

PERSPECTIVE ON THE SUITABILITY OF GENEVA™ ROOTSTOCKS FOR THE S A APPLE INDUSTRY

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- Results/Discussions
- Conclusions/Future



Introduction

Importance of Gennaro's visit

- New generation geneticists - rootstock breeding into a new direction (marker assisted breeding and marker-trait association)
- Geneva breeding program -40 years
 - national apple collection (6800 apple varieties and 1500 seed lots of wild Malus species). Kazakstan genetic variants resistant to Phy and R. solani
- We need: specific rootstocks, but also friends/colleagues and partners/collaborators




National Apple Collection



Background

- During 40ties the apple industry relied on Northern Spy as rootstock, the only rootstock resistant to woolly aphids, an enormous problem in South Africa
- This rootstock induced very high vigour and poor yields
- Pips from commercial cultivars as seedlings-variation in size and yield disadvantage
- During mid 50ties Merton 793 was released to industry. M 2 x Northern Spy

Background

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- Certified virus-free vigorous M 793 still rootstock of choice in S A 45%. Resistant to woolly aphids, Phy and suitable for replant situation, very average yield efficiency. Experiments (Bergh 1978) concluded that it would be difficult to improve on this rootstock for most situations
 - Very vigorous MM 109 in third place 18%
 - On fertile soils, semi dwarfing M 7 32%. Sucker excessively and susceptible to Woolly Apple Aphids

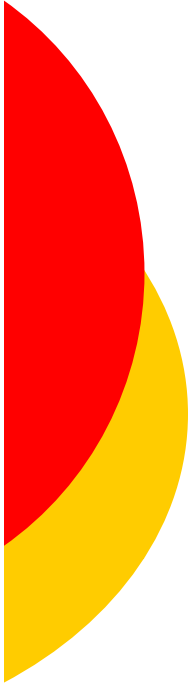


Background

Rest of world adapted to more dwarfing rootstocks

Why are we using more vigorous rootstocks?

- Woolly Apple Aphids
- Extremely high soil temperatures during summer months
- High UV exposure and light intensities – sunburn problem with dwarfing rootstocks



Background

- Relative poor sandy, gravely and shallow soils
- Marginal winter chilling
- Apple replant disease
- *Phytophthora cactorum*

But no Fire blight




Background

- Apple growers need: 1) improved, precocious, productive and yield efficient rootstocks
2) resistance to *WA*, *Phy*, replant
3) adapted to various soil types and climates
4) suitable for high intensive orchards
5) less labour intensive



Technologies available to stimulate root development


- Mulch to stabilise soil temperature
- Compos to stimulate fine root development
- More intensive water and nutrient management



Effect of water and nutrient management on root proliferation and yield


| Treatment | Feeder roots Dry mass | Yield t/ha Year 5 |
|------------|--------------------------|----------------------|
| Micro | 184 b | 39 |
| Daily drip | 332 a | 50 |
| Puls | 372 a | 56 |

Cumulative yield, yield efficiency and fruit mass after five harvest seasons of Reinders Golden Delicious on dwarfing and semi-dwarfing rootstocks (results Carlo Costa, 2008)



| Rootstock | TC (cm) | Cum yield/tree (kg) | Cum Yield Efficiency* (kg/cm²) |
|------------------|--------------------|--------------------------------|--|
| M9 cep | 24 | 152.0 d | 3.57 ab |
| CG 222 | 26 | 208.9 bcd | 4.18 a |
| CG 189 | 28 | 229.3 bc | 3.54 ab |
| M 7A | 28 | 172.8 cd | 2.56 cd |
| CG 007 | 31 | 252.1 ab | 3.33 bc |

Cumulative yield, yield efficiency and fruit mass after five harvest seasons of Reinders Golden Delicious on standard and more vigorous rootstocks (results Carlo Costa, 2008)



| Rootstock | TC (cm) | Cum yield/tree (kg) | Cum Yield Efficiency* |
|------------------|--------------------|----------------------------|------------------------------|
| CG 228 | 32 | 253.1 ab | 3.25 bc |
| M 793 | 34 | 185.4 cd | 2.01 d |
| CG 778 | 34 | 293.9 a | 3.18 bc |
| CG 239 | 36 | 264.0 ab | 3.18 bc |
| CG 934 | 39 | 272.3 ab | 2.19 d |



Results (Carlo Costa's trial, 5 years yield)

- CG 222 Highest yield efficient followed by M 9, CG 189
- M793 poorest yield efficient with CG 934 and then M7A
- In between CG 007, CG228 and CG 778
- CG 707 weak root system
- CG 253 susceptible to WA
- CG 222 show tolerance to replant in pot trials



Propagation intermediate to poor

- CG 8228, G 778, CG 222 and CG 3007
- Excellent root ability with tissue cultured plants especially CG 222
- Then into layer beds in nursery
- Plant in high density in stool bed rows, mounted with soil early in season
- Spray Regalis in mid summer to stop shoot extension growth



'Reinder Golden Delicious' on CG 222 in front then MZA and CG 707



NY

- G41 and G935 greatest yield efficiency
- G935 looks like the ideal rootstock for SA (M26, G202 size), but not resistant to WA
- G202 resistant to Phy, WA, but only partial resistant to Apple replant
- G41 resistant to Phy, WA, replant, but poor propagation
- G16 tolerant WA, but not Phy



