



What do we know about tolerance?

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Resistance vs tolerance



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Resistance & no tolerance

These varieties will stop PCN but yield may be affected in the first rotation

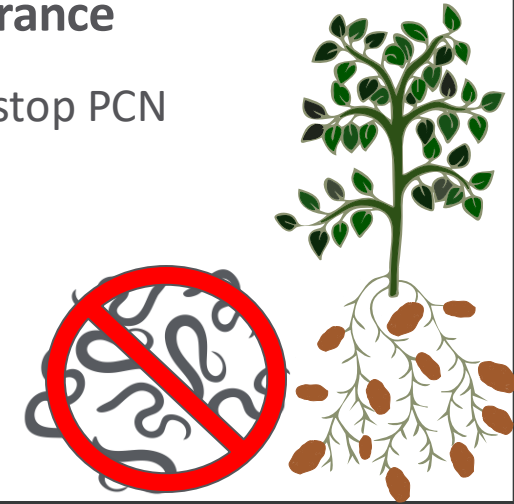
Examples:
Innovator
Panther
Ramos



Resistance & tolerance

These varieties will stop PCN and will yield well

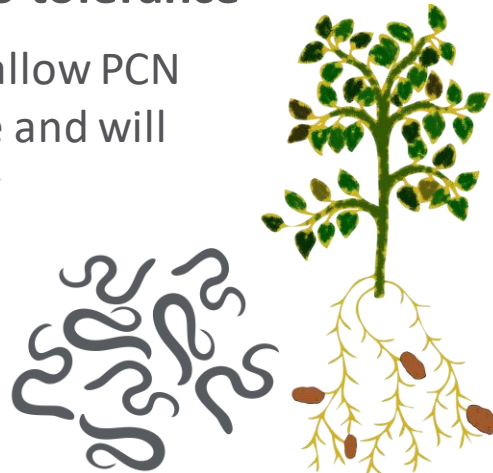
Examples:
Camel
Eurostar
Arsenal



No resistance & no tolerance

These varieties will allow PCN numbers to increase and will not yield sufficiently

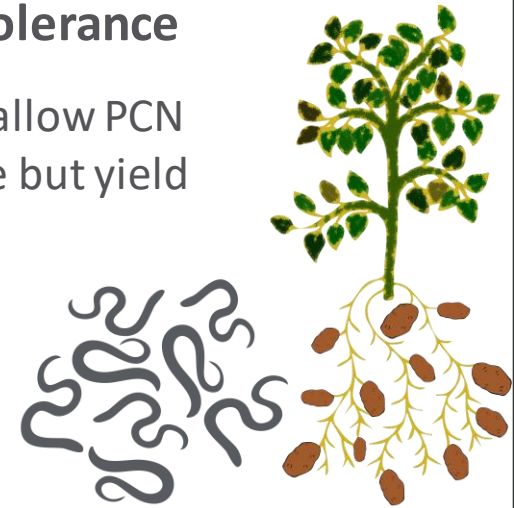
Examples:
Maris Peer
Pentland Dell
Nadine



