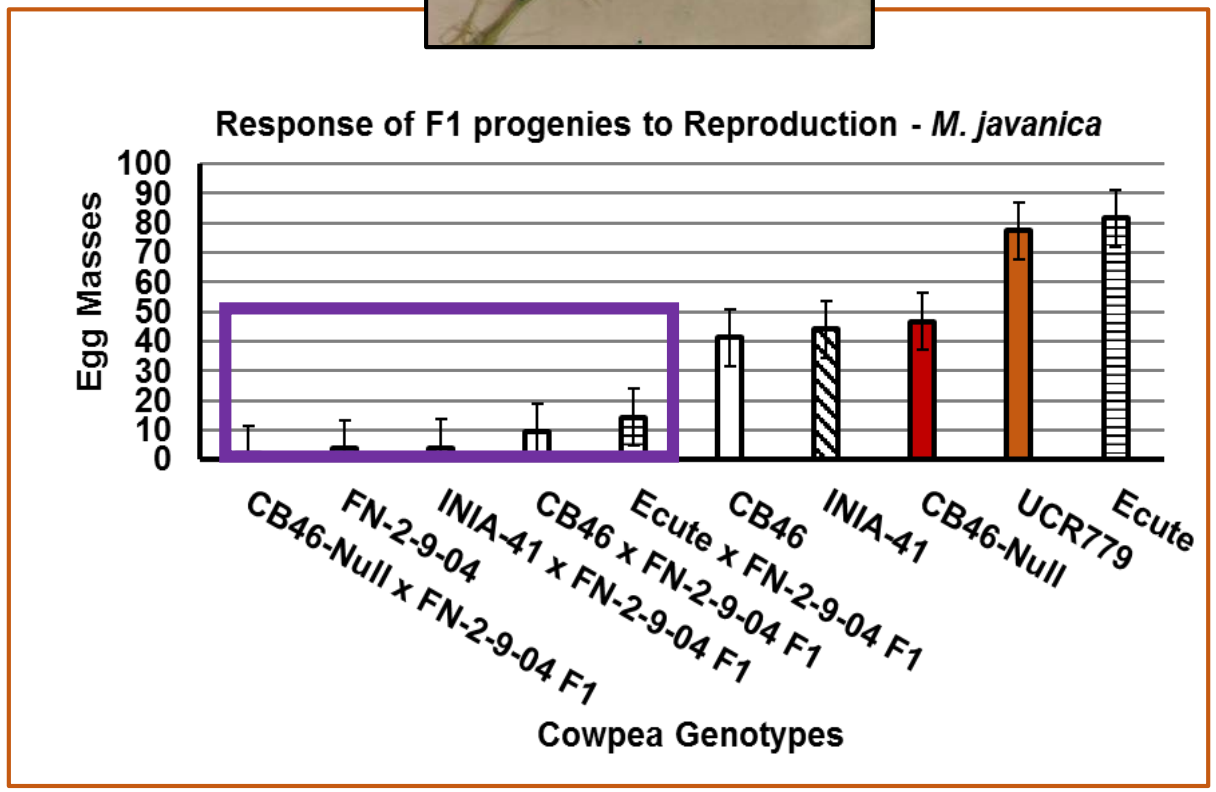
Workflow – Objectives 2 & 3



Phenotypic Response of F1 in FN-2-9-04 Crosses







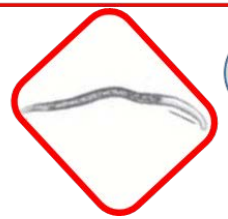
Relationship of Novel Resistance to *Rk* Gene

RK gene

X

Novel *R*-gene?

