HORTGRO science

ANNUAL REPORT
2014 - 2015

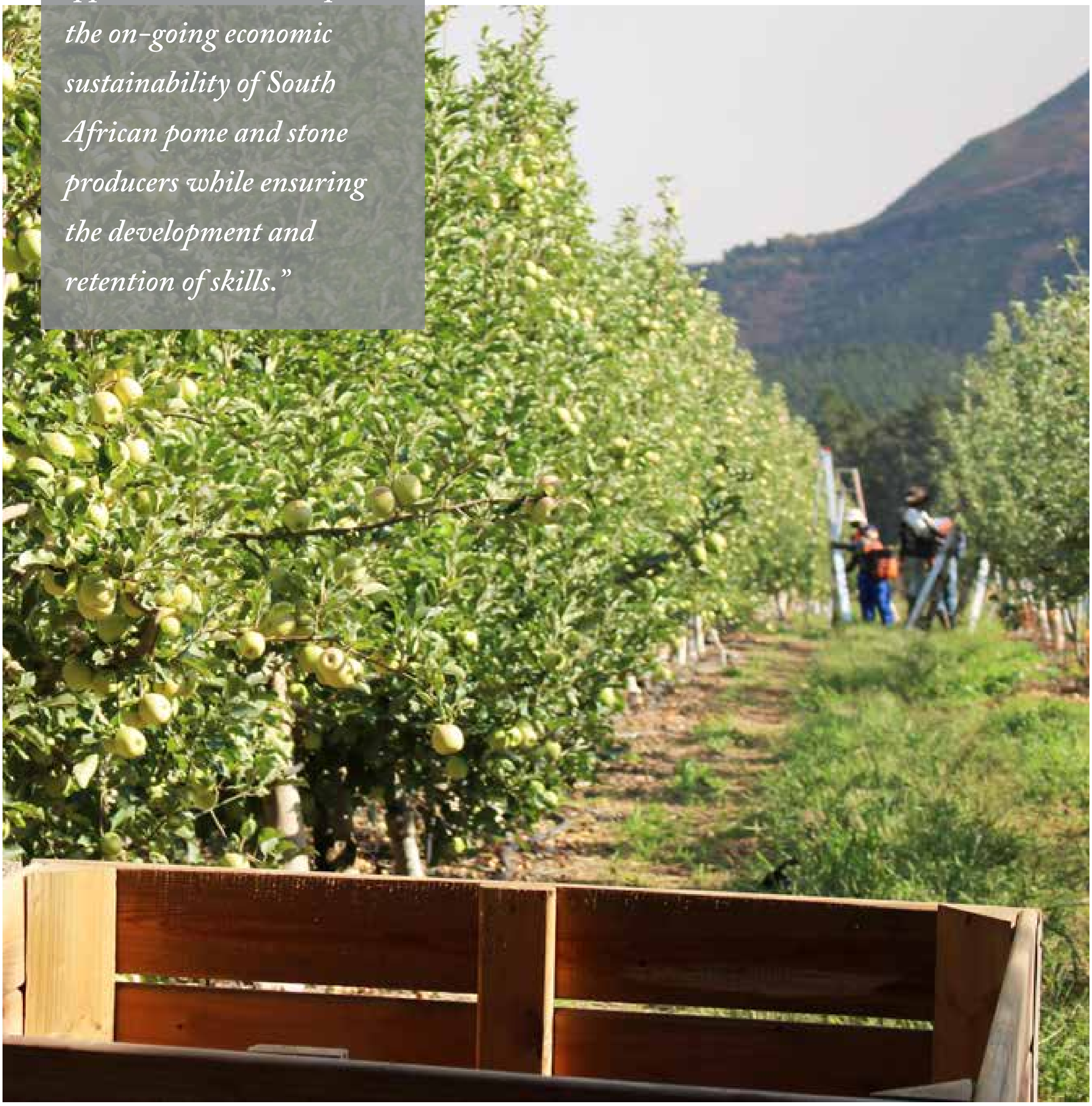
In Biology mutualism refers to the way two organisms of different species exist in a relationship in which each individual benefits. In the deciduous fruit industry a similar relationship exists between academia and the growers on the ground. At HORTGRO Science we believe in this beneficial relationship, even though there are future challenges. We endeavour to build human capital; give growers a full return on investment; promote sustainable agriculture and ensure product integrity through the supply chain. HORTGRO Science believes in: *et colet in posterum* - farming for the future.

THE TECHNOLOGY COLLECTIVE

HORTGRO Science Annual Report

OUR PURPOSE

"To generate and transfer the knowledge, technology and practices required to mitigate, avoid or overcome threats/risks, and to exploit opportunities, that impact the on-going economic sustainability of South African pome and stone producers while ensuring the development and retention of skills."



Annual Report 2015

CONTENT

HORTGRO Science believes in:
et colet in posterum – farming for the future.

I have started writing this report while traveling on a business trip in France; the group I am with is from Italy, New Zealand, Chile and the USA, all of us searching the world for ideas that add more value to the art of growing apples.

Why I have included this is to illustrate the international industry and market in which we compete, making it vitally important that we keep up with developments and contribute to science that keeps us competitive as an industry locally and internationally. We have invested R240 500, only 1% of our budget on international travel and we need to keep challenging this as international collaboration is needed in a world where research is becoming too expensive to do it all yourself and tapping into areas of specialization will become more important to address generic challenges.

I am confident that the inclusive approach adapted by HORTGRO Science is paying dividends and the research effort is focused on levy payer requirements, so much so that there is curiosity from within the grower corps to investigate ways and means of ensuring we raise additional funds so we can finance more research projects. Wide ranging demands placed on the statutory levy results in a smaller portion allocated to research, this is an unfortunate reality and we need to evaluate different ways of generating funds.

The change in varieties planted within the stone and pome fruit basket necessitates a change in various fields of research, rootstock potential also requires a different focus and we need to ensure we shift the focus to address the challenges posed by this change. Post Harvest research needs to be shifted up the priority list as the marketing of our crops takes on new dimensions from both a timing as well as market place perspective, the new generation apples and stone fruit coming our way will require better Post Harvest and storage regimes to ensure they hit the target markets in optimum conditions.

Water as a resource, both from a quality as well as quantity perspective, will require focused research effort and we need to make sure we fund the projects aimed at this.

The Orchard of the Future project started in 2011 is producing positive results and will change the look of our orchards over time; service providers, as well as researchers, need to recognize this and be proactive in ensuring that we have the knowledge and equipment in place to be successful in handling these changes. The theme of the annual symposium 'Embracing the Future' was chosen to highlight the progress made in shifting fruit growing from an art to science. Professor Sukkareih's presentation on the application of robotics in actual orchard situations illustrates the enormous strides made in this field.

Our research efforts need to generate tangible results to provide an effective return on our money invested - here are some highlights achieved in 2015: The work by Dr Mariana Jooste on broken stones in plums positively impacting on our grading standards and generating a direct impact on the price received per carton; Dr Ken Pringle's analysis of the risk of *Bactrocera dorsalis* establishing in the Western Cape and his publication on the phytosanitary host status of apples as a host for false codling moth (FCM) based on his research that clearly shows that apples are not a host of FCM. This is critical for market access negotiations. There are many more examples that can be given.

