ROOTSTOCKS: CHOOSE WHAT IS BEST FOR YOUR CROP

Researcher and rootstock specialist, Dr Piet Stassen, discusses the characteristics of high potential stone fruit rootstocks for South African conditions. This guide will help you to confidently choose a rootstock suiting your crop’s needs.
not all soil problems can be rectified with rootstocks. The necessary soil preparation, effective drainage, initial nematode treatments, effective irrigation, well rooted, hardended off and healthy nursery material are part and parcel of a successful rootstock. Timeous planning will ensure quality nursery trees with adequate feeder roots. Propagation techniques must be upgraded and adapted as necessary to deliver such quality plant material. When planted, these trees must grow and perform optimally with zero dieback. We are fortunate to have rootstocks complementing our scion cultivars, which provide the grower with opportunities to positively increase yield and fruit quality in their orchard. However, this is only possible if one begins with well-prepared soil medium, quality plant material and optimally managed orchard practises.

Dip all trees in Agrobacterium strain 84, both in the nursery and before planted in the orchard, to avoid serious crown gall development. Paint the trunk with a white paint or copper solution—especially in sandy soils. The first year in the orchard is crucial to promote feeder root development and vegetative growth.

**FLORDAGUARD**  
Peach x Prunus davidiana hybrid. *P. davidiana* is a wild peach species

Excellent for sandy (and or stony) soil. For very low chilling regions (even less than 200 Infruitec cold units, but also for higher chilling regions). Well synchronised with early cultivars. Immune towards root-knot nematodes. Not for soils that can be wet or calcareous/high pH/carbonate or bi-carbonate soils. When ring nematode numbers higher than 500/300 cm³ soil) fruit weight negatively affected. Sensitive to bacterial and fungal infections. Short dormancy period and hardening off in the nursery may be a problem. Nursery trees may have inadequate reserves and then trees must be headed back after planting in the orchard. Red-coloured leaves.

**CADAMAN**  
Peach x *P. davidiana*

Also known as Arimag. A strong grower and good for sandy soils (it is 12% stronger compared to GF 677). Good yield and fruit size. Sensitive to bacterial and fungal infections. Only minor yellowing in calcareous soil. Resistant to some root-knot, moderate tolerant to ring and sensitive to root-lesion nematodes. Good host to ring nematodes but can still have good yield and fruit size.

**VIKING**  
Multispecies, complex hybrid

Good overall rootstock for many soils but not recommended for sandy (stony) soil. Can easily dehydrate in sandy soils during warm summer months and then become more sensitive to ring nematode infestation. Fruit later compared to Flordaguard and Kakamas seedling, same as Atlas. Take caution not to let roots dry out before plant. More tolerant to bacterial and fungal infections compared to peach x almond hybrids. Resistant to root-knot nematodes. More sensitive to root-lesion nematodes than Atlas.

**GF 677**  
Peach x almond hybrid

Take and rooting % low from hardwood cuttings and many nursery trees have limited feeder roots. This can cause dieback of trees after plant in orchards, especially in stressful situations (sandy soil, ineffective irrigation, clay soils). External biotic and abiotic factors predispose trees to diseases. Very sensitive to wetness especially also when feeder roots are limited—this can cause fungal infections (Phytophthora cactorum and others). Very sensitive to root-knot, root-lesion nematodes and crown gall. GF 677 is the standard for calcareous soils and performs well in the Robertson/Bonnievale region and also in moderate saline conditions. Other propagation methods should be used to ensure successful nursery trees. Smaller fruit with nectarines compared to Atlas and Cadaman.

**SAPO 778**  
Complex hybrid

Not recommended for low-chill regions (>100 to 350 Infruitec cold units), or early cultivars. Synchronisation between early cultivars and this rootstock in stress situations (sandy soil/ fluctuating water tables) can cause fungal infections (*Leucos unarmed*). Ripening is delayed. Sensitive to calcareous or saline soil. Tolerant against ring nematodes. Very good fruit size.

**GARNEM**  
Nemared peach x almond hybrid

Red-coloured leaves and strong grower. Good host for ring nematodes but performs well in terms of yield and fruit size even when high numbers occur. Resistant to root-knot nematodes but has increased susceptibility to bacterial canker. Peach x almond hybrids are sensitive to bacterial and fungal infections when external biotic and abiotic factors predispose trees to diseases. A 20% stronger grower than GF 677). Not enough information regarding sandy soils. Included in new evaluation trials.

**GUARDIAN**  
Nemaguard peach cross

Not enough local information. Included in new evaluation sites especially in sandy soils. Fruit weight suspicious—poor fruit weight, the same as a Kakamas seedling under stress conditions, but yield is better than Kakamas seedling. Not for calcareous soil. Vigour more like Atlas but less than Garnem. Resistant to root-knot nematodes. Host to ring nematodes but less than Marianna. According to overseas information this rootstock is resistant to bacterial diseases.