No resistance & tolerance

These varieties will allow PCN numbers to increase but yield will be unaffected

Examples:
Cara
Cultra
Royal

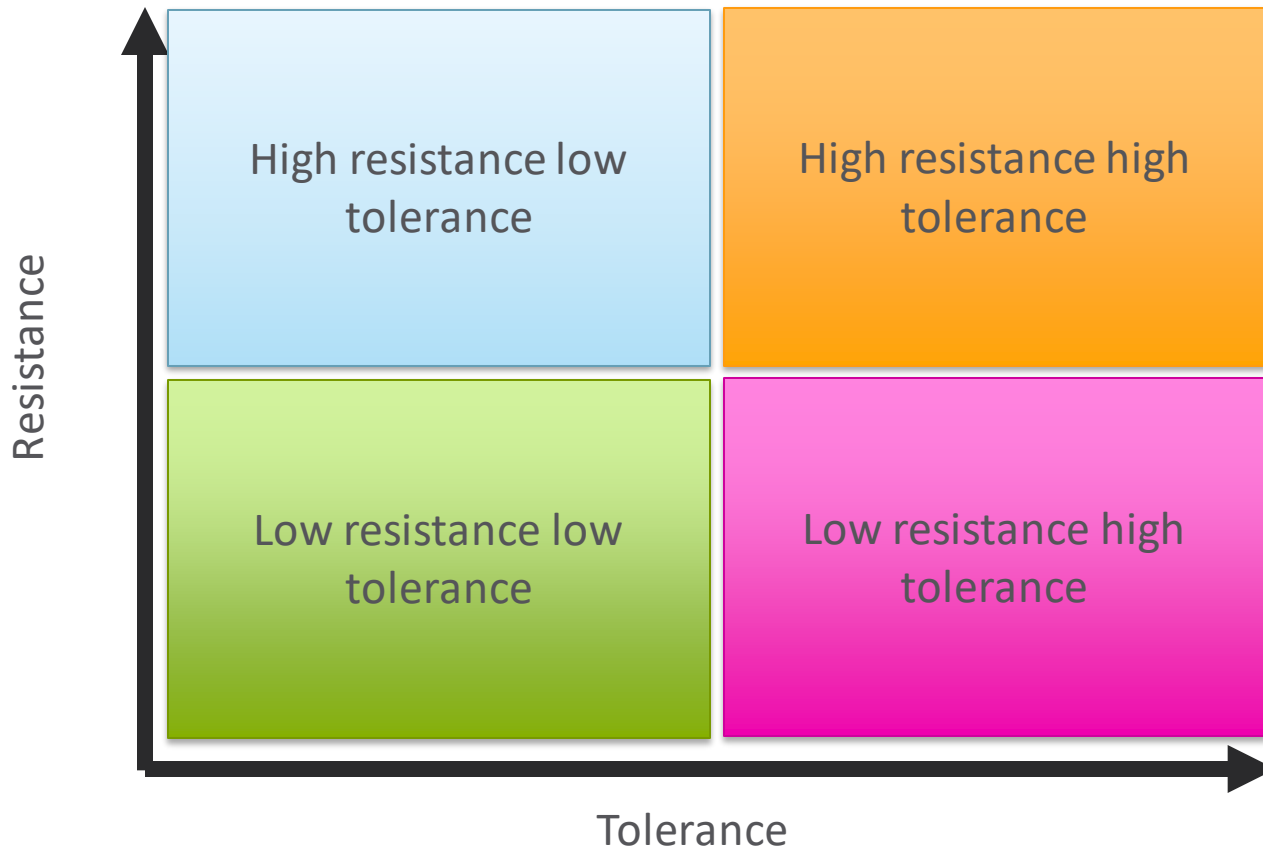


Resistance vs tolerance

- Molecular markers for resistance genes aid breeding programs in production of new varieties
- There are currently no molecular markers for tolerance meaning tolerance can only be scored after lengthy field trials in the presence of PCN



Resistance vs tolerance



- Resistance and tolerance can be plotted but need measurable values
- Resistance can be measured using **pi:pf ratios**
- Tolerance can be measured using **yield** in the presence of PCN