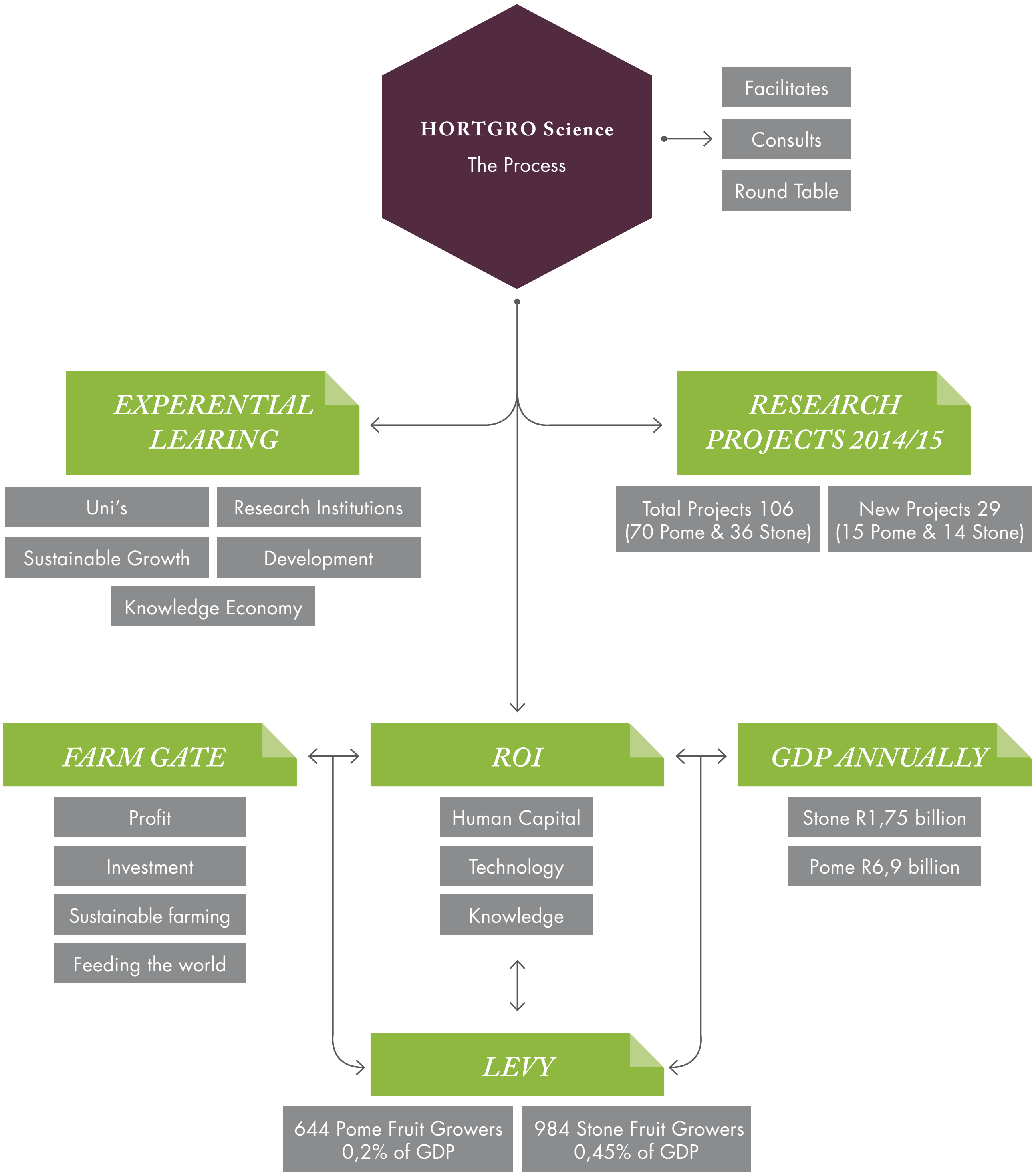
All of the above can only be produced if we have the human capital that can generate the level of research we need to compete internationally, knowledge workers need to be recognized for the role they play in ensuring our industry remains competitive. I would like to take this opportunity to thank all who are involved in research, often toiling away unnoticed and far removed from the average grower. On behalf of us all, well done and keep up the good work. We remain committed in ensuring we have a stream of young graduates focused on filling the talent gap left by retiring researchers.

HORTGRO Science recognized the importance of communication and I hope you, the levy payer, have experienced the effort we have made in this field.

Lastly, I would like to thank the team that executes the strategy we have put in place, Hugh, Wiehann, Richard, Matthew, Elise-Marie and Theresa, what a pleasure it is for me and the rest of the committee to spend time with you all feeding on your creativity, passion and drive to add value to our industry.

Thank you to all and may our industry continue to recognize the value that R&D adds to our integrated value chain.

Stephen Rabe



"It is through the foresight of my predecessors that Stellenbosch University is in this unique position as they have always strived to maintain a strong department with close interaction with the industries it serves. It is important to maintain this interaction as the four year academic programme trains students for a professional career and the training therefore needs to be very relevant to industry. The biggest danger for an academic department is to lose senior academic staff as it takes time for younger academics to find their feet in both academia and industry. Careful succession planning is therefore import. Also the pressure from the University is towards academic output and academics are not rewarded for working closely with industry on industry related problems."