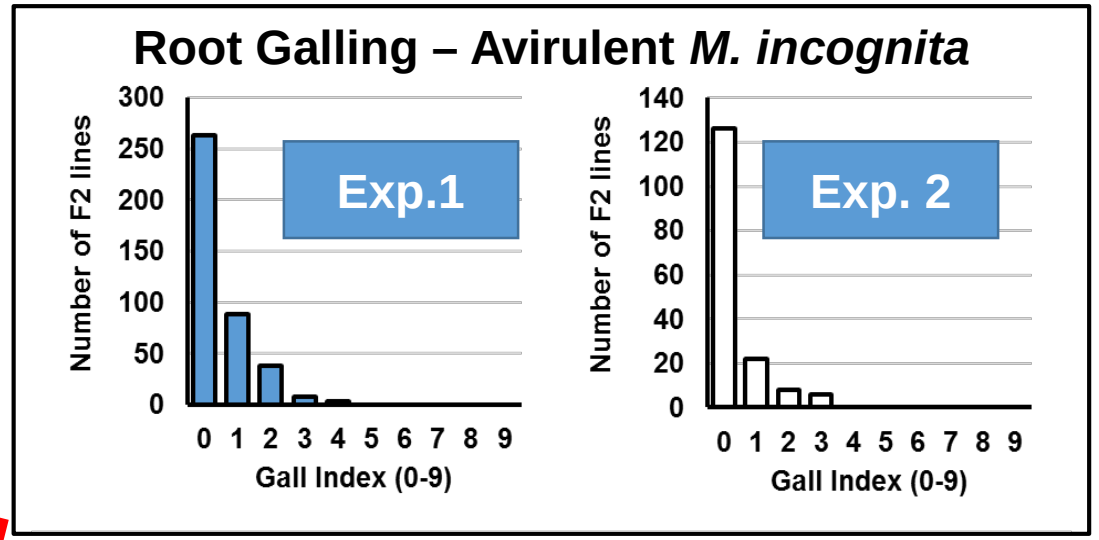
M. Incognita (*Avir*)

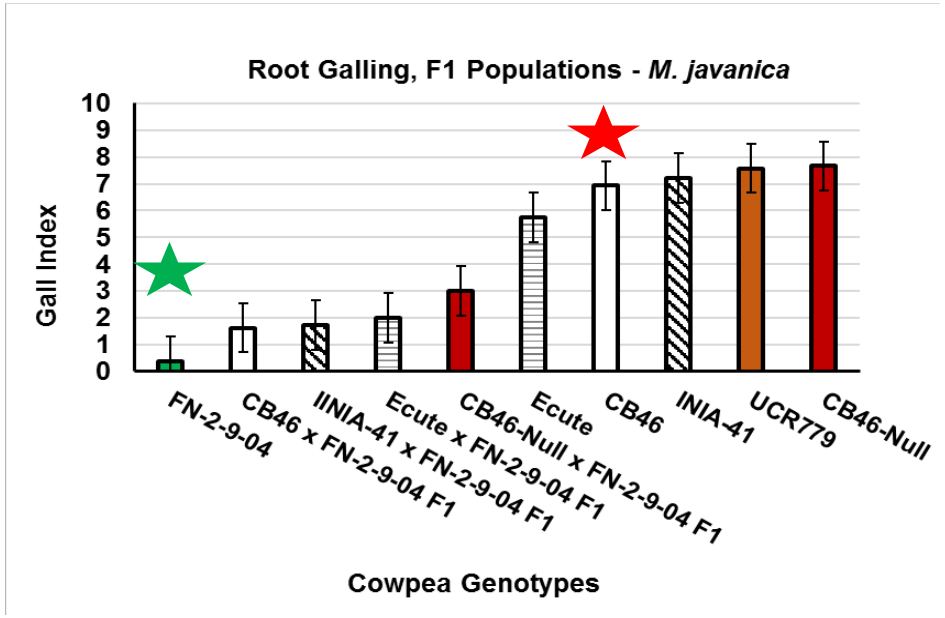


+

F2

No Segregation





QTL Mapping Populations

Phenotyping

Nematodes

Root galling

> 150 F2 & 150 F2:3

Reproduction

+

Genotyping

51 128 SNP

17 208 Poly.

