# Tackling the threats of major diseases to UK potato production

The James Hutton Institute

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# Outlines

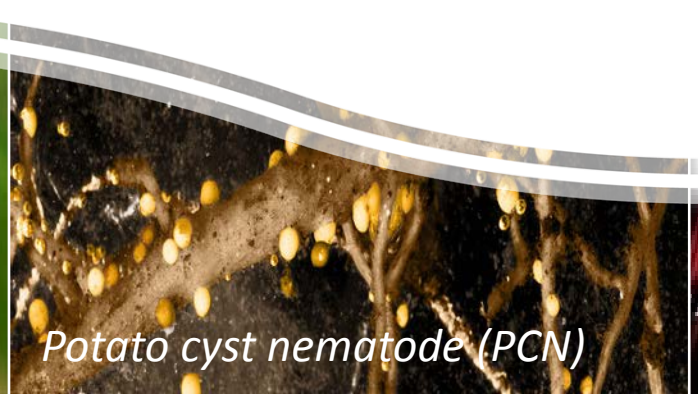
1

- *P. infestans* (evolution, cultivar managements, and resistance durability)

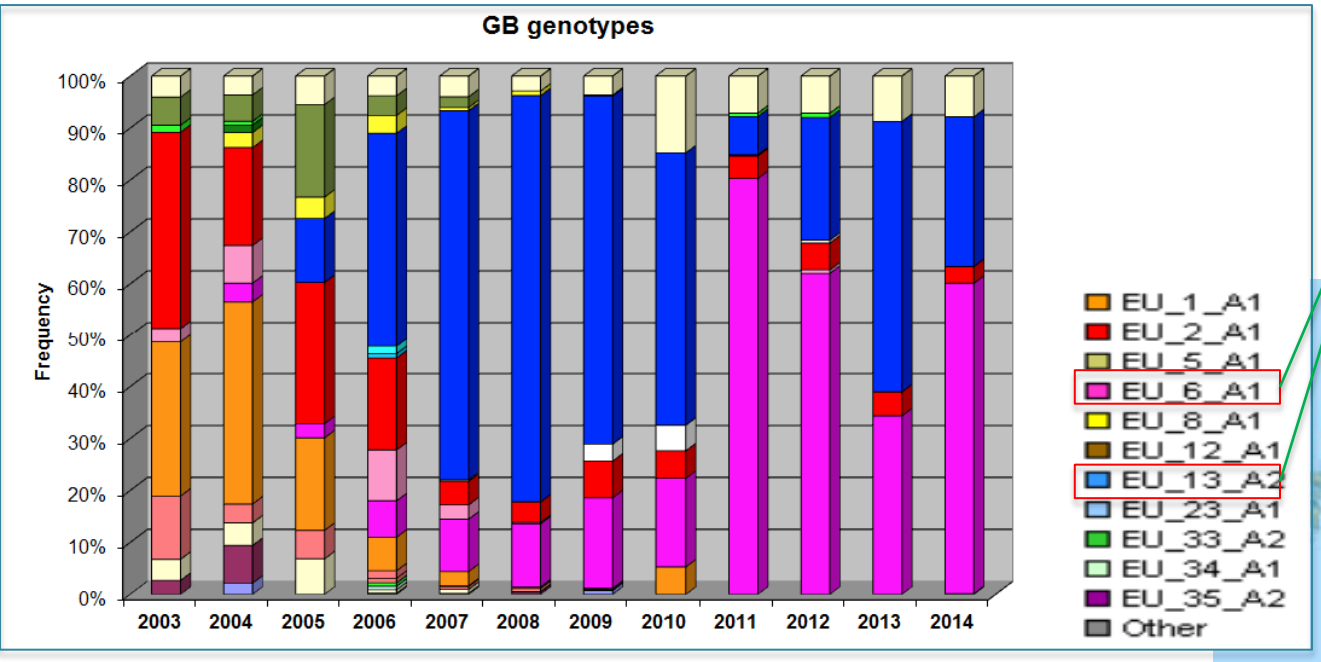
2

- PCN (pathotypes, resistance sources, marker-assisted pyramiding)