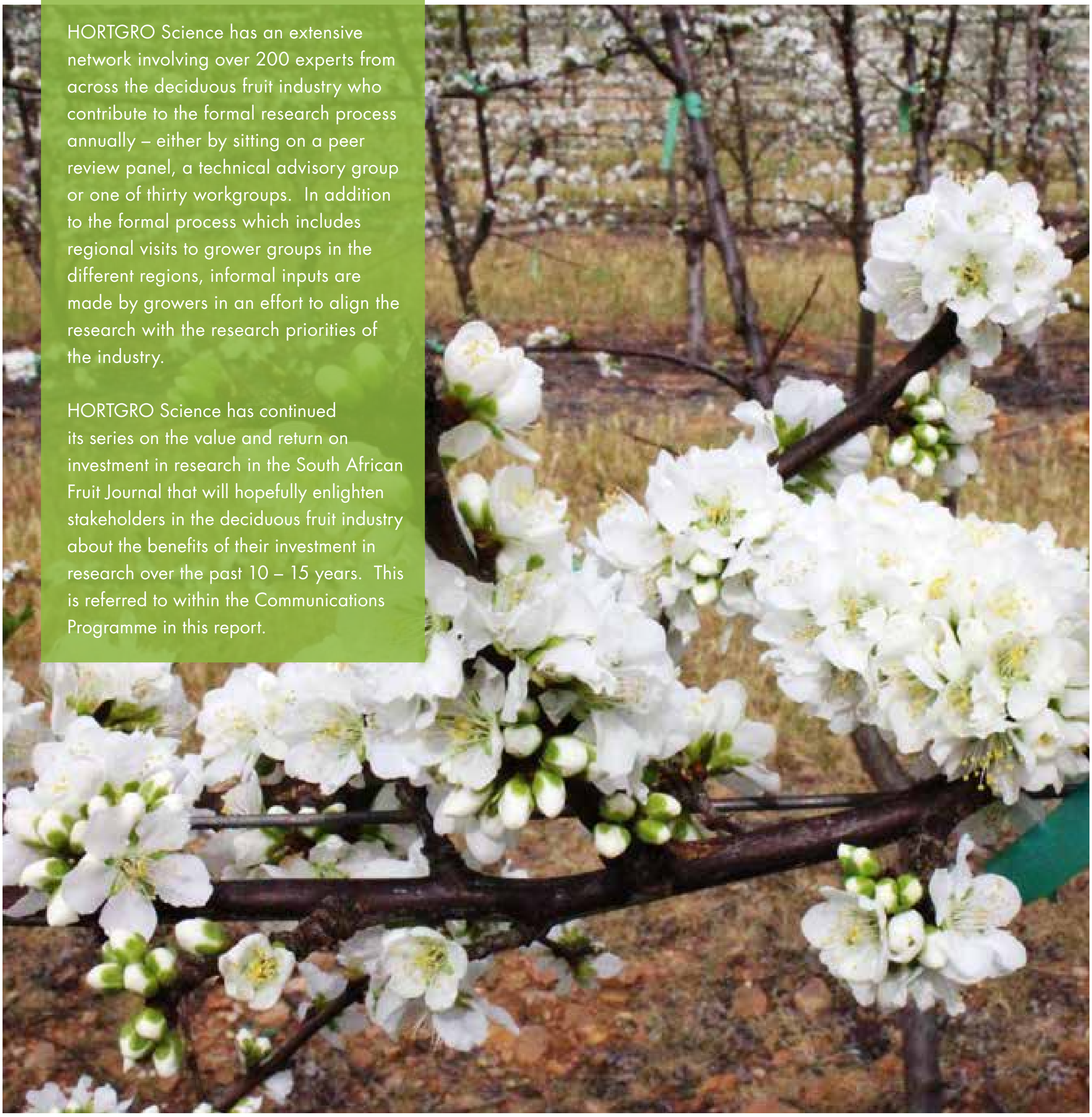
Prof Karen Theron

INTRODUCTION

Research within the stone and pome fruit industries is driven by the need to address present and future challenges by developing technologies and creating knowledge while at the same time providing a constant stream of well-trained people. The research is driven by the needs of the orchard, packhouse, exporter and finally the customer. It is informed by future risks that include: water availability and quality, market access, phytosanitary risks, training and key positions, plant quality and climate change.

HORTGRO Science has an extensive network involving over 200 experts from across the deciduous fruit industry who contribute to the formal research process annually – either by sitting on a peer review panel, a technical advisory group or one of thirty workgroups. In addition to the formal process which includes regional visits to grower groups in the different regions, informal inputs are made by growers in an effort to align the research with the research priorities of the industry.

HORTGRO Science has continued its series on the value and return on investment in research in the South African Fruit Journal that will hopefully enlighten stakeholders in the deciduous fruit industry about the benefits of their investment in research over the past 10 – 15 years. This is referred to within the Communications Programme in this report.



PERSONNEL / MANAGEMENT

The staff of HORTGRO Science is as follows:

Hugh Campbell
- General Manager

Richard Hurndall
- Research & Technology Manager
- Programme Manager – Post Harvest

Prof Wiehann Steyn
- Programme Manager Crop Production (Extraordinary Associate Professor in the Dept of Horticultural Science – Stellenbosch University)

Matthew Addison
- Programme Manager Crop Protection – based at the Department of Conservation Ecology and Entomology – Stellenbosch University

Elise-Marie Steenkamp
- Communications Specialist

Theresa Sonnenberg
- Research administrator

Dr Xolani Siboza
- Regional Fruit Production Researcher (from 1 December 2014)

Dr Daleen Stenekamp
- Applied Researcher: Crop Protection (from 1 January 2015)

Terence Asia
- Technical Assistant: Crop Protection (from 1 January 2015)

The staff seconded to Stellenbosch University are the following:

Dr Ken Pringle
- Department of Conservation Ecology and Entomology

Dr Shelly Johnson
- Department of Conservation Ecology and Entomology

Dr Mariana Jooste
- Department of Horticulture Science (5/8 appointment)

Chair in Applied Pre-harvest Deciduous Fruit Research:

Dr Elmi Lotze
- Based at Department of Horticultural Science, Stellenbosch University

Contract positions funded through research projects:

Dr Juanita Heunis
- Department of Conservation Ecology and Entomology

Ms Laura Allderman
- Dormancy Projects

HORTGRO Science welcomes Dr Xolani Siboza on board. Xolani has taken over the applied research portfolio from Willie Kotze who has moved into a technical capacity within industry. This has been a planned process and part of the industries contribution to the development of the next generation of technical people supporting the industry. Daan Brink is also a product of this initiative.

The Chair in Applied Pre-harvest Deciduous Fruit Research was implemented at Stellenbosch University, Department of Horticultural Sciences from 1 October 2014 and the industry is privileged to have Prof Karen Theron in the Chair.

The objectives of the chair are as follows:

• To ensure focused research as well as training of undergraduate and postgraduate students in the area of pre-harvest deciduous fruit production takes place;

• To act as interface between Stellenbosch University and the deciduous fruit industry facilitating the required transfer of relevant research outputs to the industry;

• To assist in succession planning for the Chair and other key positions within the Department of Horticultural Science.

The research process is managed on a programme as follows:

1. **Genetic optimisation (Breeding):** Ken Tobutt from the ARC leads the stone and pome fruit breeding and evaluation programme. Strategic direction for this programme is provided by the Fruit Route Advisory Committee.
2. **Sustainable farming:** Crop Production Manager - Prof Wiehann Steyn / Crop Protection Manager - Matthew Addison.
3. **Product integrity (Post Harvest):** Richard Hurndall.
4. **Market Alignment and a Sustainable Supply Chain:** Lindi Benic, in her capacity as Manager of Trade and Market Access, leads the market alignment programme.
5. **Communications programme:** Elise-Marie Steenkamp.

RESEARCH PROJECTS / FUNDING

HORTGRO Science receives its primary funding from the grower levy from SAAPPA and SASPA. This funding provides the seed funding to catalyse its research. 54% of the standard levy for pome fruit and 45% of the stone fruit levy is channelled to research and development. Additional funding is leveraged from the following funds:

- Parliamentary Grant - channelled through the ARC from the Department of Agriculture, Forestry and Fisheries (DAFF). All projects at the ARC are co-funded;
- The Post Harvest Innovation Fund (PHI). This fund is part of the sector innovation fund, one of the funding programmes at the Department of Science and Technology (DST). PHI focuses on Post Harvest research within the fruit and vegetable industries;
- National Research Fund (NRF) is funded through DST and provides bursaries;
- Technology and Human Resources for Industry Programme (THRIP) funding – a Department of Trade and Industry (DTI) initiative focused on research and training of postgraduate students;
- Western Cape Department of Agriculture (WCDA). WCDA are the primary funders of the Confronting Climate Change Initiative.
- International Atomic Energy Agency (IAEA). The focus of the IAEA is on the utilisation of sterile insect release for the control] of key pests.
- Other industries. A number of projects are co-funded by other industries (mostly dried fruit, canning fruit, as well as the table grape, citrus and wine industry).

Figure 1 below indicates the funding leverage for pome and stone fruit. For every R1 of industry funding (levy) in a project, R1,45 is leveraged from alternative sources. The pie graph in Figure 2. reflects the funding allocation for 2014/15 and is very similar to the distribution of funds during the previous year (2013/14).