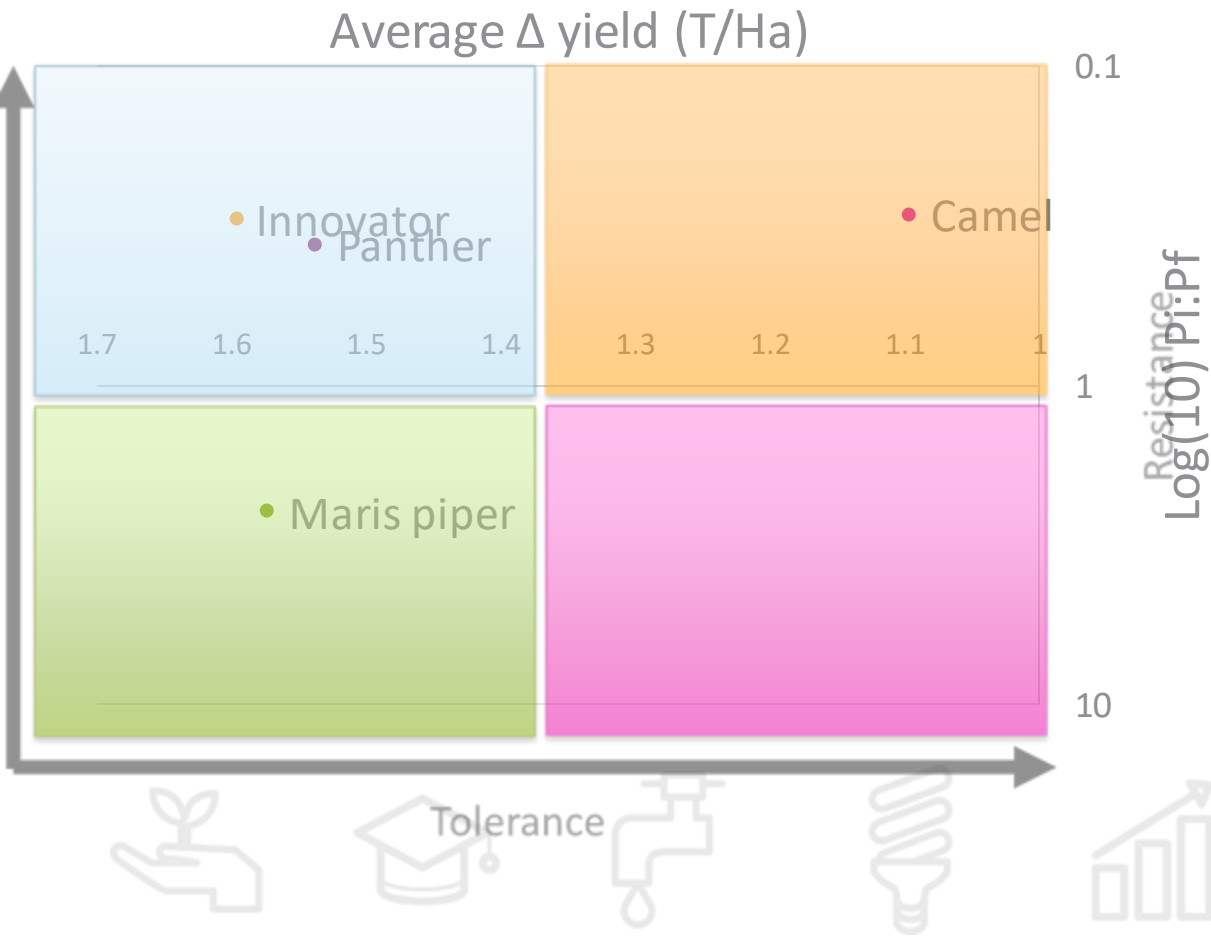
Nematicides

- Nematicides don't reduce PCN populations but they do protect yields, mimicking tolerance.
- Calculating the change in yield between treated and untreated plots shows the potential yield in a PCN-free environment