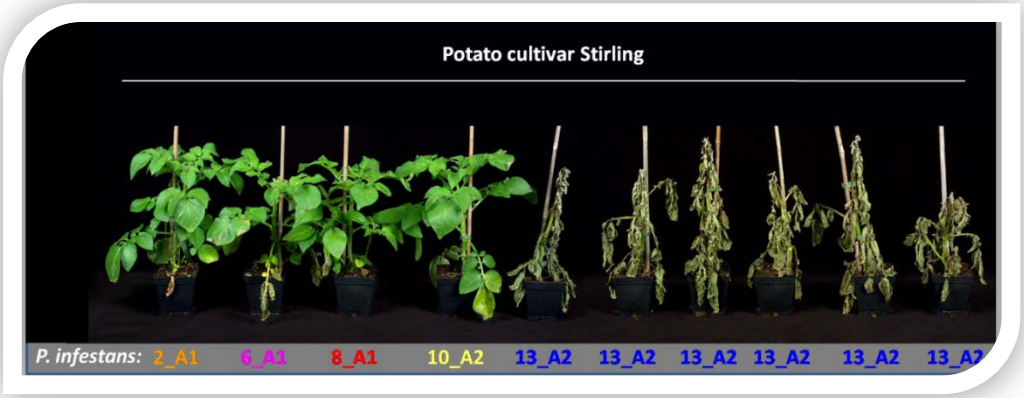

*P. Infestans*

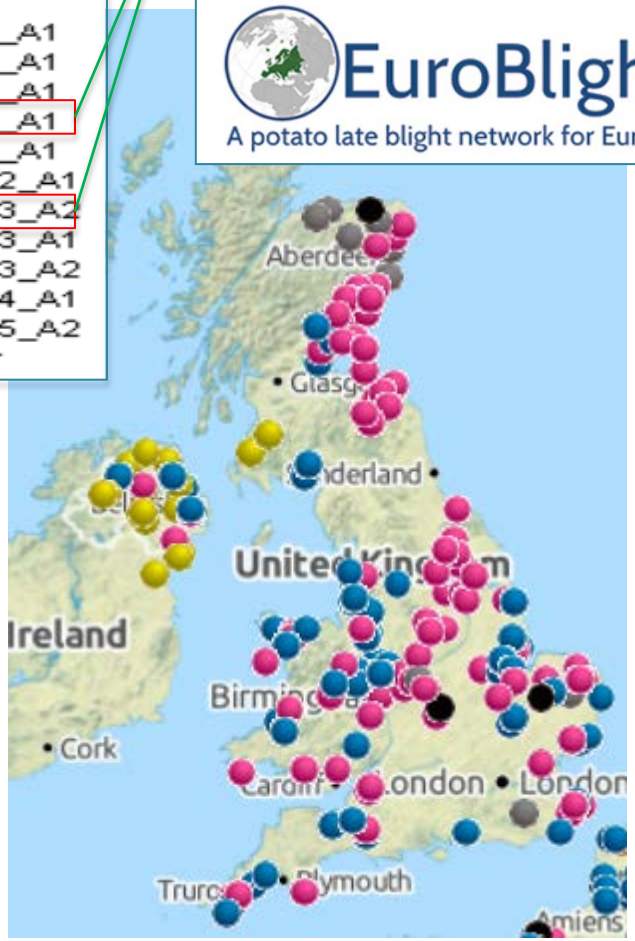

*Potato cyst nematode (PCN)*

# Dynamics of Pi population




Predominant genotypes




David Cooke et al.