119 F2

=

QTL mapping: Mixed-model (Xu, 2013)

Root galling

Reproduction

119 F2

M. javanica

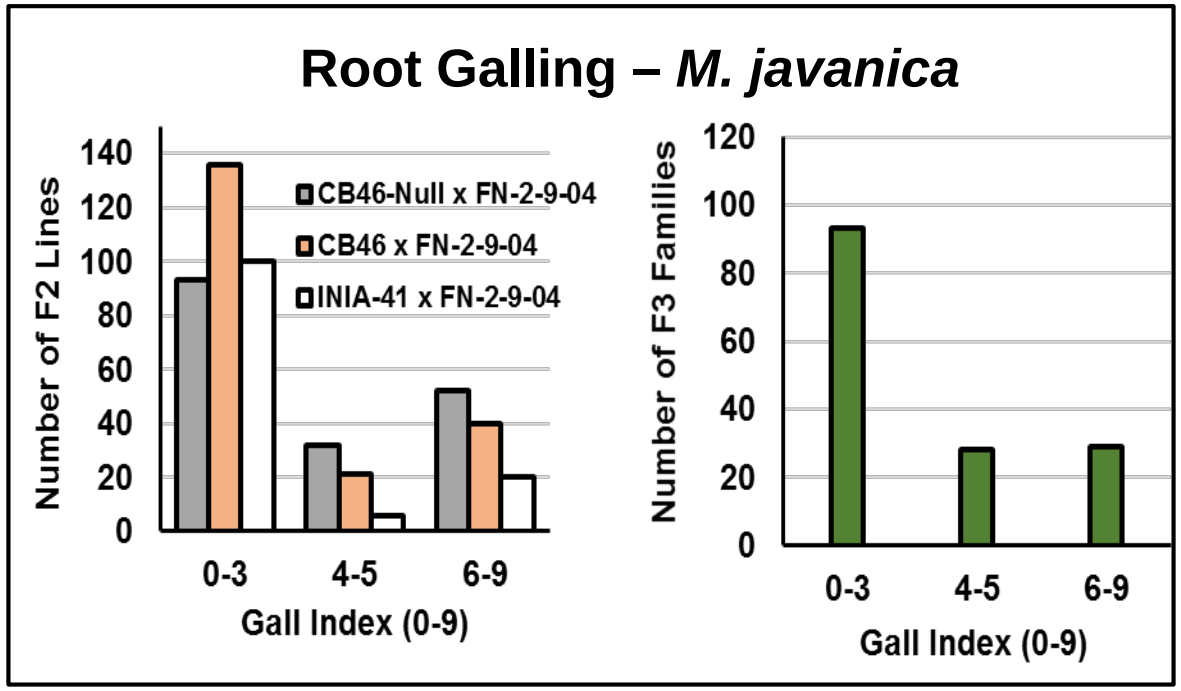
+