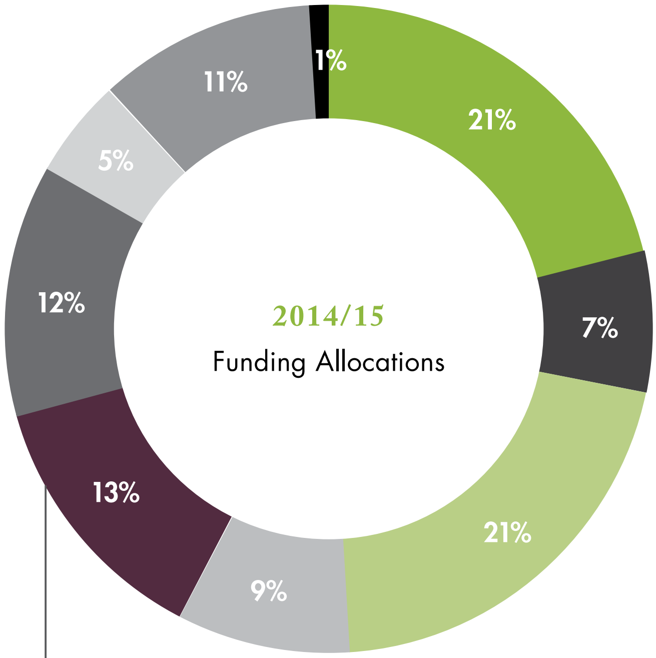


FIGURE 2: 2014/15 FUNDING ALLOCATIONS

- ARC Breeding
- ARC Projects
- Stellenbosch University
- ExperiCo
- Other Research Institutes
- Research Posts
- Tech Tansfer
- Prog / Project Man / Tech Services
- International Congress

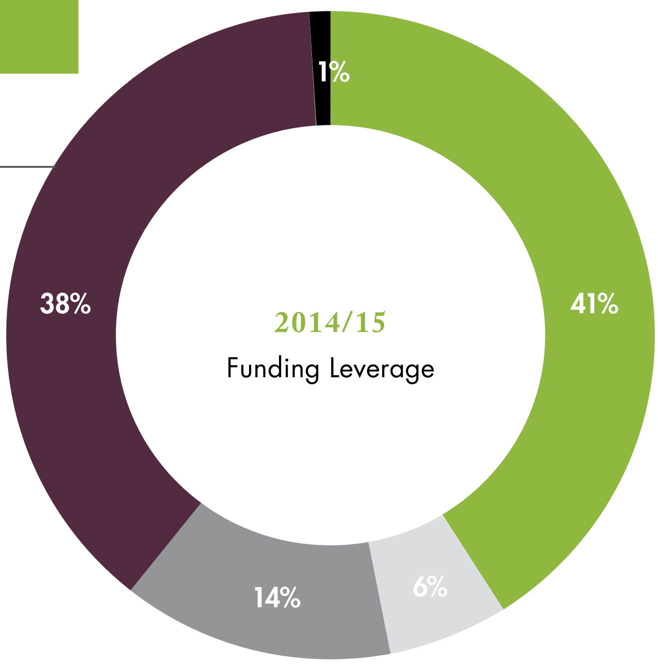


FIGURE 1: 2014/15 FUNDING LEVERAGE

- SAAPPA/SASPA levy - projects
- PHI
- THRIP
- Parliamantary Grant (ARC) / Other industries
- WCDoA

Research projects conducted during 2014/15:

TABLE 1: 2014/15 RESEARCH PROJECTS

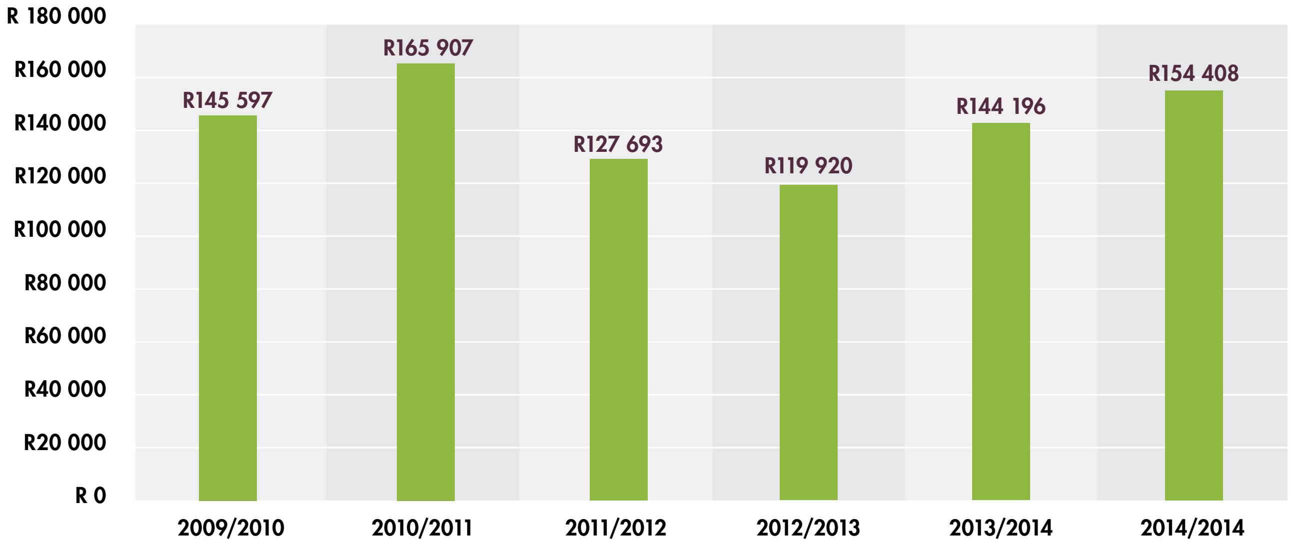
PROJECTS	TOTAL	POME	STONE
Projects conducted in 2013/2014	116	78	38
Projects completed in 2013/2014	38	22	16
Projects continuing in 2014/2015	78	56	22
New projects initiated in 2014/2015	32	16	16
TOTAL PROJECTS IN 2014/15	**110**	**72**	**38**

Research institution utilised in 2014/15:
The following table gives an overview of the research institutions utilised in 2014/15:

TABLE 2: RESEARCH PROJECTS PER RESEARCH INSTITUTION

RESEARCH INSTITUTE	PROJECTS 2014/15	PROJECTS 2013/14	PROJECTS 2012/13
ARC Infruitec-Nietvoorbij	**30**	**36**	**36**
ARC Breeding	21	21	21
ARC Research Projects	09	15	15
Stellenbosch University	**34**	**39**	**38**
US – Horticulture	14	16	15
US – Pathology	5	5	5
US – Entomology	14	18	18
US – Engineering	1		
HORTGRO Science Technical Services	**15**	**20**	**20**
ExperiCo	**19**	**16**	**15**
CA Science	**1**	**1**	**1**
Nemlab	**1**	**1**	**1**
Blue North	**1**	**1**	**1**
University of Pretoria	**2**	**1**	**1**
UP – Zoology	1	1	1
UP - Crop Production	1		
CSIR	**1**	**1**	**1**
Westcape Biotech	**1**		
Consultants	**5**		
C Jarmain	1		
P Stassen	3		
K Bouwer	1		
TOTAL PROJECTS	**110**	**116**	**114**

FIGURE 3: AVERAGE PROJECT COST PER YEAR 2009-2014



The average cost per project went up in 2014/15 by 7%. These figures must be viewed with caution as the reasons for a project cost increase are multiple.

Funding allocation per research investment focus area:
The following graphs give a representation of the funding allocation per programme.