Results

Dressel farm Hudson valley

Crist farms NY

NC – 140 trial Geneva

North Carolina - Mike Parker

France – Marie Helene Simard

NZ – Stuart Tustin







North Carolina Dwarf Rootstocks

| Rootstock | TCSA (cm ²) | Cum. Yield kg/tree |
|----------------|-------------------------|-----------------------|
| CG.3041 | 55.9 ef | 126.1 cde |
| CG.5179 | 77.6 bcd | 184.5 ab |
| CG.5202 | 81.8 be | 158.4 bcd |
| CG.5935 | 78.5 bcd | 236.8 a |
| M.26 EMLA | 88.6 b | 125.6 cde |
| M.9 NAKBT337 | 50.6 efg | 113.6 def |





GD on promising rootstocks, Geneva

| Rootstock | TC cm | C yield kg/tree | C yield eff kg/cm² | Fruit g |
|------------------|------------------|----------------------------|--|--------------------|
| M9 T337 | 15.4 | 32.2 | 2.14 | 147.7 |
| CG 3041 | 15.9 | 42.1 | 2.69 | 151.5 |
| G16 | 16.3 | 30.2 | 1.89 | 139.4 |
| CG 5935 | 18.6 | 40.8 | 2.22 | 133.2 |
| CG 5179 | 20.0 | 38.1 | 1.93 | 122.7 |
| M9 Pajam | 20.9 | 39.9 | 2.17 | 160.1 |
| CG 4210 | 30.3 | 63.2 | 2.10 | 140.7 |
| LSD | 6.2 | 10.0 | 0.5 | 17.6 |



Ten year yield Empire on dif rootstocks,NY

| Rootstock | TC % M9 | Cum Y % M9 |
|------------------|----------------|-------------------|
| CG 3041 | 99 | 123 |
| CG5935 | 138 | 122 |
| G 202 | 153 | 101 |
| CG 222 | 203 | 97 |
| M 7 | 276 | 46 |



Jonagold two rootstocks NY

| Rootstock | TC | C yield eff |
|------------------|------------|--------------------|
| M9 Emla | 100 | 100 |
| CG 3041 | 111 | 142 |

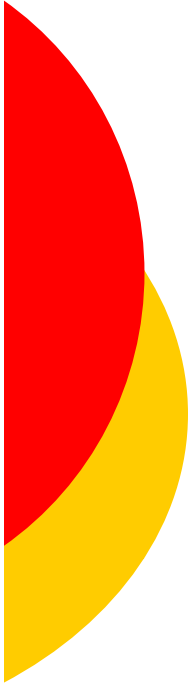
RG on G 202 and GD on G 935





Promising rootstocks for SA (currently)

| | | | | |
|-------------|-------------------------------|----------------|----------------|----------------|
| M 9 | M 26 | M 7 | M 793 | MM 109 |
| G 41 | G 202 CG 222 | CG 3007 | CG 8228 | CG 4778 |
| | G 935 | CG 5202 | | |



Promising rootstocks (future)

- Several semi dwarfing rootstocks with yield efficiency far superior to M 7 and growth less and more



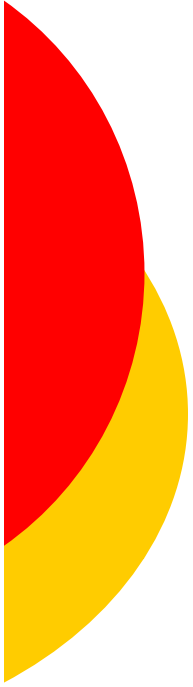
CG 3041 Results NY

- **Vigour as M9 Emla**
- **Cum Yield eff higher M 9 most productive rootstock**
- **Excellent fruit size**
- **Have wide crotch angles**
- **Resistant phy**
- **Tolerance to apple replant disease**
- **Resistance to woolly aphids**



G 202 NZ release 2002

- **Slightly larger than M 26**
- **Resistant woolly apple aphid and Phy**
- **High tolerance to replant**
- **High precocity and yield efficiency higher than M 26**
- **Good alternative to M 26 in warm climate**



CG 5935 NY, N C

- **Most precocious rootstock in M 26 size**
- **Excellent fruit size**
- **Wide crotch angles**
- **Resistant to Phy**
- **Tolerance to replant**
- **Not WAA resistant**



CG 5202

- Yield efficiency higher than M 26
growth between M 26 and M 7
- Resistant Phy
- Pot exp partial resistant to replant
- Not WAA tolerant



Future

There are promising Geneva rootstocks for apples, but it is still early days. Many of the Geneva rootstocks that we are interested in for our industry, do not necessarily have all the characteristics that we need.



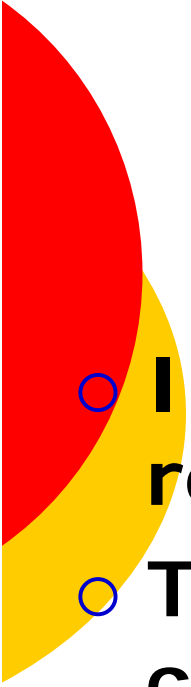
Future

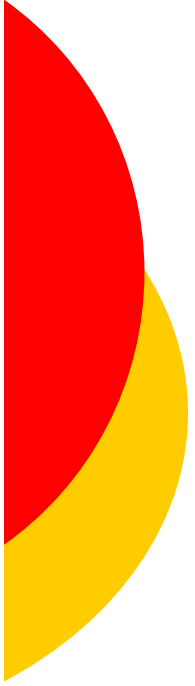
The Geneva breeding program is based on scientific foundation and they have access to a massive source of genetic material, good infrastructure and dedicated people



Future

After visiting their facilities/trials one feels confident in the way they are planning ahead. It is important for our apple industry to keep contact with this and other programs and maybe become more closely involve.

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- **I am positive about the Geneva rootstocks**
 - **There are rootstocks with potential that can out perform our current rootstocks**
 - **This process of finding the most desirable rootstocks for our requirements, must receive the highest priority if we want to be part of intensive orchards of the future**



THANK YOU