Challenges Breeding Commercial Rootstock

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1. Tomato
   a) Reasons for increased use of rootstocks
   b) Key rootstock traits
   c) Soil disease challenges
   d) Disease resistance breeding
   e) Comment

2. Pepper
   a) Reasons for use of rootstocks
   b) Advantages of rootstock
   c) Pepper grafting techniques
   d) Some results
   e) Comment
Why is grafting increasing?

• Numerous kinds of soil diseases break out because of over crop.
• High yield is demanded to reduce production costs.
• Environment-friendly production.
Key rootstock traits?

- Multiple disease resistance
- Good germination and uniformity
- Easy grafting
- High vigor (interspecific > intraspecific)
Soil diseases on Tomato

Root knot nematode
*Meloidogyne incognita*
*Meloidogyne javanica*
*Meloidogyne arenaria*
*Meloidogyne mayaguensis*

Corky root
*Pyrenochaeta lycopersici*
Soil diseases on Tomato

Fusarium wilt
*Fusarium oxysporum* f. sp. *lycopersici*
race 1, race 2 and race 3

Bacterial wilt
*Ralstonia solanacearum*
Left: no grafted tomato  Right: grafted tomato
Disease resistant breeding

- Use of MAS (Molecular Assistance for Screening)

- Inoculation test

Mi : Meloidogyne incognita
Fol1 : Fusarium oxysporum f.sp. lycopersici race1
Fol2 : Fusarium oxysporum f.sp. lycopersici race2
Fol3 : Fusarium oxysporum f.sp. lycopersici race3
Vd1 : Verticillium dahliae race1
Vd2 : Verticillium dahliae race2
Forl : Fusarium oxysporum f.sp. radicis-lycopersici
P1 : Pyrenochaeta lycopersici
Rs : Ralstonia solanacearum
ToMV : Tomato mosaic tabamovirus
1. **Disease resistance.** Multi resistance required e.g., Mi / Mj / Ma / Fol: 1,2,3 / Vd-1 / Forl / Pl / ToMV. It takes long time to fix all of them. In case of resistance to Rs, the resistance is polygenic. More challenging to fix.

2. **Scion compatibility.** Strong vigor scions generally need medium vigor rootstocks and vice versa. The balance between quantity (yield) and quality (taste) is important. We have to supply a rootstock variety suitable for scion.

3. **High germination / uniformity.** Interspecific hybrids inclined to low germination. Sometimes priming is required.

4. **Customer needs.** Disease pressure, long cycle, **GSPP**, ...
Why is grafting increasing?

• Resistance to soil pathogens
• Yield increase of >30%
• Reduce the soil salinization
• Increase the production longevity
Why is grafting increasing?

• Faster solution ~ less time required
• Less expensive than chemical treatment and hydroponic cultivation
• Health / food safety considerations
• Environmental considerations
• Organic production
• Reduced chemical inputs / availability
Various grafting techniques

V

“Splice”

“Tongue”
Results:

Pepper roots with nematode
Other disease resistances that rootstock prevents: Phytophthora, Bacterial wilt, ...

Same pepper variety grafted. Without nematode
Results:

Increased yield potential

✓ Brazil - Green house in pepper production
  Production of 24kg by plant in 15 months of harvest

Bacterial wilt control
Comment

1. Rootstock with new resistances, e.g., to Nacobbus aberrans, Meloidogyne enterolobii, ...
2. More tolerant to high EC (electric conductivity) and water stress conditions
3. Improved tolerance to temperature stress, nutriment utilization, ...
4. Create a rootstock that increases the yield. The actual rootstock can increase the yield in >30%.
5. Create a rootstock to the improve fruit quality, e.g., fruit with better color or sugar, ...
Summary Comment

1. **Unique local challenges.** Modify and adapt programs to target and address the local needs.

2. **Cost / Risk of development.** Challenge to address new and developing markets.

3. **Technical development and support.** Challenge to ensure this is adequate to provide the best opportunity for success.

4. **Focus.** Much of the high end commercial rootstock development and pioneering is orientated around high tech culture.