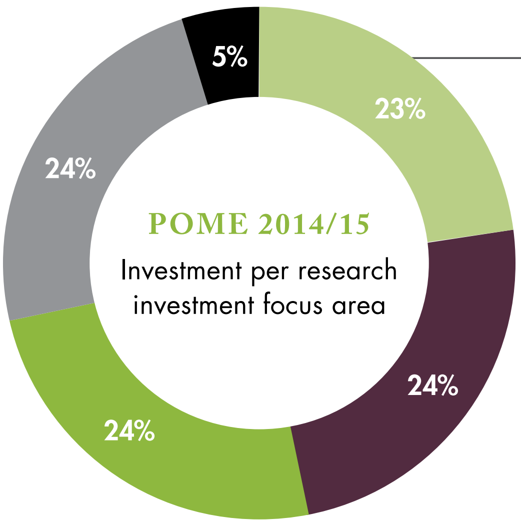


FIGURE 4

- Genetic Pool Optimisation (Breeding)
- Sustainable Farming (Crop Protection)
- Sustainable Farming (Crop Production)
- Product Integrity through the supply-chain (Post Harvest)
- Marketing Alignment (Market Access)

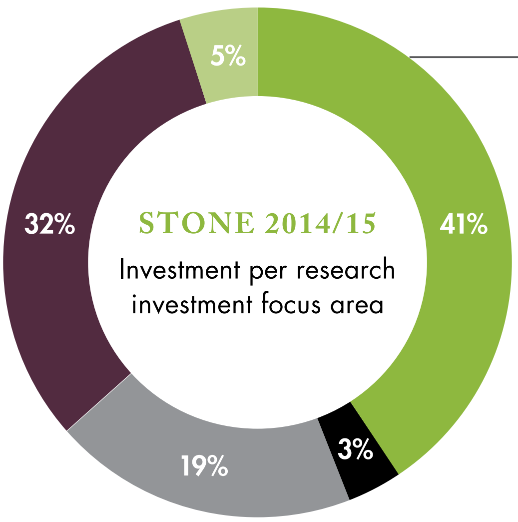


FIGURE 5

- Genetic Pool Optimisation (Breeding)
- Sustainable Farming (Crop Protection)
- Sustainable Farming (Crop Production)
- Product Integrity through the supply-chain (Post Harvest)
- Marketing Alignment (Market Access)

Research programmes and projects per investment area: Each research investment area or research programme is discussed in more detail within this report. Please refer to the relevant chapter of this report for a summary of each research project funded during the 2014/15 financial year.

RESEARCH CAPACITY AND TRANSFORMATION

One of the strategy objectives of HORTGRO Science is to address the research capacity challenge that our industry is facing. It is a perpetual challenge to build the next generation of researchers while ensuring that we maintain the key research capacity that is necessary to meet the current needs of the deciduous fruit industry. In parallel with this, we would like to change the profile of our researchers to better reflect the demographics of the country. Currently 53% of the research projects have a female as the project leader (up from 37% last year) and 22% of the projects have a black project leader, up from 13% last year. What is encouraging is that 33% of our projects involve the training of students at post-graduate level and as noted below, 44 post-graduate students are currently registered on HORTGRO Science projects. 50% of our post-graduate students are black. We are encouraged by these figures and are looking forward to seeing these post-graduate students landing in industry in different positions.

HORTGRO Science interacts with the Deciduous Fruit Development Chamber (DFDC) in order to identify the specific research needs of the emerging growers. The DFDC acts as a vehicle through which to communicate with emerging growers. The DFDC is represented on the HORTGRO Science Advisory Council by Joseph Hendricks and William Myburgh. All technology transfer events organized by HORTGRO Science are made available to emerging growers at no cost if facilitated through the DFDC. The video series of 35 videos covering all the production aspects of production continues to be used as an aid to production and most of the videos are available in English, Afrikaans and Xhosa. These videos are freely available to all and are housed on http://www.saorchard.co.za

The Post Harvest Innovation Fund (PHI) is partnering HORTGRO Science in developing an app to more effectively communicate Post Harvest issues to emerging and commercial growers.

UNIVERSITY PROJECTS – STUDENT COST AND AVAILABILITY

44 post-graduate students are funded through bursaries supplied by research projects. During the reporting year, PHI funded a number of bursaries on projects related to Post Harvest. The full value of these bursaries amount to R2 301 863 or 13% of the funding allocated to research projects. This excludes specific bursaries funded through HORTGRO that focus more on undergraduate students. It is also noted that additional funding was leveraged by the universities and research organisation from the Department of Trade and Industries THRIP fund. This fund requires students to be registered at a university in order to match funds put into a project involving students.

TABLE 3: POST GRADUATE STUDENTS WORKING ON PROJECTS FUNDED BY SAAPPA / SASPA

TOTAL	MSC	PHD	POST DOC	TOTAL BURSARY
44	26	16	2	R2 806 893

POST GRADUATE STUDENTS	MSC	PHD	POST DOC	TOTAL
White Male	7	4		11
White Female	7	3	1	11
Black Male	11	6	1	18
Black Female	1	3		4
TOTAL	26	16	2	44
Projects with students (36)	33%			

OVERSEAS VISITS

HORTGRO Science contributed to the funding of the following overseas visits:

- Technical Meeting of the International Pink Lady® Association – Rancagau, Chile: Mr Richard Hurndall, HORTGRO Science, was co-funded to attend this meeting. Report on the visit is published in the Aug/Sept 2015 issue of the SA Fruit Journal.
- 8th International Symposium on the Irrigation of Horticultural Crops – Lleida, Spain: Dr Sebinasi Dzikiti from CSIR was co-funded to present at the symposium. His presentation was titled: "Measurement and modelling of water use by high yielding apple orchards and orchards of different age groups in South Africa." Report on the visit was published in the October/November 2015 issue of the SA Fruit Journal.
- Visit to review best practice of overseas CA research facilities and technologies, with the view of developing a blueprint of future RSA CA research facilities: Mr Kobus van der Merwe and Jeff Wedgwood (Refrigeration Engineer) visited CA facilities at Laimburg - Italy, Wageningen University - The Netherlands, Leuven University - Belgium, Wenatchee, Stemilt and UC Davis, California in order to review best practice of their facilities for a blueprint for RSA industry CA research facilities. Report presented to SAAPPA Board and CA Group.

AWARDS

The following awards were made during the 2014/15 year. HORTGRO Science would like to congratulate the award winners.

- **Deciduous Fruit Industry Researcher of the year 2014:**
This award is given for outstanding performance by an individual or research team/programme involved in scientific, technical, marketing or economical deciduous fruit research. Dr Ian Crouch from ExperiCo was given this award for his contribution to the Forelle Early Market Access Programme (FEMA). With his experience in SmartFresh^{SM} research, Ian devised a strategy whereby Forelle is allowed to become eating ripe on the tree, harvested and treated with SmartFresh^{SM}. The net benefit to SA growers for the 2014/15 season is estimated at R29 million with a cumulative benefit of R75,6 million over the past 4 seasons.

- **Deciduous Fruit Innovation award for 2015:**
The Deciduous fruit Researcher award was changed to the Innovation award in 2015. The recipient of this award for 2015 is Mr Tinnie du Preez, a well know and highly respected technical advisor in the area of soil science. Tinnie has also made a vast contribution to the industry as a mentor. There is a generation of technical advisors working in the industry who have had the benefit of having Tinnie as their mentor or who have been through his stable.

- **Energy Globe Award:**
The Confronting Climate Change Initiative, a cross-industry initiative chaired by HORTGRO Science (H Campbell) was selected as the national winner for South Africa.

- **HORTGRO Science Best Semi-Scientific Article for 2014:**
Awarded to Karien Bezuidenhout and Louise van Schoor for their article titled: "Managing apple replant disease in the Vyeboom region with biological soil amendments vs fumigation". Published in the April/May 2014 issue of the SA Fruit Journal.

- **HORTGRO Science Best Popular Article 2014:**
Awarded to Dr Elmi Lötze for her article titled: "Taking the Mystery out of Mulching" Published in the June/July 2014 issue of SA Fruit Journal.

- **HORTGRO Science / Daan Strydom prize for the Best Undergraduate Student in Horticultural Science in 2014:**
Helen Marais was awarded this prize. She is currently a Masters student in the Department of Horticultural Science at Stellenbosch University.