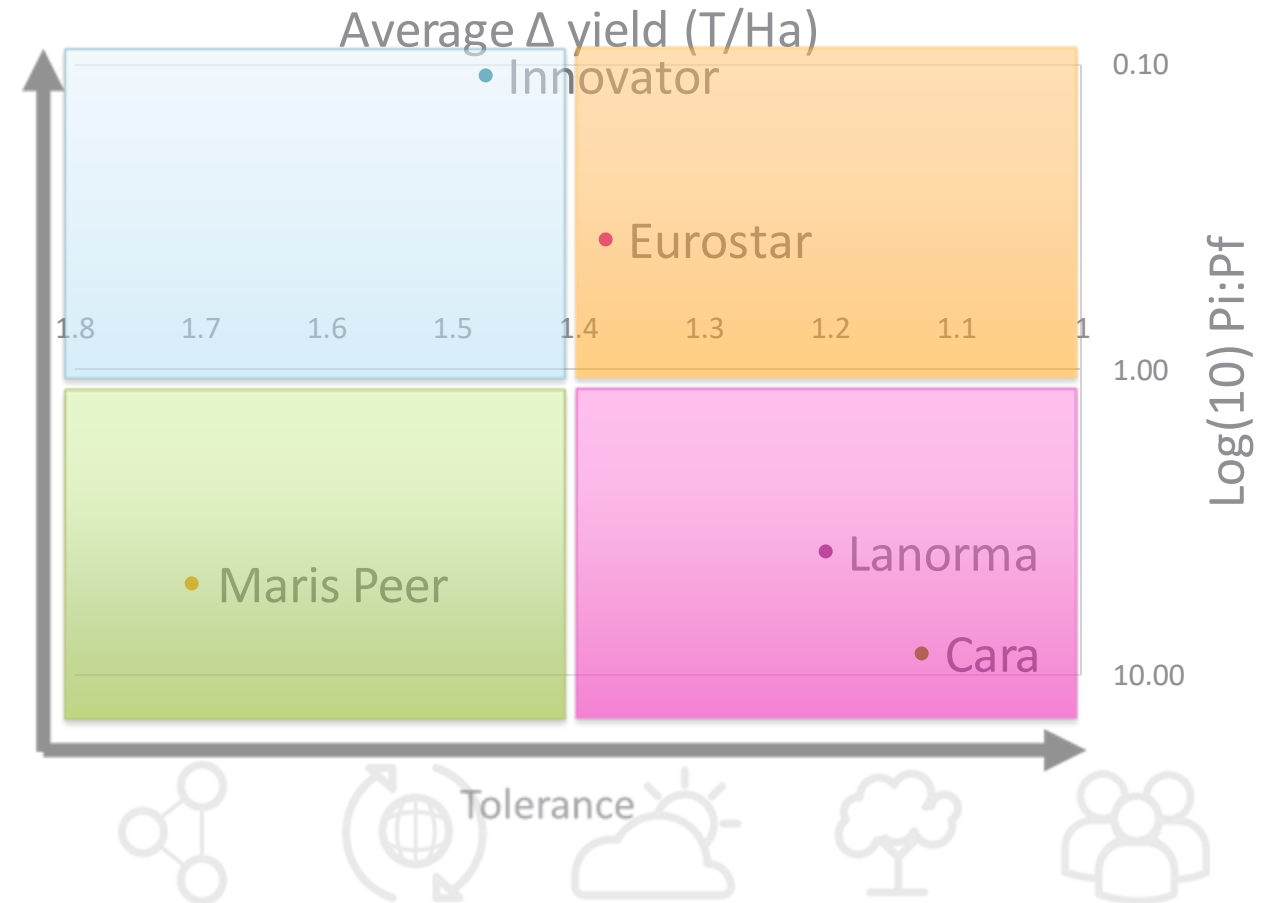


Field trial data

Field trial 2021



Field trial 2022



No field trial data?

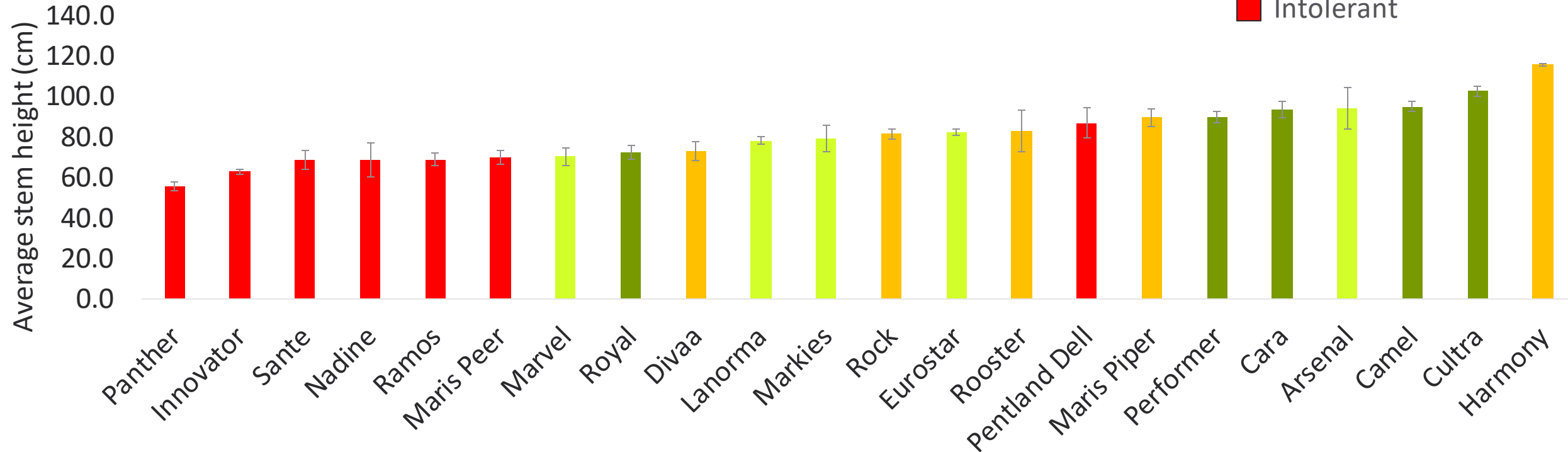
- Field trials take too long and are expensive
- Pi:Pf resistance value can be replaced with 2-9 resistance score (*G. pallida*)
- No alternative measurement for tolerance