**MARIANNA**  
*P. cerasifera x P. munsoniana*

Very sensitive to ring nematodes, bacterial canker and fungal infections especially so in sandy soil (external biotic and abiotic factors predispose trees to diseases). Small fruit when stressed and high numbers of ring nematodes occur. Shallow horizontal growing rootstock (need about 40mm good soil) therefore ideal for soil with clay layers in underground. Good rootstock for medium to high potential soil.

**MARIDON**  
Tetraploid of Marianna

Shallow horizontal growing rootstock (need about 40mm good soil)—ideal for soil with clay layers in underground. Relatively less sensitive to bacterial canker than Marianna. Flowers abundantly in Little Karoo region putting fruit size under pressure. High numbers of ring nematodes probable and moderately sensitive for calcareous soil (less than Flordaguard, SAPO 778 and Kakamas seedling). Small fruit when stressed and when high numbers of ring nematodes occur.

**KAKAMAS SEEDLING**  
Peach seedling selection

A semi-dwarfing rootstock. Easily stressed on sandy soils and during warm autumns bud drop occurs. Fruit size negatively influenced by stress conditions (sandy soil, root-knot nematodes, high pH, saline and wetness). Good rootstock for medium to high potential soil, free from any stress factors or limitations. Sensitive to crown gall—must be treated with Agrobacterium strain 84. Not recommended for sandy soils where yield and fruit weight are negatively affected. Rather use Flordaguard or Atlas, depending on the site conditions.

**ROYAL SEEDLING**  
Apricot seedling

Compatible with all South African apricot scion cultivars. Excellent for well-drained shale soils, sensitive to wet soils. To use any of the other rootstocks available to the peach and plum growers, Royal interstem is a prerequisite to avoid breakage at the bud union. Very sensitive to bacterial and fungal diseases.
ROOTSTOCKS FOR STONE FRUIT

This is a generic guide set up by Dr Piet Stassen to assist growers in their rootstock decision-making.

SOIL TEXTURE

| SAND: 90% and higher (also high percentage stone) | Flordaguard, Atlas, Cadaman |
| SAND: 80% to 90% | Atlas, Flordaguard, Viking, Garnem, Marianna/Maridon (not for peaches), SAPO 778, Cadaman |
| SILT AND CLAY: 20 to 35 % | Atlas, GF 677, Marianna/Maridon (not for peaches), Viking, Garnem, Cadaman, SAPO 778, Kakamas seedling |
| CLAY: below 20% | Viking |

FRUIT SIZE

| VERY GOOD FRUIT SIZE | Atlas, Garnem, SAPO 778 |
| GOOD | Cadaman, GF 677, Flordaguard, Viking, Marianna, Maridon, Kakamas seedling |
| SMALL FRUIT UNDER STRESS CONDITIONS | Viking (summer months), Flordaguard, Marianna, Maridon (when high numbers of ring nematodes occur). Kakamas seedling under any stress condition (sandy soil) |

GROWTH

| VERY STRONG GROWTH | Garnem, Cadaman, Flordaguard |
| MODERATELY STRONG GROWTH | GF 677, Atlas, Viking, SAPO 778, Marianna |
| SEMI-DWARFING | Kakamas seedling, Maridon |

CALCAREOUS/ HIGH PH/ FREE LIME/ CARBONATE SOIL

| GF 677, Atlas, Viking, Garnem, Cadaman |

SENSITIVITY TO BACTERIAL AND FUNGAL INFECTIONS

| VERY SENSITIVE | Garnem, GF 677, Marianna |
| SENSITIVE | Flordaguard, Cadaman, SAPO 778 |
| MODERATELY TOLERANT | Kakamas seedling |
| TOLERANT | Viking, Atlas |

NEMATODES

| IMMUNE: Flordaguard, Marianna and Maridon |
| RESISTANT: Atlas, Viking, Guardian and Garnem |
| VERY SENSITIVE: Kakamas seedling and GF 677 |

ROOT-KNOT

| All rootstocks are good hosts for ring nematodes. |
| VERY SENSITIVE: Marianna and Maridon |
| SENSITIVE: GF 677 and Kakamas seedling |
| SENSITIVE TO TOLERANT: Flordaguard and Viking |
| TOLERANT: Atlas, Cadaman and Garnem |
| TOLERANT TO MODERATELY RESISTANT: SAPO 778 |

RING

| VERY SENSITIVE: GF 677 |
| SENSITIVE: Flordaguard, Cadaman, Viking, SAPO 778, Kakamas seedling, Marianna and Maridon |
| TOLERANT: Atlas and Garnem |
Every stone fruit grower knows when it comes producing an excellent crop you have to get your rootstock right. But the true conundrum lies in that there’s not magic rootstock to guarantee you’ll get cash for your crop. Fresh Quarterly asked deciduous fruit industry veteran and rootstock expert Dr Piet Stassen to guide growers in their rootstock selection. After completing 24 stone fruit rootstock evaluation trials in the past 15 years, Stassen says it boils down to an unwavering principle: proper planning.

