Breeding for IPM in fruit crops

Felicidad Fernandez
Talk overview

• General points about breeding for sustainable production

• NIAB fruit breeding

• Which pests?

• Illustration of pest-resistance breeding in our research

• Final thoughts
Breeding for pest and disease resistance

• IPM as an arms race
  • Pest evolution against plant resistance and pesticides

• Resistance breeding is an additional layer of protection
  • Targeted use of pesticide protects the durability of resistance and use of resistant genotypes protect the effectiveness of the pesticide

• Plant response
  • Susceptible (range of attractiveness and responses to infestation)
  • Tolerance
  • Resistance:
    • Gene-for-gene (large raspberry aphid)
    • Quantitative
    • Pyramiding
• Part of the NIAB group since 2016
• East Malling site focused on fruit research since 1913
• Recent developments on the EM site: upgraded facilities, experimental winery and control environment growth rooms
NIAB Fruit Breeding

Stone Fruit

Pip Fruit

Berries
Which pests?

• Sources of resistance available

• Reliable/reproducible phenotyping

• Inheritable trait

• Importance of the pest (in itself or as a vector)

• Priority within breeding objectives (cost-benefit)

• [Marker-assisted breeding]
Which pests?

Credit: RHS
Spotted Wing Drosophila (Drosophila suzukii)

SWD- Key pest in soft and stone fruit
Mitigation and crop loss due to damage is estimated at £20 - £30 million p.a. in UK

Screening for ‘resistance’ to Spotted Wing Drosophila (Drosophila suzukii) in strawberry and raspberry accessions
Project number 10025468
The Project
Background

• Known variation in ‘resistance’ in some *Fragaria* species

The Project and Team

Aim

To identify UK relevant strawberry and raspberry germplasm with natural resistance to SWD for future variety development.

• Offspring emerging
• Preference between accessions
• Identify any clear fruit characteristics which are associated with ‘resistance’
Focus 2022 - Strawberries

76 accessions

Fragaria X ananassa

Diverse origin

Trait variation

Grown in insect proof tunnel
Fruit assessment, parameters measured:

- Berry size
- Skin colour
- Skin strength
- Flesh firmness
- Brix
Fly assessments

Berry exposed to SWD for egg laying

Number of emerging offspring assessed after two weeks
(Very) preliminary results
Next steps

- Choice tests (strawberry pulp)
- Re-screening selected strawberry genotypes
- Preliminary screen of raspberry accessions
- 55-75 genotypes of raspberry including yellow, purple, black raspberry accessions & some species level material.
Large raspberry aphid: *Amphorophora idaei*

- European large raspberry aphid (*Amphorophora idaei)*

- Vector of the raspberry mosaic disease (RMD) viral complex:
  - raspberry leaf spot virus (RLSV)
  - black raspberry necrosis virus (BRNV)
  - raspberry leaf mottle virus (RLMV)
  - *Rubus* yellow net virus (RYNV)

- Reduced vigour, longevity and yield
- Difficult chemical or biological control as transmission can occur ≤ 2 h
- Vector resistance has been a breeding objective in the UK for >50yrs
## Raspberry-aphid interactions

Series of single dominant conferring biotype-dependent resistance

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<th>Plant Species</th>
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# Raspberry-aphid interactions

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Classic resistance breeding

- Generate breeding families segregating for one or more of the resistance genes
- Phenotype seedlings
- Limitations:
  - Cost
  - Timeliness
  - Gene pyramiding
- Marker-Assisted Breeding
Mapping resistance genes vs markers for breeding

- More difficult for quantitative traits
- Marker validation across germplasm is essential
- Tracking haplotypes and marker inheritance through multiple generations
- Practical considerations such as marker types and detection modes (SSRs to SNPs), overall cost ...

Sargent et al 2007
Applied Marker-Assisted Breeding

• Still rare in fruit crops for pests but increasing common for disease
  • Apple scab
  • Fire-blight (quantitative trait)

• Marker validation and change in ‘markers of choice’ require ongoing investment

• Cost-benefit analysis needed for each breeding programme
Breeding for IPM in fruit crops

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