Tolerance indicated through growth patterns

- 23 varieties with yield-inferred tolerance information
- Grown for 9 weeks, 24L pots, glasshouse, no PCN

Very tolerant
Tolerant
Moderate tolerance
Intolerant

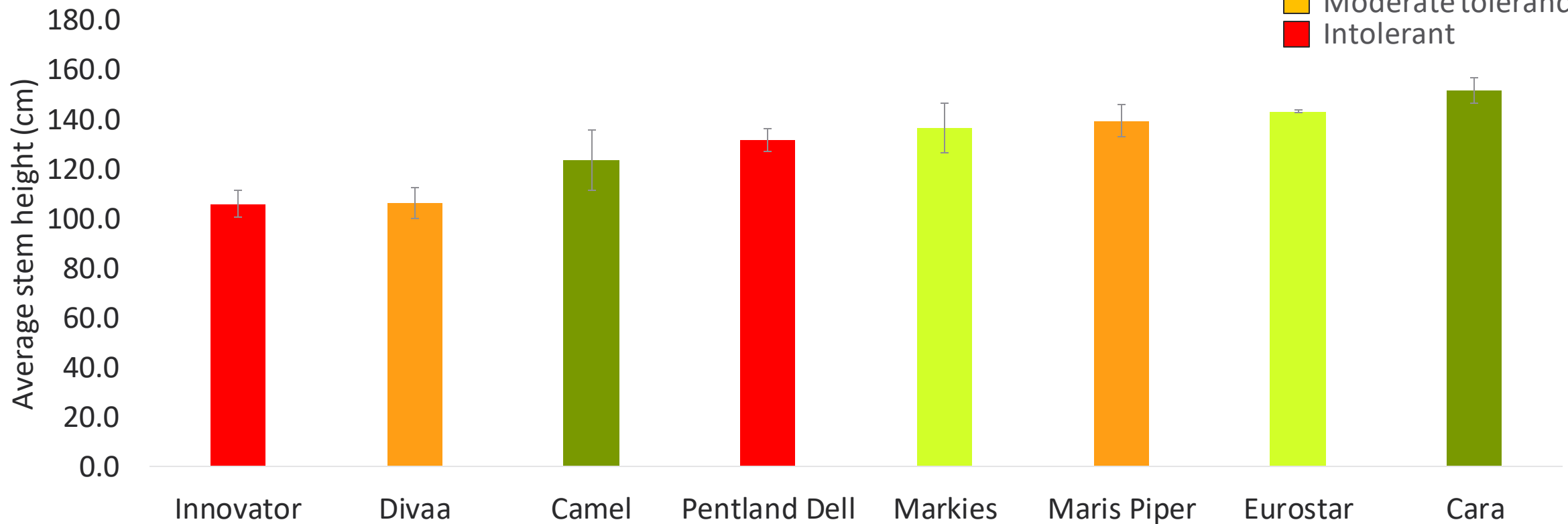
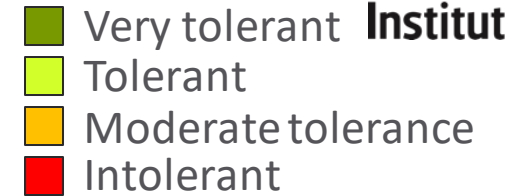


...and with PCN

- 8 varieties with yield-inferred tolerance information
- Grown for 9 weeks, 24L pots, glasshouse, + PCN