# Why is Late blight still a major problem for potato growers?

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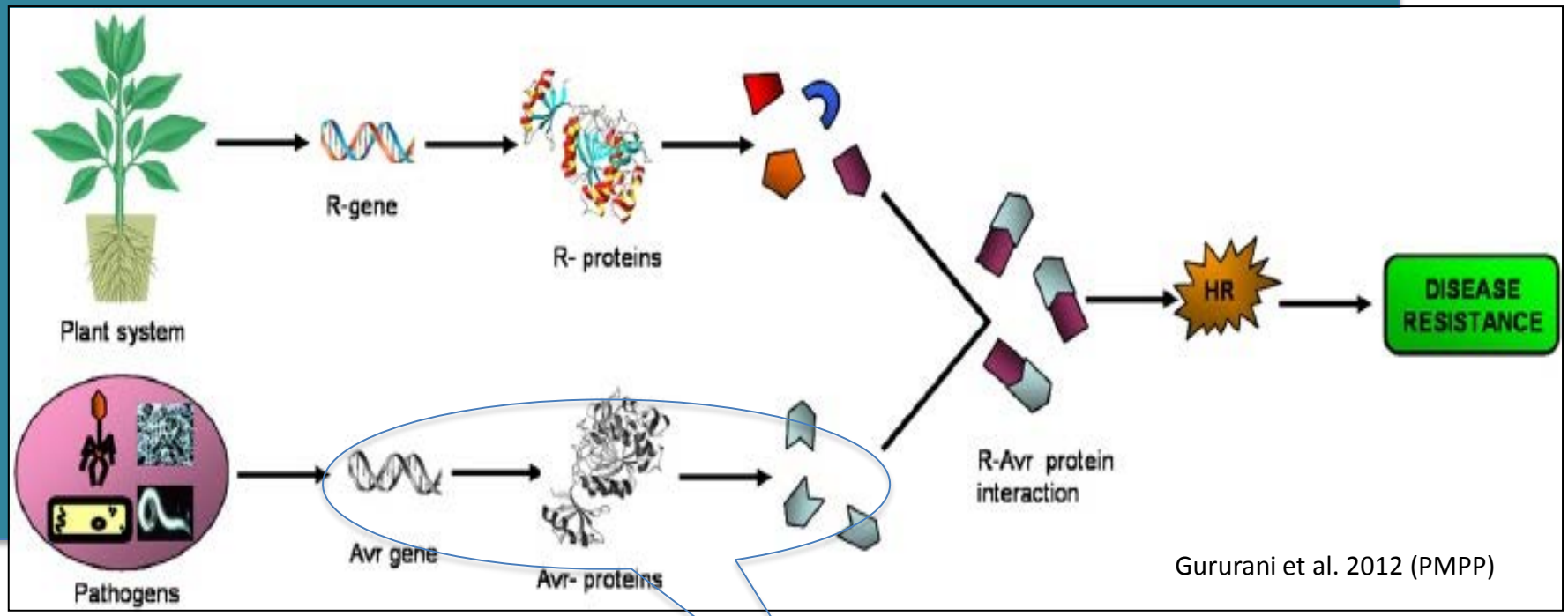
## *Basis of resistance vs susceptibility*