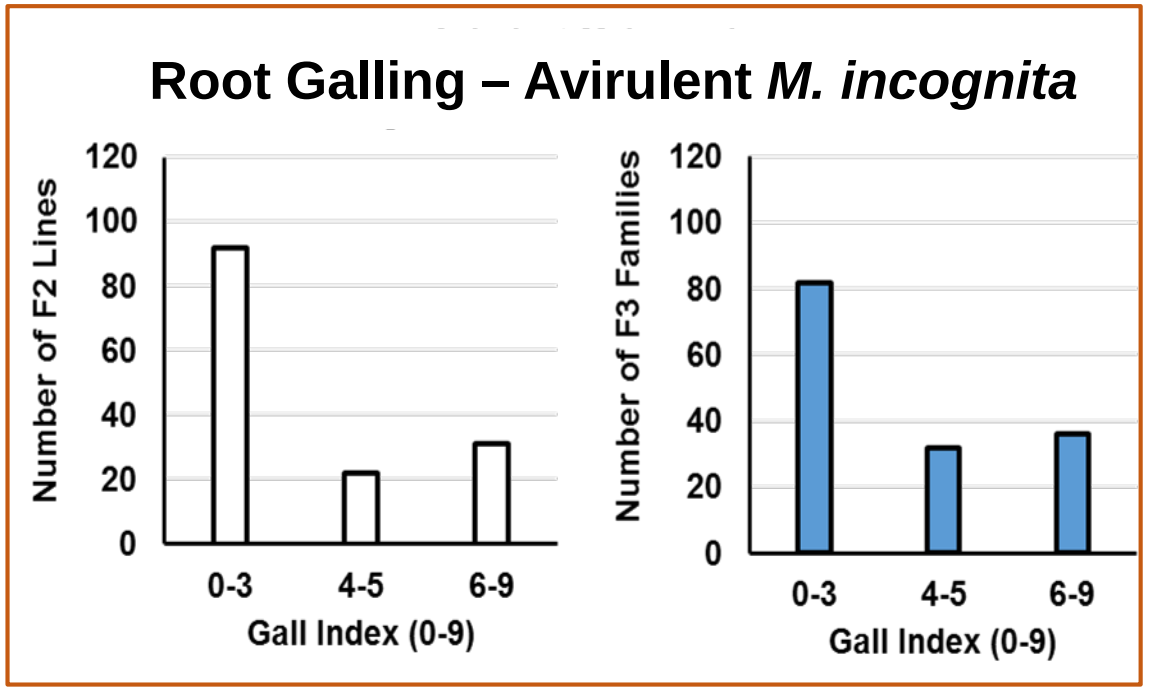
119 F2:3

Root galling

M. javanica & *M. incognita*

Distribution of Root Galling Response in F2 and F2:3