See peer work groups (PWG's) on page 78 appendix.

Hugh Campbell

TIMELINE

2014

OCTOBER

- Hugh Campbell returns from Europe after a production fact finding mission.

- Alan Winde is welcomed as Western Cape Minister of Economic Opportunities at HORTGRO.
- Post Harvest Peer Work Group (PWG) and Entomology PWG meet.
- HORTGRO Golf Day.
- PHI funding meeting.
- Crop Production and Crop Protection Managers meet with the Fruitways group.

NOVEMBER

- Cheryl's Conference Bill MacHardy Integrated Plant.

- Researcher Thank-You Breakfast @ Mont Marie in Stellenbosch.
- Advisory Council Meeting.
- Announcement of Prof. Karen Theron as the first incumbent of the Chair in Applied Pre-harvest Deciduous Fruit Research at Stellenbosch University. The chair's operations focus on the pre-harvest side of the industry, and thus on what happens in the orchard.
- Cultivar Fruit Exhibition starts.
- Rootstock Evaluation Committee visits Piet Stassen's stone fruit rootstock evaluation sites.

- HORTGRO Science Crop Production and Crop Protection Managers meet with KROMCO group.

DECEMBER

- Langkloof Seminar and Orchard walk

- HORTGRO Science Strategic Session – STIAS
- Dr Xolani Siboza starts at HORTGRO Science as applied researcher
- Cultivar Bosberaad
- China opens up for SA apple market

2015

JANUARY

- Strengthening export ties - Thailand delegation visits HORTGRO Science.

- IPM meeting
- Confronting Climate Change Meeting
- Post Harvest Seminar at STIAS
- Wiehann Steyn and Xolani Siboza attended the Combined Congress in George with one of our PhD students, Giverson Mupambi, who won the SASHS price for the best PhD presentation and also a travel award for the best overall presentation by a member of the SASHS.
- Hugh Campbell visits Northern Province Emerging Growers with Kevin Maart from DFDC
- Crop Production TAC visit Vyeboom trial site.

FEBRUARY

- Orchard of the Future (OOF) meeting

- Agricultural Research Council visits HORTGRO Science
- FEMA inspectors meet with Post Harvest Manager
- HORTGRO Science Strategy Session
- Rootstock Evaluation meeting
- Pink Lady AGM

Calla du Toit, Peter Dall, Dr. Elke Crouch and Richard Hurndall at the Pink Lady AGM

MARCH

- Laborie Transformation Talks launched
- Western Cape Research and Technology Symposium Elsenburg
- National Agriculture Research Foundation meeting in Pretoria
- OFF Key lessons video
- Dr. Ken Pringle – final Scout Session @ Geelbos

APRIL

- Klipbokkop HORTGRO Strategy Session
- HORTGRO Retailers meeting with Woolworths
- Richard Hurndall attends Rosy Glow Meeting in Ceres
- OOF Visits Grabouw
- Student Meet and Greet

MAY

- Confronting Climate Change Meeting; CCC wins prize

- Packhouse Action Group (PAG) Loadshedding meeting
- ISOL CEL Meeting discussing DCA trends
- SAPO Trust Pome Exhibition
- HORTGRO bosberaad in Cederberg
- Hugh gets a new car

JUNE

- HORTGRO Science Technical Symposium 2015.

1. HORTGRO Science Advisory Council Chair, Stephen Rabe, and Helen Marais, Best Horticulture Student 2014

2. Salah Sukkarieh, Robotics Expert from Sydney University.

3. Kevin Sanders, 'The Colonel' – shared his Aussie orchard wisdom

- International Pink Lady Research Conference in Chile. Dr. Elke Crouch and Richard Hurndall attend.

Dr. Elke Crouch and Richard Hurndall attends Pink Lady Conference in Chile

- Tygerhoek/Fruitroute Meeting
- Ethiopean delegation at ARC
- Agri Processing R & D
- Rebirth Project Johannesburg
- Pathology PWG

JULY

- Waitrose visits HORTGRO Science
- Waitrose Seminar
- NAMC dinner Paarl
- Agri's got Talent

Armando Baartman is crowned Agri's Got Talent winner 2015

- BFAP Launch

AUGUST

- HORTGRO Communications Strategy Stias
- Advisory Council Meeting
- Pick 'n Pay visits HORTGRO
- Polymorph – App workshop
- National Fresh Produce Market/ Rebirth Project
- HORTGRO Gala Evening

HORTGRO Science's Communication Programme really soared this year. The emphasis of our communication actions were on identifying our stakeholder's needs, producing quality content, timeous dispersion, and the integration of information on various platforms.

COMMUNICATIONS

Sharing a magazine with other partners is never easy and in this regard the South African Fruit Journal remains a challenge. We focused on producing quality material, with a high-standard of visual aid. The series of stories about return on investment, brought about by HORTGRO Science's research projects, highlighted the many spin-offs associated with this process. The following ROI articles were published: The Art of Mutualism – focusing on the complex relationship between academia and the growers in the orchard; EPN – our Biological Superweapon; Crystal balling storage life: The DPA Dilemma; Bigger and Better through Research – plum breeding success stories. In addition to the ROI series, 15 technical articles were published this year, as well as several other general news articles and report-backs on overseas visits.

IPHONE & TABLET

A lot of energy went into refreshing the HORTGRO Science website making it more user-friendly. In order to make the website more dynamic we added an archive section which in due course will be linked to our research data base that is still in production. The news section on the website has had regular items posted which were also landed on our Facebook page. A search function was installed with key word identification. Registration for events is now done on-line and soon we will be adding a self-generating invoice-system as well as an e-commerce option enabling registrants to pay-online.

The Facebook page evolved in its own time, and currently stands on 230 likes, with 62% of fans being male and 37% female. Our fan base stretches from Malaysia, India, Saudi Arabia, UK to the USA. About 30% of our fans are between 25 – 34 years of age. In the past year we also uploaded a total of 27 videos onto YouTube. The three most viewed slots were: the Crop Protection Seminar lecture by Elleunorah Allsopp on Thrips Management with 129 views, Entomon Lab with 112 views, and the Rosy Glow Trials with 92 views.

NEWSPAPER & BROCHURE

In June, the annual HORTGRO Science Technical Symposium was a resounding success, as was attested by the record attendance figures over the four days and the positive feedback we received. This year two international guest speakers, both Australians, shared their expertise. Prof. Salah Sukkarieh, a robotics expert from Sydney University, talked about future smart farms, and Kevin Sanders, APAL Director and leading fruit grower, explained what his ideal orchard looks like. We also had an interesting mix of presenters ranging from Mercia Isaacs, CEO of Vuya! Foundation, Vito Rugani – the "African Carrot King" to emerging growers Pitso and Nono Sekhoto. This year's symposium also boasted an exhibition tent which added an extra dimension to the symposium and proved to be very popular. The symposium generated ample coverage in the print and television media. Despite icy weather the pome fruit Field Day in the Koue-Bokkeveld was well attended, as was the stone fruit workshop held in the Overhex, near Worcester.

A total of 14 Fresh Notes were sent out during the last year, with information ranging from root rot, browning, irrigation principles and MRL notifications. HORTGRO Science also released two press releases to the general media: Acknowledging Karen Theron as the new US Chair in Horticulture and the Student Bursary Evening. Both stories were picked up by local and Western Cape newspapers, as well as national magazines.