Mutation of avirulence gene results in Susceptibility

# Why is Pi still a major problem for potato growers?

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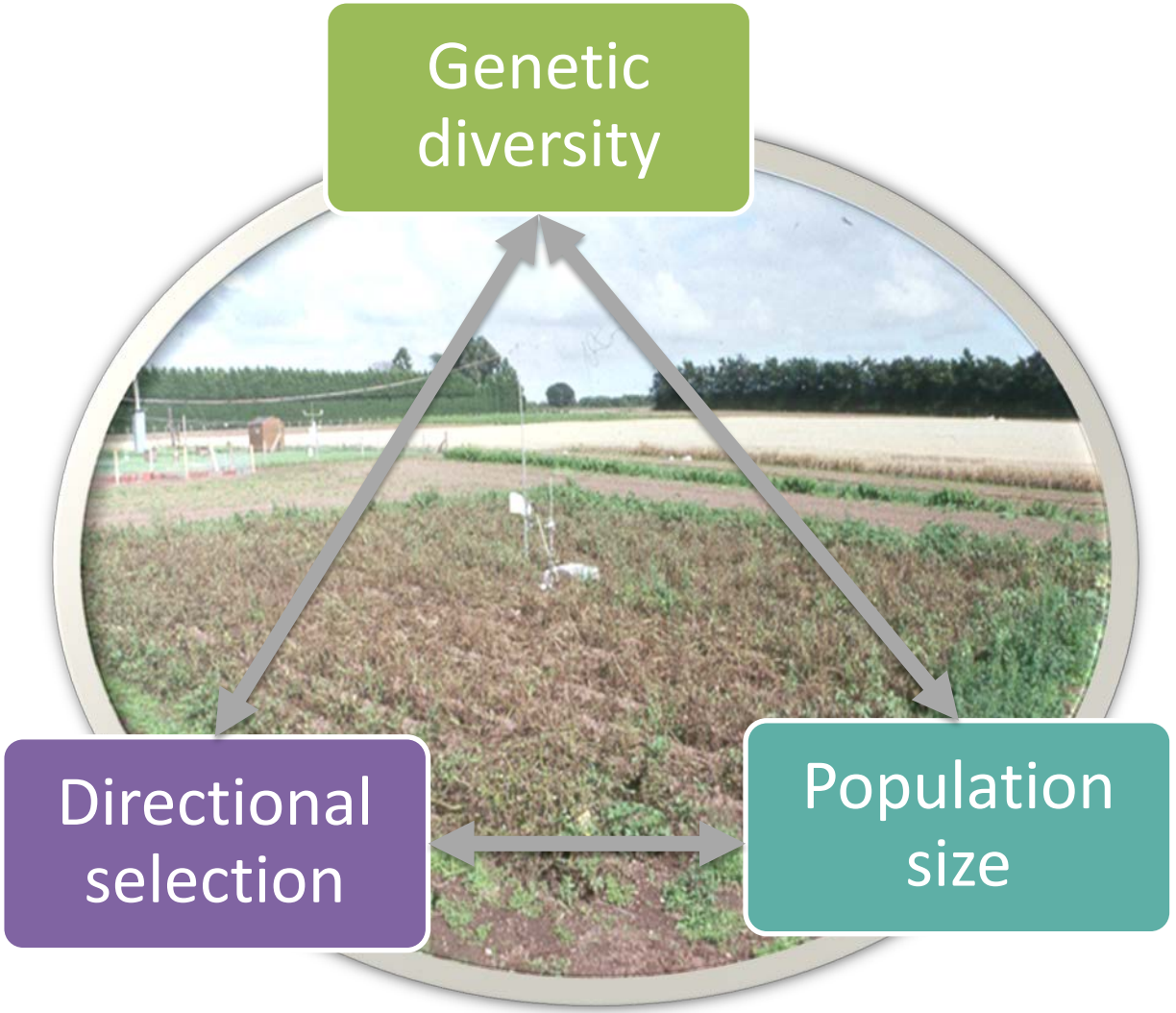

# Two factors to be considered to extend resistance life span


**Factor 1**

## Pathogen gene/genotype diversity

the number and frequencies of a single locus or multi-locus genotypes in a population

**Factor 2**

## Pathogen gene/genotype flow

Gene or genotype exchange among geographically separated populations

# Strategies of sensible deployment and management of resistance

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**Factor 1**

Gene/genotype diversity?

High | Low

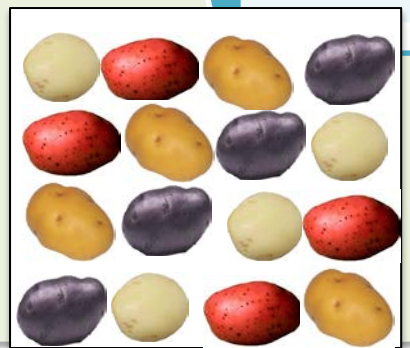
**Factor 2**

Gene/genotype flow (High | Low)