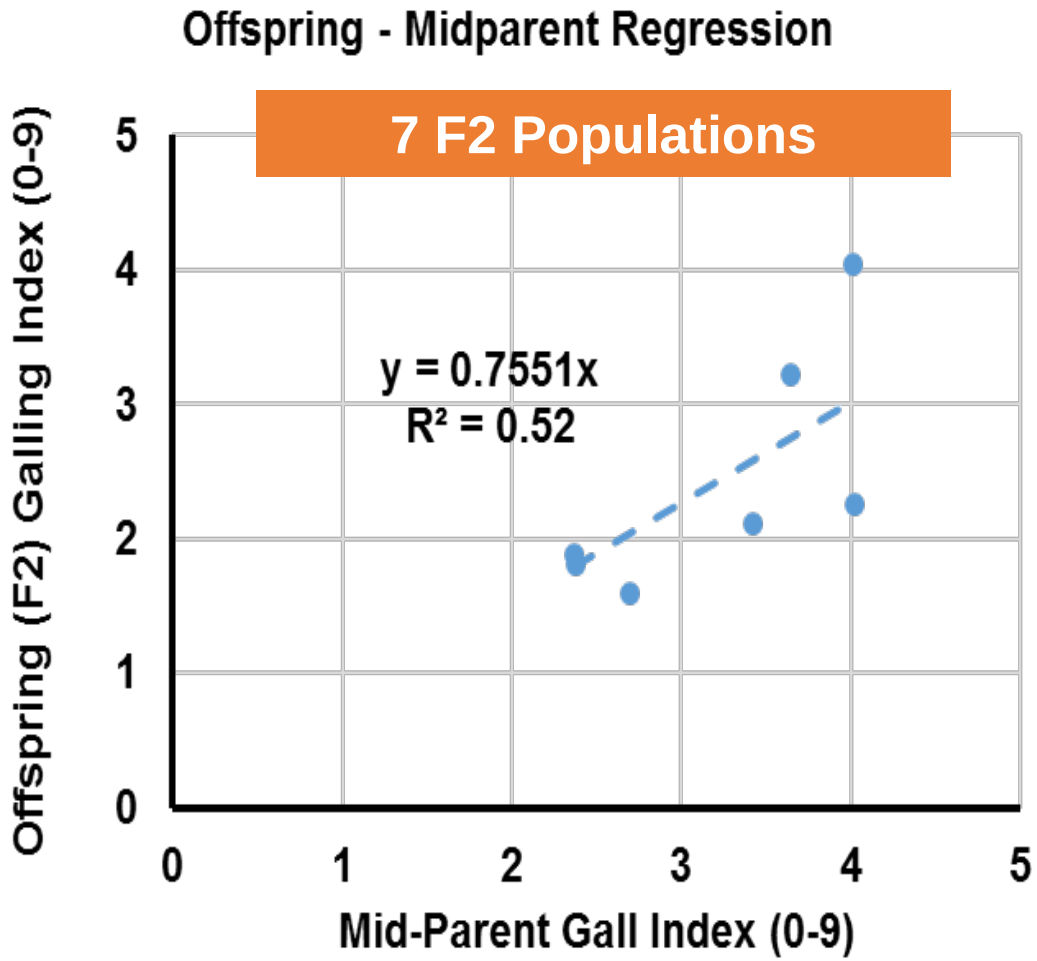




Heritability of Resistance in FN-2-9-04

X

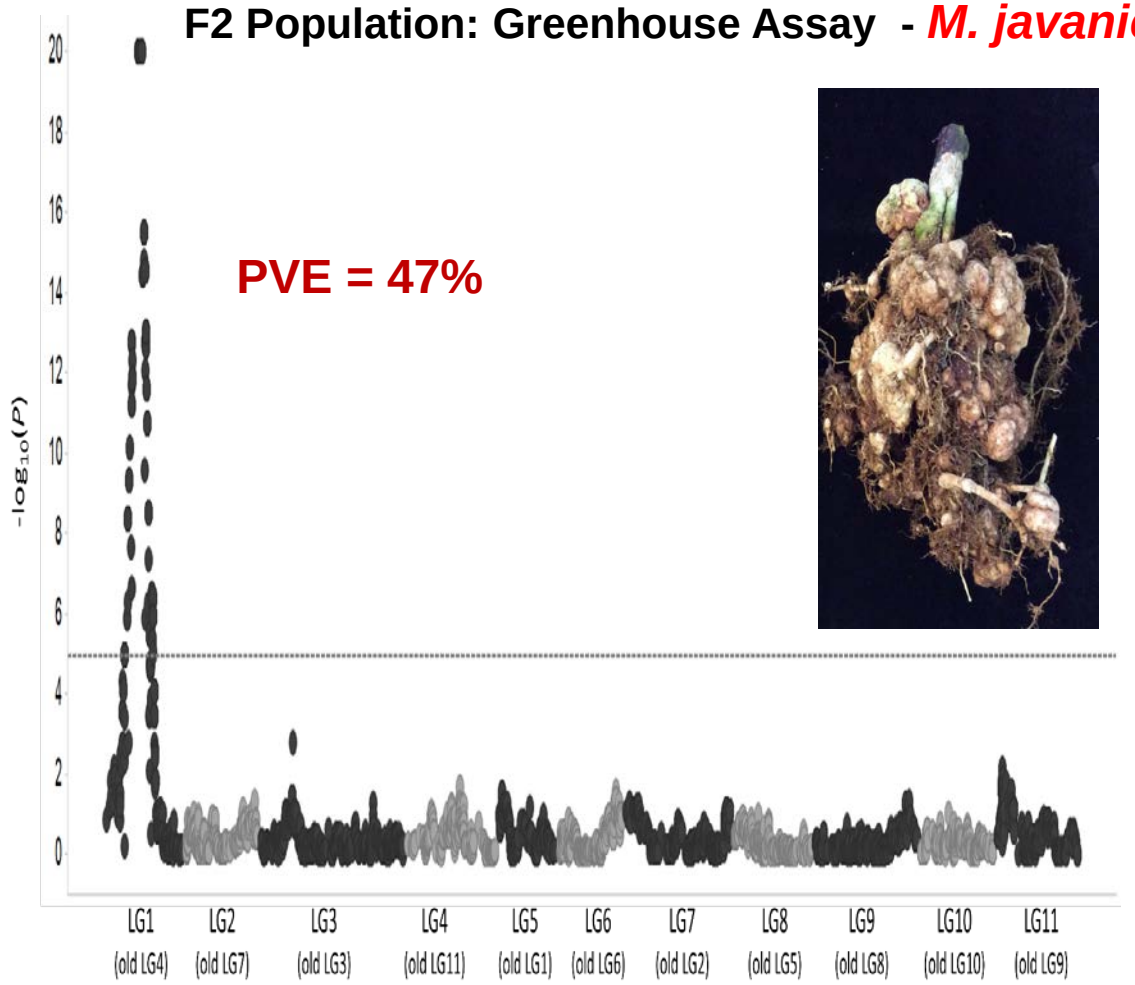