Elise-Marie Steenkamp
Communications Specialist

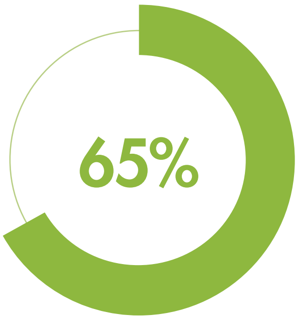
See information Days, workshops and symposiums on Page 80 appendix as well as the SAFJ publications list.

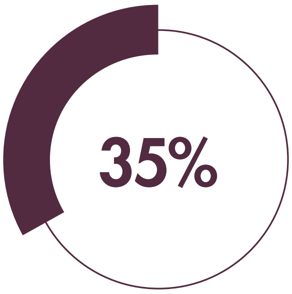
We also hosted a Langkloof Field Day in December 2014; a Post Harvest Seminar in January 2015 and a Crop Protection Seminar in September 2015, which were all well attended by various industry role-players.

In September and October 2015 HORTGRO Science reached out to our grower base and took part in three Information Days in Franschhoek, Tulbagh and Piketberg. These face-to-face sessions are valuable information exchanges.

Breeding and Evaluation

The ARC's Breeding & Evaluation programmes for apples, pears, apricots, peaches and plums that are part-funded by industry pay particular attention to adaptability to warm winters and resistance to pests and diseases, as well as to yield and fruit quality, in the case of scion cultivars, and to ease of propagation and orchard performance, in the case of rootstocks. Progress is reviewed each winter by Culdevco, ARC's licensee, and in the spring by the Fruit Route Steering Group. And promising Phase 2 selections are displayed at periodic Fruit Exhibitions held at the Infruitec campus.





The current Breeding & Evaluation research projects are listed in Table 1 and two which concluded in 2014-15 in Table 2. Parliamentary grant (nominally 65%) and industry funding (nominally 35%) covers the costs of the traditional stages of the programmes: maintaining and improving genebanks, making controlled crosses, selecting the most promising seedlings (Phase 1) and evaluating them in trial (Phase 2). This work is now underpinned by appropriate genetic studies, which are mostly funded by NRF via a THRIP project which was renewed in April 2015 for three years. The actions and outputs are described briefly in the accompanying summaries.

Reskilling of existing staff and training of students continues, in conjunction with Stellenbosch University. Trevor Koopman is busy writing up his PhD thesis on races of apple scab and Louisa Blomerus, Carl Hörstmann and Werner Pieterse are continuing with their studies. Student Solomon Ntladi (NRF-funded) is completing his thesis on the mapping of the blush trait in pear and Zama Mbulawa (THRIP funded) is continuing her PhD. Student Khethani Mhelembe (HORTGRO Science funded) was awarded his MSc, on fingerprinting the pome-fruit genebanks, and is preparing to undertake a PhD; and Thembeka Nyawo and Lawrence Kwalimba (both funded by HORTGRO Science) are in the final year of their MScs. The links with the supervisors in the Departments of Genetics, Horticultural Sciences and Plant Pathology and the Institute of Wine Biotechnology are of great value to the Cultivar Development Division.

Trevor attended the XVIII International Plant Protection Congress 2015 in Berlin, Germany, in August 2015 and Solomon the 2nd International Plant Breeding Congress in Antalya, Turkey, in November 2015. And Khethani spent a three month period learning genomics skills in the Edmund Mach Foundation, San Michele, Italy from February to March 2015.
A challenge of the coming years will be to reduce the areas planted for Phases 1 and 2 to a sustainable level as a review of farm costings indicates that the breeding and evaluation programmes have been 'living beyond their means'. Marker-assisted breeding, allowing more informed choice of parents and early discard of undesirable seedlings, should play a part but the money needed for this will reduce that available for the farm plantings still further! Once again the ARC team is grateful for the support received from ARC, THRIP, SAAPPA, SASPA, CFPA, DFTS and HORTGRO Science.

Ken Tobutt, ARC Infruitec-Nietvoorbij

TABLE 1. RUNNING PROJECTS
ALL CONDUCTED AT ARC INFRUITEC-NIETVOORBIJ

RESEARCHER	PROJECT TITLE
Dr J Kriel - Apple	Breeding high quality disease resistant apples for first and second economies
T Human - Pear	Breeding of pear cultivars
W Pieterse - Peach	Breeding of peaches and nectarines for commercial and emerging farmer
S Booi - Plum / Peach / Apricot	Breeding of new peach rootstocks
C Hörstmann - Plum	Breeding of Japanese plums for commercial and emerging farmers
C Hörstmann - Apricot	Breeding of apricot cultivars for commercial and emerging farmers
Dr K Soeker - Apple	Phase II evaluation of apple cultivars
Dr K Soeker - Pear	Phase II evaluation of pears in the Western Cape
C Smith - Peach	Phase 2 evaluations of peach and nectarine cultivars in the Winter rainfall region
C Smith - Plum	Phase 2 evaluations of plum cultivars in the Winter rainfall region
Chris Smith -Apricot	Phase 2 evaluations of apricot cultivars in the Winter rainfall region
I Meintjies - Plum / Peach / Apricot	Evaluation of stone fruit in the Summer rainfall area
W Pieterse - Apple / Pear Plum / Peach / Apricot	Planting and maintenance
K Tobut - Apple / Pear / Plum Peach / Apricot	Planting and maintenance of germplasm of pome fruit and stone fruit
J de Klerk - Plum	Determination of cross pollinators for plum varieties
S Booi - Plum / Peach / Apricot	Evaluation of newly bred stone fruit rootstock hybrids
E Lotz - Apple / Pear / Plum Peach / Apricot	Cold storage characteristics of new cultivars and selections
T Koopman - Apple	Determination of apple scab races occurring in South African apple growing regions to underpin breeding for resistance

TABLE 2. PROJECTS COMPLETED IN 2015
ALL CONDUCTED AT ARC INFRUITEC-NIETVOORBIJ

RESEARCHER	PROJECT TITLE
T Koopman - Plum / Peach / Apricot	Evaluation of newly developed stone fruit cultivars and training in fruit growing for the Second Economy
T Koopman - Appel / Pear	Evaluation of newly developed pome fruit cultivars and training in fruit growing for the Second Econom

BREEDING HIGH QUALITY DISEASE RESISTANT APPLES FOR FIRST AND SECOND ECONOMIES

J KRIEL

Objectives & Rationale

ARC Infruitec-Nietvoorbij's apple breeding programme aims to provide South African growers with a range of cultivars that are easy to grow and easy to sell on the home market and overseas, i.e. that are well adapted, reliably cropping, and disease-resistant with excellent appearance and eating quality and good storage ability.

Methods

The breeding involves maintaining gene-banks, hybridizing parents with desirable traits, screening and selecting Phase 1 seedlings from large populations and promoting the best to Phase 2 – and is underpinned by appropriate complementary genetic studies.

Key Results

Budwood of nine selections from Phase 1 orchards at Drostersnes short-listed in 2014 was provided to SAPO to raise trees for Phase 2. Nearly 8000 seedlings in Phase 1 were assessed for crop, visual appeal, and season and 38 were harvested for assessment of storage performance; thirteen full red selections were short-listed for promotion to Phase 2. Forty cross-pollinations were made e.g. to combine fruit quality with lower chilling requirement or to raise progenies for genetic studies e.g. into scab and woolly aphid resistance; about half of the resulting 20,000 seeds were sown. A recently completed fingerprinting study on the ARC pome fruit collection revealed that 78 of 540 apple accessions were not true-to-type and should be removed. Apple accessions were also characterised in terms of the 1-aminocyclopropane-1-carboxylate synthase (ACS1) gene involved in fruit ripening; analysis of the accessions allowed genotyping of two major alleles. Ten accessions from East Malling Research were released from quarantine and await planting. Two staff members are continuing with their PhD studies.