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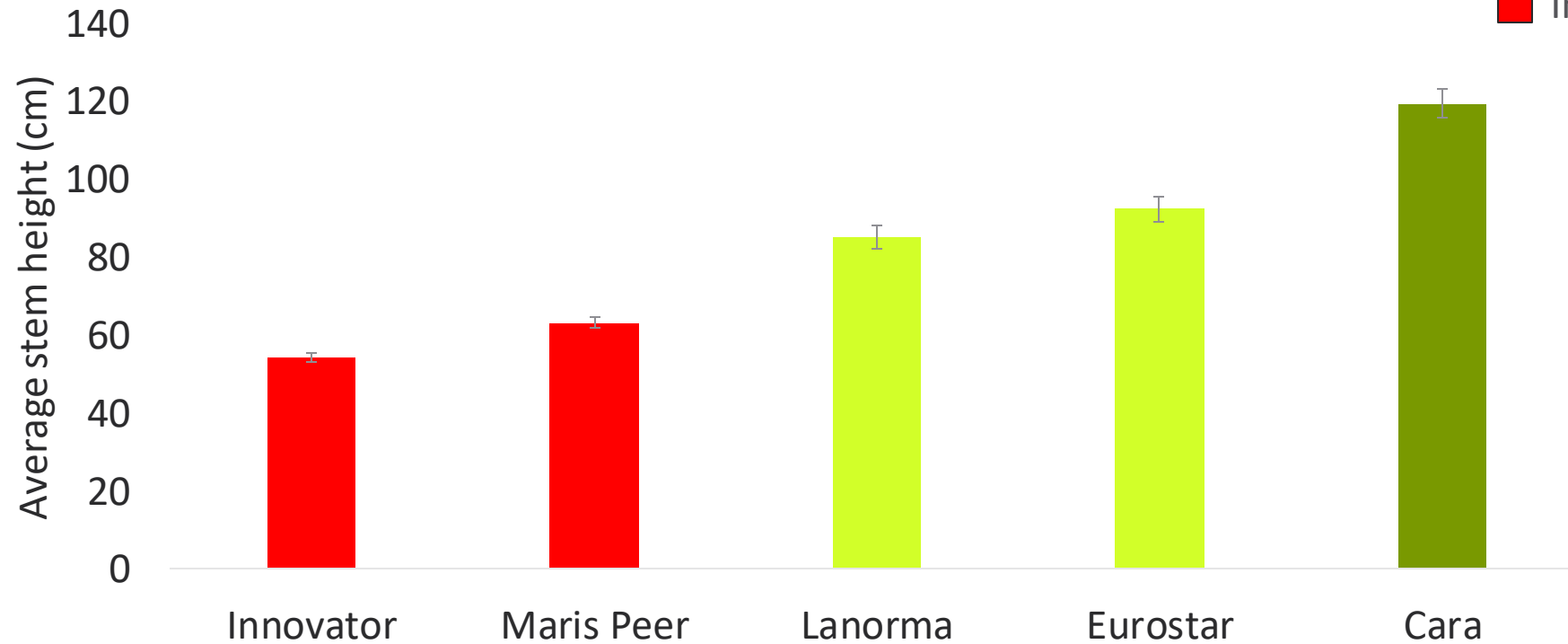
Barnyards 2022 data



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- 5 varieties with yield-inferred tolerance information
- Field trial, PCN

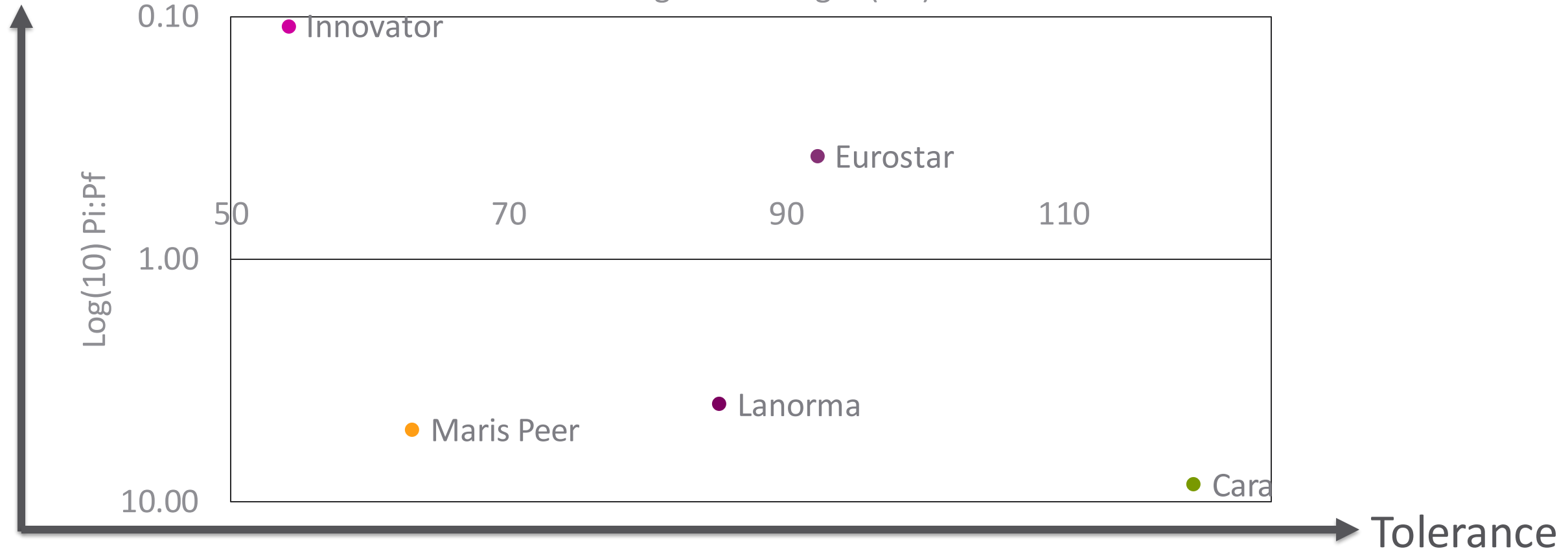
■ Very tolerant
■ Tolerant
■ Moderate tolerance
■ Intolerant