F2



Genomic Location of a Novel RKN Resistance QTL

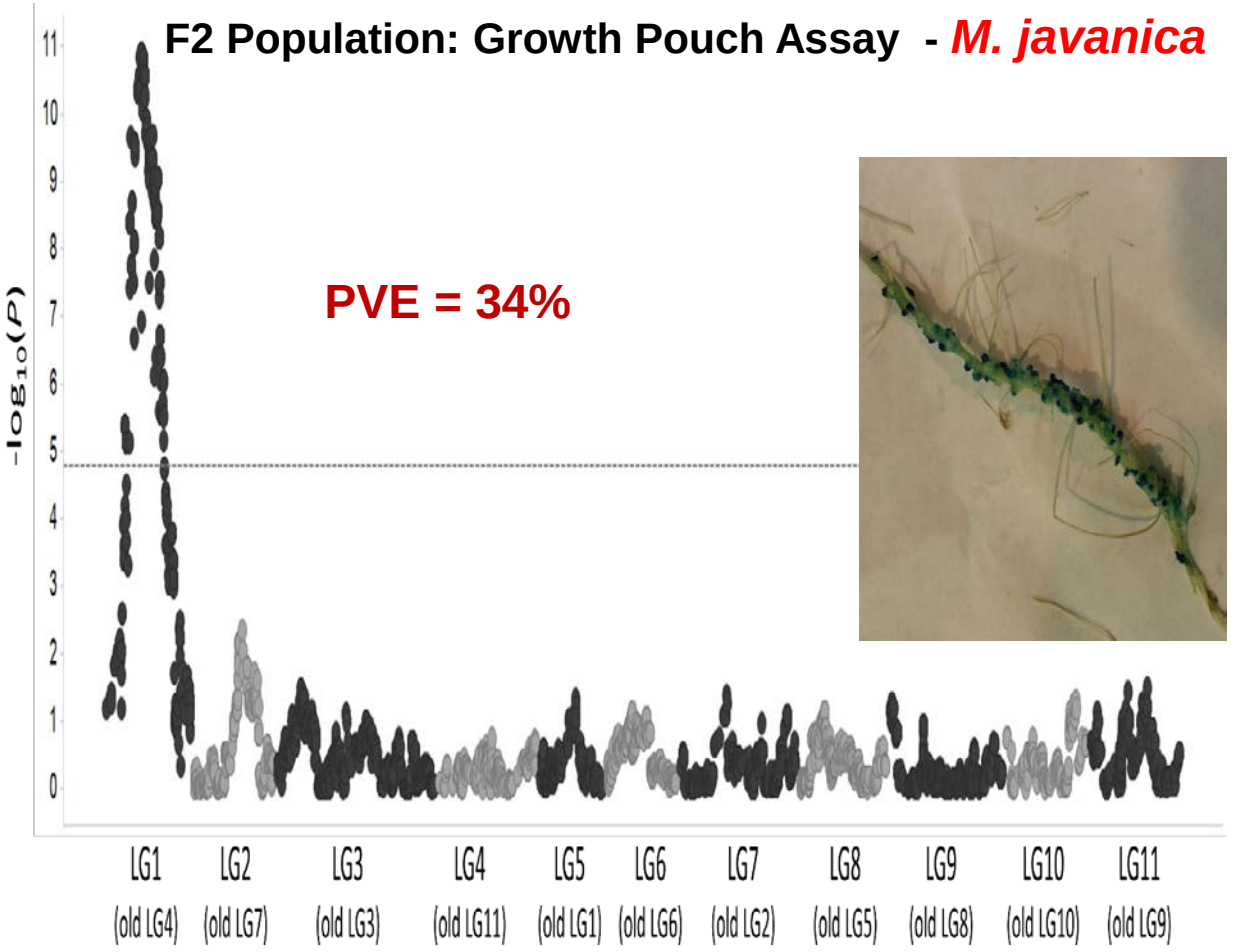
F2 Population: Greenhouse Assay - *M. javanica*