Many people think rootstock evaluation is straight forward. Is this true?

No. Many factors play a role in this process because they influence yield, fruit size, and root and tree growth. Soil is the most important factor to consider. Other factors include: water tables and drainage problems, calcareous soils, plant parasitic nematodes, and the pre-disposing factors for bacterial and fungus diseases. All of these factors must be quantified accurately, in order to draw up generic information about each rootstock. Each rootstock trial site is selected to get very specific information. Every site must be well defined in terms of the abovementioned factors and climatic conditions so one can ultimately draw up generic information about each rootstock.

In the past most, rootstock trials were done on experimental farms. These farms weren’t always representative of the regions where the rootstocks would be planted, and the farm management wasn’t the same standard as that of leading producers. With the co-operation of some producers, I planted rootstock trials within commercial orchards. This is a great system, but needs plenty of good communication—the information you get from evaluation trials is only as trustworthy as the effort and support provided by those involved.

What should a researcher consider when advising growers on rootstocks?

Not all soil problems can be solved by rootstocks. The necessary soil preparation, effective drainage systems and nematode treatment must be in place. Rootstocks can’t necessarily fix wrong cultivar choices and problems. But, can significantly improve horticultural traits and soil adaptability of good scion cultivars. It’s important to have all information about the soil, climate, pests and diseases. Researchers give better recommendations when they have a feeling for the soil, region, location and cultivation practices of a specific farm.

Is there a single rootstock that’ll do well under the various conditions South African stone fruit growers encounter?

Presently, there is nosuper rootstock for all conditions. An all-rounder like Atlas performs consistently well in terms of yield, fruit size, and tolerance to plant parasitic nematodes and diseases under many conditions. Flordaguard excels in low chill areas and well drained sandy soil, and works well for early cultivars. GF677 is the standard rootstock for calcareous soils, but Garnem, Cadaman, Atlas and Viking provide the same results depending on the factors involved. A rootstock must compliment the scion cultivar to optimise yield and fruit quality over the lifespan of the orchard. It must be adaptable to the soil conditions in a specific orchard, as well as be resistant or tolerant to pests and diseases.

What are the most common mistakes growers make when choosing rootstocks?

Long-term planning is a necessity. To get good quality plant material from nurseries, planning must be done well in advance. Key tips here include: Growers having information on their rootstock of choice two years in advance, this almost guarantees they’ll get the most suitable rootstock from the nursery. Skipping the planning phase can lead to growers losing out on their choice of rootstock, and having to settle for second-best.

Using the easy to propagate rootstock—to skip on bearing royalties—isn’t always the cheaper option. Only choose this option if the situation calls for it. Commercial rootstocks may greatly outperform standard rootstocks in terms of yield, fruit size, and root and tree development. It all depends on which rootstock will be more adaptable to the conditions of that specific orchard. Clonal rootstocks can provide sad results due to: poor feeder root development, trees that weren’t hardened off, or nursery trees with inadequate reserves to sustain performance in the orchard. This issue needs attention so clonal rootstocks don’t get a bad reputation.

Could growing rootstocks through tissue culture and growing nursery trees in bags improve the quality of trees and their orchard performance?

Improving propagation methods requires attention. Producing nursery trees by seedlings provide good rooting and taproot trees, which can better withstand the transplant to the orchard. Previously, virus free Kakamas pips were abundantly available from canning factories. Kakamas isn’t a preferred peach cultivar anymore, and pips aren’t easily available. Pips can also mixed with those of other cultivars. The solution is to get virus free pips from trees planted from seed in mother blocks. When in the mother blocks, protect these trees from other trees to keep them virus free, genetically uniform and free from bacterial and fungal diseases. Presently, Kakamas seedling as rootstock provide limited adaptability to medium and high potential soil where no abiotic or nematode limitations occur. Guarantee genetic uniformity of horticultural and other traits by using clonal rootstocks in the stone fruit industry.

Rootstocks like GF677 however, have a low take and rooting percentage from hardwood cuttings in the nursery; making it less economically viable for nurserypersons. It may also produce poor root systems without enough feeder roots, and can put the trees at risk when planted in the orchard—especially in risky soil conditions, where irrigation is ineffective, and other poor management conditions.
To produce high quality nursery material with an effective feeder root system the industry must consider and evaluate any propagation methods (including tissue culture, and micro- or mini-propagation) and tree management system (bags, growing mediums, effective nutrient and water systems, netting structures and less handling) to promote fine root development, tree health and tree growth—any effective and practical solution to provide the grower with high quality nursery material.