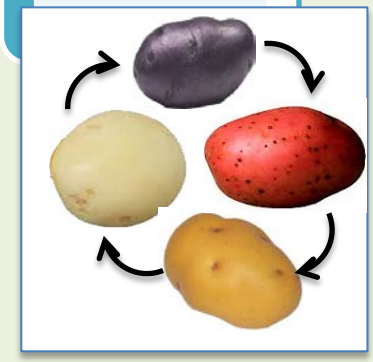
Gene/genotype flow (High | Low)

**Options**

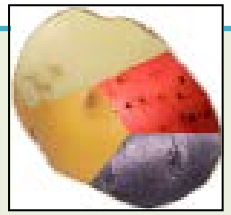
- *Use QR
  *intensively manage MGR using cv mixture or multilines



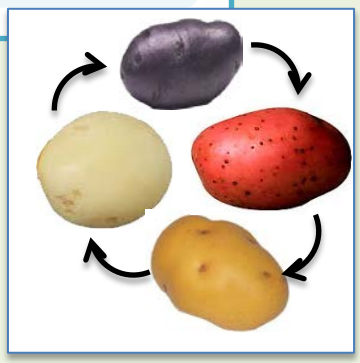
- *Use QR
  *Use MGR on regional a basis



- Pyramid MGR



- Use MGR



QR=quantitative resistance
MGR=major gene resistance

# PCN: contrasting characteristics to *P. infestans*

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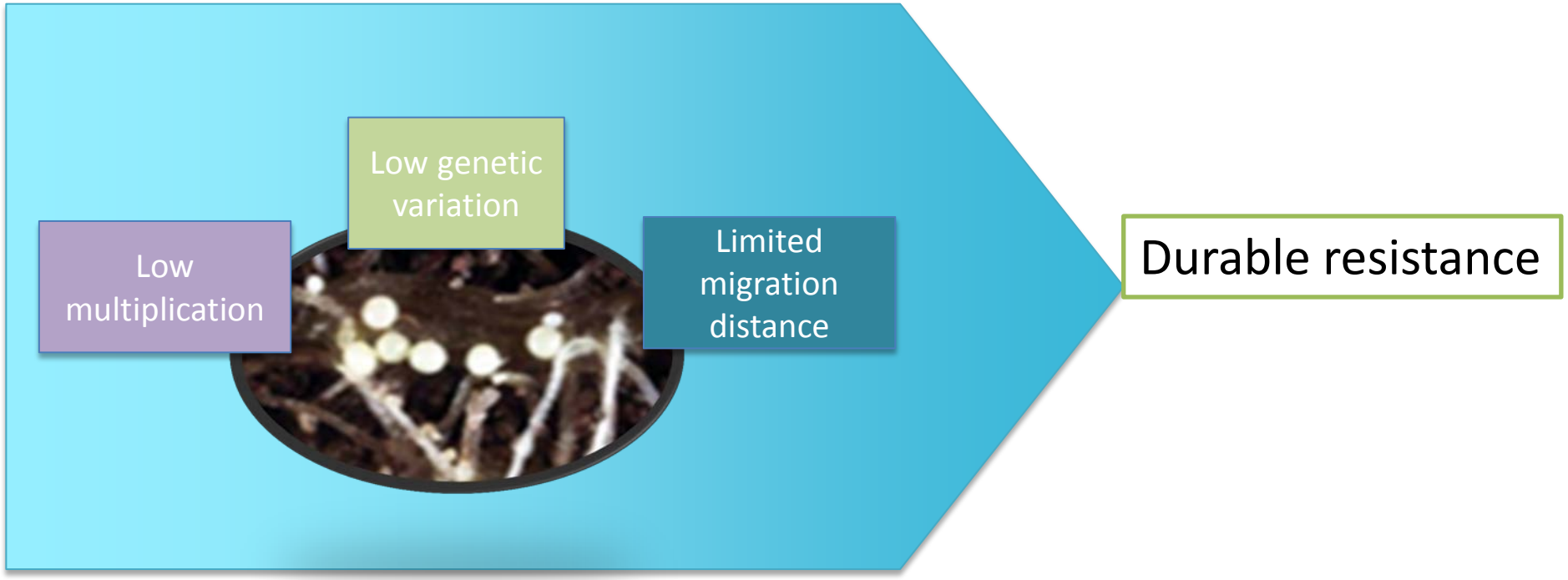