PVE = 47%



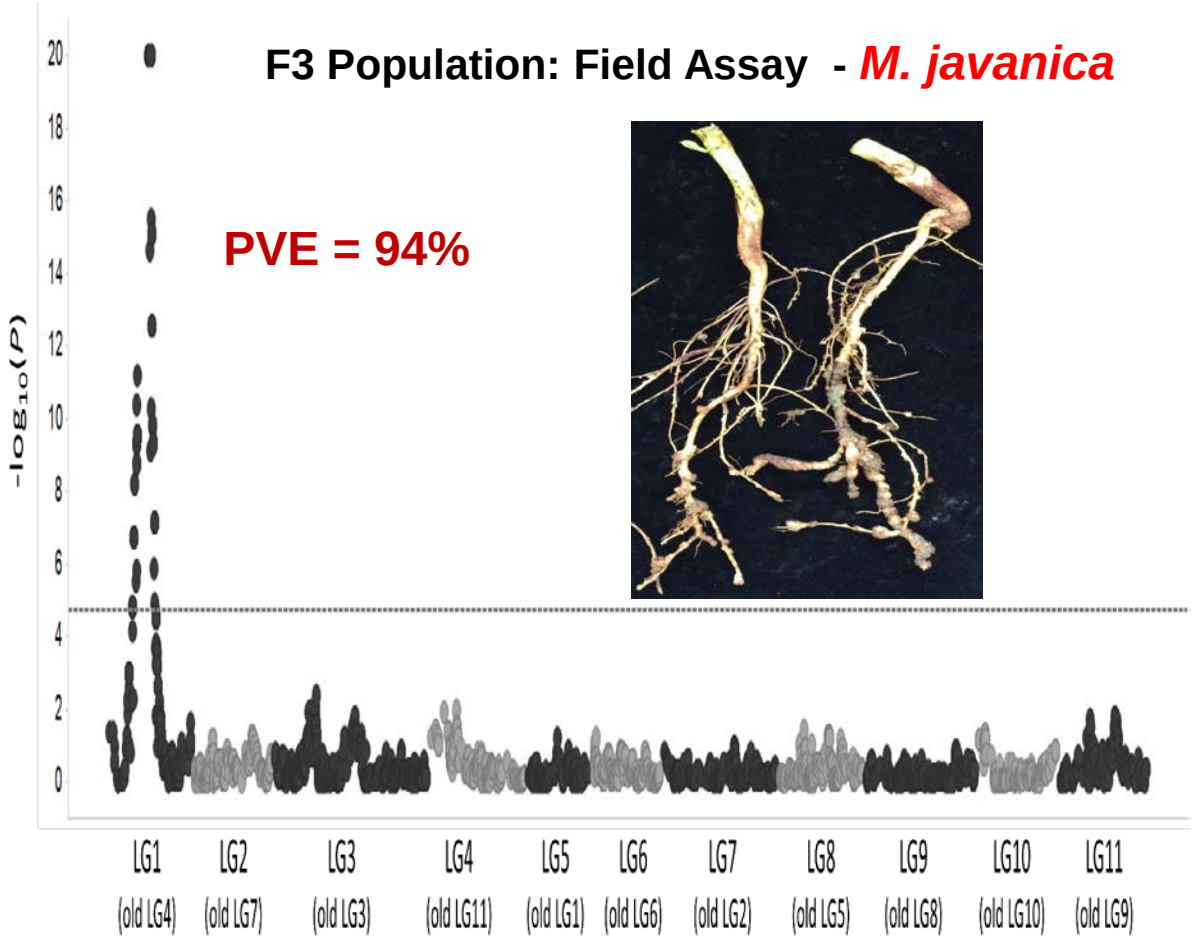
F2 Population: Growth Pouch Assay - *M. javanica*