Most nurseries find it difficult getting ideal nursery soils every year. Using bags with mediums that promote root formation, tree health, and development may be a good solution. It is imperative for growers to plant healthy trees with effective feeder roots, and to manage those trees optimally to prevent dieback or poor tree growth that affects the orchard performance.

An orchard’s first year determines its long term potential. Don’t spend money on soil preparation, draining systems, ridges, training and irrigation systems, and netting then neglect choosing the best suited rootstock and highest quality nursery material available to us. Improving propagation and using top quality rootstocks must be a priority to increase production, fruit quality, orchard health and tree development.

What are the key characteristics of a good rootstock evaluator?

This person must have the following:

- A good knowledge of fruit trees, and their problems and behaviour.
- A practical understanding of soils and soil related problems.
- The skill to combine all relevant aspects into practical information to benefit the grower.
- Excellent relationships with growers and nurserypersons, since the industry must trust the information and recommendations made available to them.

What is your prediction for our stone fruit industry 30 years from now? Focussing on rootstocks and cultivation practices.

I’m optimistic about the future. The industry has a generation of young innovative growers, keen to get and use research information, and who are prepared to invest in technology to optimise their fruit businesses.

In the next few decades I see many rootstock breeding programs run by various research or private institutions; using intraspecific and interspecific crosses, and marker-assisted selections to identify specific advantageous genes. High potential rootstocks from current programs will be available.

The plum industry is growing, and is a lucrative business for the committed grower. Climatic conditions and land availability may shift many of these plantings towards the Worcester, Robertson, Bonniveale and little Karoo regions.

How would you like those in the stone fruit industry remember you for?

My career spans over decades, and rootstock evaluation was a small part in my research career. Although the majority of my research is stone fruit based, I’ve also done several studies on apples, and was fortunate to work with other committed researchers and fruit and soil specialists.

During the 1970’s and 1980’s, I worked on improving the cultivation practices of stone fruit orchards. The importance of the autumn period in supporting the budding stage with its associated improvement in budding, flowering and fruit set of quality fruit was established. Studies on nitrogen timing and quantity of application on the spring development of the tree were conducted. The principles of achieving higher yield per unit surface area sooner through higher density plantings along with better light management by correct tree manipulation, training systems and summer pruning was developed. The importance of carbohydrate reserves and its employment for energy requirements and as carbon building blocks was studied in detail. I began the first rootstock evaluation program for peaches in 1971, and for plums in 1974.

I would like to be remembered for all these contributions as the first steps on the path of developing a more scientific fruit industry, and for my commitment in helping fruit growers being successful. I want to pay tribute to all the researchers I’ve worked with and the support from growers and the fruit industry.
A list of rootstock-related research projects and publications. This theme’s articles was compiled using information from industry funded research.

Completed Projects

2004 Investigate the effect of stone fruit rootstocks on fruit quality of nectarines (Gustav Lötze)

2006 Comparative economic efficiency of training systems and rootstocks for 'Alpine' nectarines (Piet Stassen)

2010 Evaluation of apricot rootstocks (Piet Stassen, Hester de Wet, Gustav Lötze)

2010 Evaluation of peach rootstocks (Piet Stassen, Hester de Wet, Gustav Lötze)

2010 Evaluation of plum rootstocks (Piet Stassen, Hester de Wet, Gustav Lötze)

2012 Tolerance and susceptibility of commercial stone fruit rootstocks to plant-parasitic nematodes (Piet Stassen, Freddy Rabothata)

2013 Determining the chill requirement of important stone fruit rootstocks available to the South African fruit industry (Laura Allderman)

2018 Evaluation of apricot rootstocks (Piet Stassen)

2018 Evaluation of peach rootstocks (Piet Stassen)

2018 Evaluation of plum rootstocks (Piet Stassen)

Current Projects

- Evaluation of peach rootstocks for the South African fruit industry at Vaalwater, Limpopo (Iwan Labuschagne, Piet Stassen)
- Evaluation of peach rootstocks for South African fruit industry: Rawsonville planting (Slanghoek) (Iwan Labuschagne, Piet Stassen)
- Evaluation of plum rootstocks for the South African industry at Simondium (Keunenberg) (Iwan Labuschagne, Piet Stassen)
- Evaluation of plum rootstocks for South African fruit Industry: Robertson planting (Roodehoogte) (Iwan Labuschagne, Piet Stassen)

Publications

Scientific Journal Papers


Scientific Conference Proceedings


Popular Articles

Please refer to the SA Fruit Journal and Die Krat as this list is extensive.