Field data 2022 – Pi:Pf vs height

Resistance

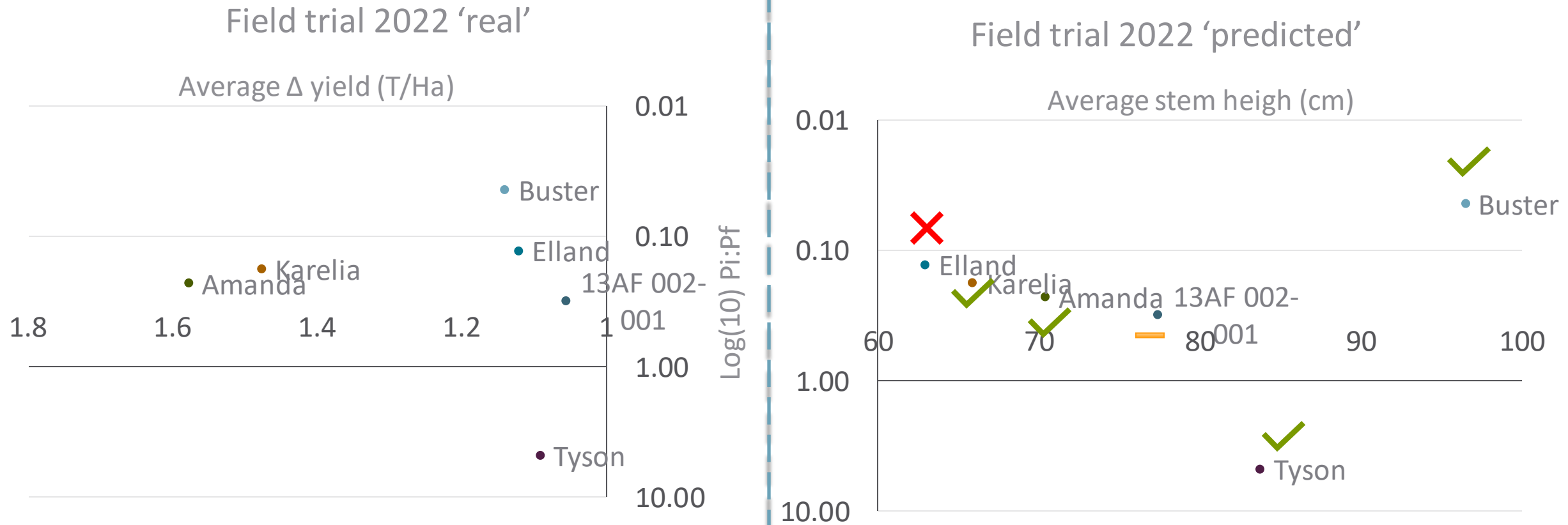
Average stem height (cm)



Tolerance



Predicting tolerance in 'new' varieties



Stem height model is a gateway not a solution

- There is a clear trend that varieties with higher PCN tolerance have tall stems, supported by both field and greenhouse data
- Stem height isn't solely genetic. Environmental effects will have impact on stem height.
- Creating a link between stem height and tolerance allows further characteristics to be investigated.