PVE = 34%

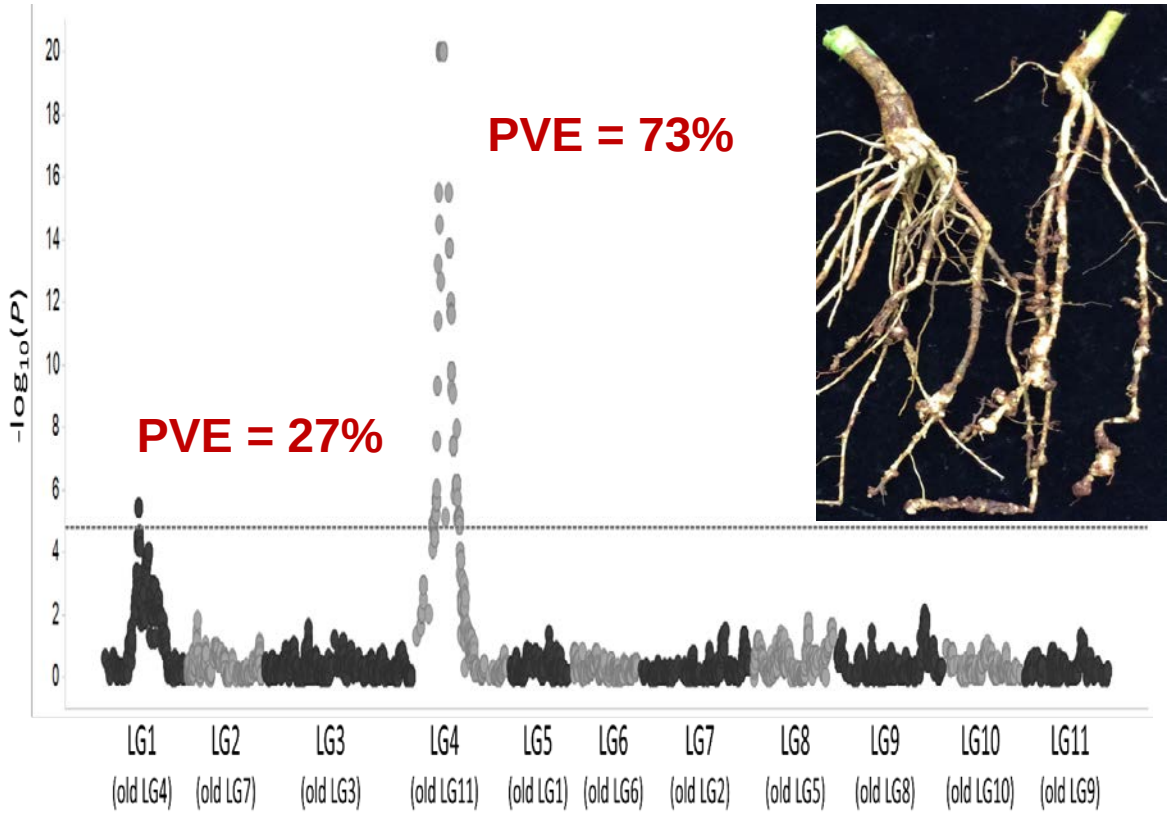


Genomic Location of the Novel RKN Resistance QTL

F3 Population: Field Assay - *M. javanica*



F3 Population: Field Assay - Avr *M. incognita*



Conclusions

- Allelism tests showed that, in addition to the *Rk* locus found in current cultivars, FN-2-9-04 carries unique RKN resistance factors;
- Resistance in FN-2-9-04 controlled by 2 major QTLs on Chr1 and Chr4;
- RKN root-galling and reproduction are under control of major genes with partial dominance, putatively with enhancement by minors factors;
- High heritability of resistance to *M. javanica* in FN-2-9-04 indicates easy selection for breeding RKN resistant cowpea cultivars.

The UC-Riverside Cowpea Research Group

- Philip A. Roberts
- Timothy J. Close
- Bao Lam Huynh
- Maria Munoz-Amatriain
- Steve Wanamaker
- Bill Matthews
- Jansen Santos
- Sassoum Lo
- Yi-Ning Guo
- Ira Herniter
- **Arsenio Ndeve**