| PCN species | pathotypes | UK pathotypes | Resistance sources |
|---|---|---|---|
|   | Ro1,2,3,4,5 | Ro1 | H1 (andigena)<br>half cv |
|   | Pa1,2,3 | Pa1 (rare)<br>Pa2/3 (popular) | H2 (multidissectum)<br>H3 (andigena)<br>Gpa5 (vernei) |

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- H1 and H2: complete resistance
- H3 and Gpa5: partial resistance
- All resistances introgressed but separately spread, not effective

**Screen for H1 using 57R diagnostic PCR marker**


Can we enhance resistance by stacking up all resistances into single cultivar?

Yes, Marker-assisted selection

No, traditional selection

# Developing markers for H3 and Gpa5

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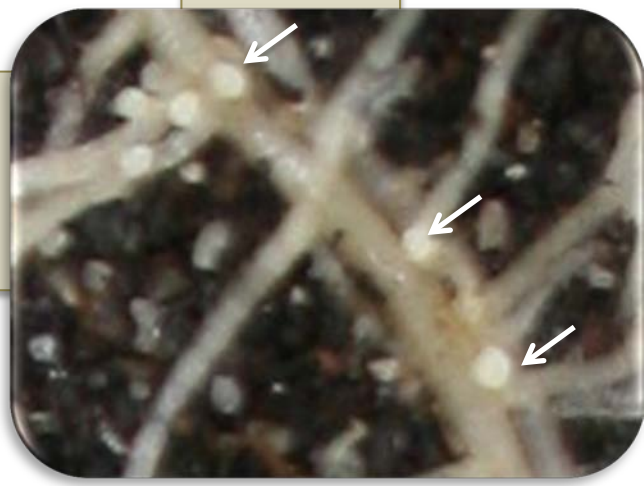
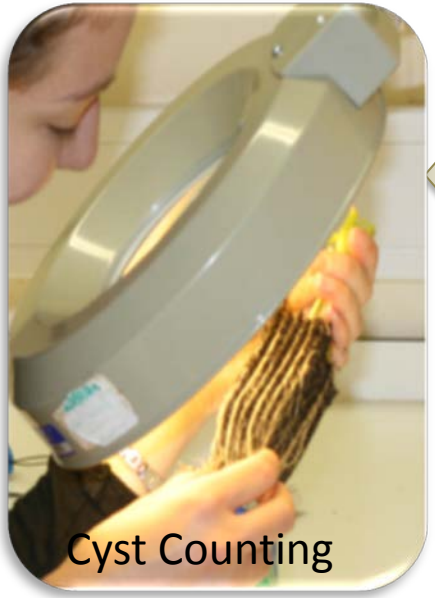
Step 1: test >230 clones for resistance to Pa2/3

Grow plants in cyst-inoculated root trainers

Check on female development 7 wpi





Cyst Counting

Tedious and time consuming

V. Blok et al.

# Developing markers for H3 and Gpa5

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Step1: test 230 clones for resistance
Step 2: marker-genotyping >230 clones at target loci
Step 3: identify tightly linked markers for each of the resistance