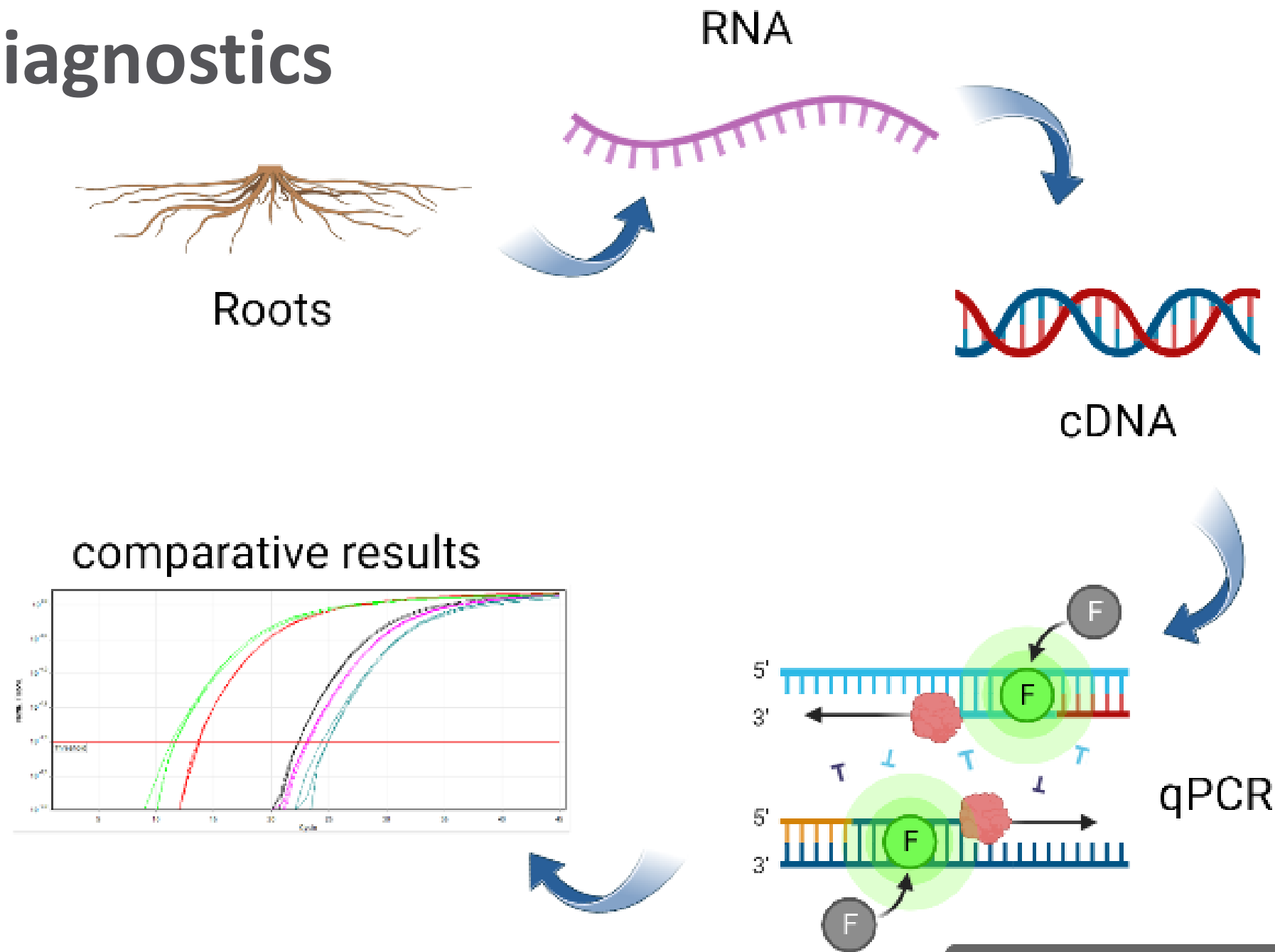


Determinacy

- Indeterminate varieties are taller than determinate varieties
- Determinacy could be linked to tolerance
- Genetic markers for determinacy are currently being tested



Molecular diagnostics



With thanks to:

- JHI glasshouse staff
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- Neill Smith



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