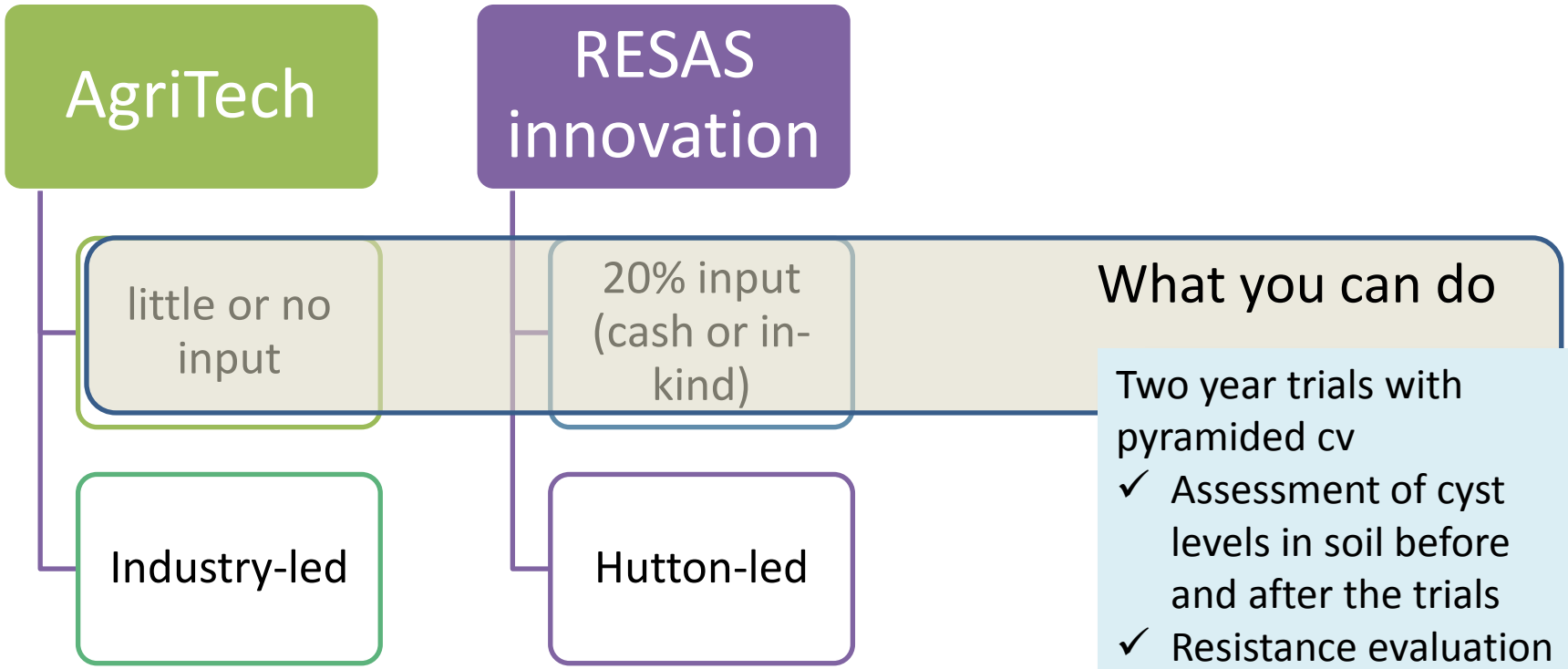
**Step 4: Pyramiding resistance**

- 300 clones from cross (Innovator x Vales E.)
- 400 clones from cross (Innovator x 12601ab1)

**Output**

1) Diagnostic markers for H1, H3 and Gpa5 developed and made available to potential partners
2) Potential cv pyramided with multi-source resistance

# Seeking partners to tackle the problems through joint efforts



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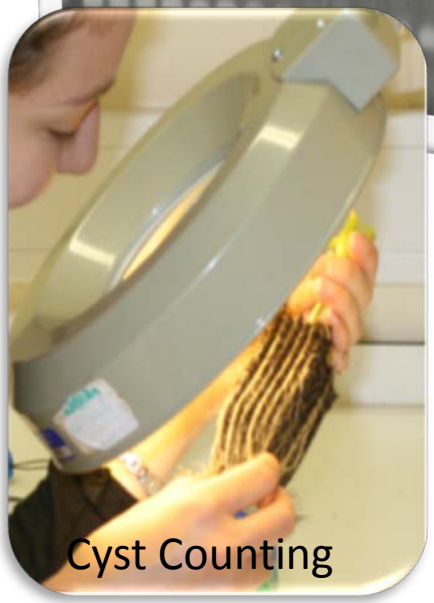
# Let's crack it together!



Cyst Counting