Conclusion / Discussion

The refocusing of the programme is continuing and particular attention needs to be paid to the enhancement of the genebanks and the application of molecular markers.

BREEDING OF PEACHES ANDNECTARINES FOR COMMERCIAL AND EMERGING FARMERS

W PIETERSE

Objectives & Rationale

The ARC peach and nectarine breeding programme focuses on developing cultivars with good cold storage ability adapted to the South African growing conditions and fruit quality traits aligned to the demands of the target markets – fresh, dried and canning, which include emerging farmers. This sets it apart from foreign breeding programmes.

Methods

Crosses are made and seedlings selected, mostly on the basis of fruit quality.

Key Results

Six Phase 1 dessert peach selections, harvested from week 47 to week 1, and one Phase 1 dessert nectarine selection were propagated for Phase 2 evaluation. Seven dessert nectarine and seven dessert peach selections were made in Phase 1 for advanced evaluation. Three yellow skin nectarines were selected and should be evaluated for drying. Eighteen hand pollinations were performed and one open pollination was harvested. The number of crosses for various objectives were: 2 for canning types; 5, and 1 open pollination, for drying type nectarines; 5 for drying type peaches; 3 for dessert nectarines (2 for early to mid-season and 1 late); and 3 interspecies crosses for disease resistance and research. In all ~3800 seeds were stratified and ~2500 seedlings reared. As part of a PhD study, fruit of five peach cultivars and one almond as well as of selections of a Phase 1 plum population were collected and processed for UPLC analyses for pigment profiling. Some of these samples were first used to adapt analytical methods developed in viticulture to stone fruit. Pollen of ten cultivars selected as breeding parents will be shipped to South Africa in accord with a Material Transfer Agreement (MTA) signed with CRA-FRU, Italy. A student is making good progress with fingerprinting the stone fruit genebanks.

Conclusion / Discussion

The breeding programme has made progress in selecting yellow skin nectarines from controlled crosses for evaluation for drying. Seedlings will be molecularly screened for the free stone trait and only suitable candidates will be planted in Phase 1 orchards.

PHASE 2 EVALUATIONS OF PEACH AND NECTARINE CULTIVARS IN THE WINTER RAINFALL REGION

J DE KLERK / W SMITH

Objectives & Rationale

The project evaluates locally ARC bred peach and nectarine selections adapted to South African growing conditions for the export, canning and drying industries.

Methods

Fruit samples were harvested each week from November 2014 to February 2015 at Bien Donné and Robertson Research

Farms as well as at a commercial farm, Uitkoms in Ceres. The samples were subjected to cold storage, canning and drying trials at the Post Harvest and Wine Technology Division. Representative fruit samples were also collected to evaluate their external and internal traits and the data captured on the MS Access data base.

Key Results

Two peach and six nectarine selections scored ≥80% (cut-off point) in the cold storage evaluation. Eighteen peach selections obtained 70% or higher in the final canning evaluation. Four peach and nectarine selections scored ≥ 70% in the final drying evaluation. At request of Culdevco several promising selections were given special attention regarding their horticultural traits. Four fruit exhibitions were held at ARC Infruitec-Nietvoorbij and were attended by approximately 160 people from the fruit industry. Several meetings were held with Culdevco and its clients with regard to new apricot varieties and planting guidelines. Continuous support was given to the second economy projects in the Cultivar Development Division.

Conclusion / Discussion

Post Harvest and horticultural evaluations as well as the fruit exhibitions will continue in 2015/16. New selections will be planted at the three evaluation sites. Selections that do not perform well after three years of evaluation will be removed from the evaluation blocks at Bien Donne and Robertson Research Farms.

PHASE 2 EVALUATIONS OF PLUM CULTIVARS IN THE WINTER RAINFALL REGION

J DE KLERK / W SMITH

Objectives & Rationale

The project evaluates ARC bred plum selections adapted to the South African growing conditions for the export industry.

Methods

Fruit samples were harvested each week from Decembr 2014 to February 2015 at Bien Donné and Robertson Research Farms as well as at a commercial farm, Uitkoms in Ceres. The fruit samples were subjected to cold storage trials at single and double temperature regimes at the Post Harvest and Wine Technology Division. Representative fruit samples were also collected to evaluate their external and internal traits and the data was captured on the MS Access data base.

Key Results

Two red skin and four yellow skin selections obtained ≥80% (cut-off point) in either the single or double temperature regimes or both in the cold storage evaluation. Ten new plum selections were planted at Bien Donne and Robertson Research Farms. At the request of Culdevco, several promising selections were given special attention regarding their horticultural traits. Three fruit exhibitions were held at ARC Infruitec-Nietvoorbij and was attended by a total of approximately 120 people from the fruit industry. Several meetings were held with Culdevco and its clients with regard to new plum varieties and planting guidelines. Support was given to the second economy projects in the Cultivar Development Division. There was regular liaison with the Deciduous fruit industry and technical support as well as technology transfer was given in South Africa and abroad.

Conclusion / Discussion

Horticulture and Post Harvest evaluations as well as the fruit exhibitions will continue in 2015/16. If available new selections will be planted at the three evaluation sites. Selections not performing well after three years of evaluation will be removed from the evaluation blocks at Bien Donne and Robertson Research Farms.

PHASE 2 EVALUATIONS OF APRICOT CULTIVARS IN THE WINTER RAINFALL REGION

J DE KLERK / W SMITH

Objectives & Rationale

The project evaluates ARC bred apricot selections adapted to South African growing conditions for the export, canning and drying industries.

Methods

Fruit samples were harvested each week from November 2014 to February 2015 at Bien Donné and Robertson Research Farms as well as at a commercial farm, Uitkoms in Ceres. The samples were subjected to cold storage, canning and drying trials at the Post Harvest and Wine Technology Division. Representative fruit samples were also collected to evaluate their external and internal traits and the data captured on the MS Access data base.

Key Results

Three selections scored ≥80% (cut-off point) in the cold storage evaluation. None of the selections submitted for canning evaluation scored 70% (cut-off percentage). Three selections obtained more than 80% in the drying evaluation. At request of Culdevco several promising selections were given special attention regarding their horticultural traits. One fruit exhibition was held at ARC Infruitec-Nietvoorbij and was attended by approximately 40 people from the fruit industry. Several meetings were held with Culdevco and its clients with regard to new apricot varieties and planting guidelines. Continuous support was given to the second economy projects in the Cultivar Development Division.

Conclusion / Discussion

Post Harvest and horticultural evaluations as well as the fruit exhibitions will continue in 2015/16. If available new selections will be planted at the three evaluation sites. Selections not performing well after three years of evaluation will be removed from the evaluation blocks at Bien Donne and Robertson Research Farms.

EVALUATION OF STONE FRUIT IN THE SUMMER RAINFALL AREA

I MEINTJES

Objectives & Rationale

The project aims to evaluate and release new peach, nectarine, plum and apricot selections in the summer rainfall regions, which are better adapted to the various microclimates than the existing range of commercial cultivars, and to fill gaps in the harvesting season.

Methods

Fruit samples were harvested weekly from October to January at the three trial sites in Mookghopong (Limpopo province), Bufland Farm, and Pro-Plum Farm, and one at Groblersdal, (Mpumalanga province), Collette Farm, and subjected to horticultural evaluation, where after the data were captured on a MS Access database.

Key Results

Evaluations were conducted on 746 Phase 2 selections at the three evaluation sites at Collette Farm, Bufland Farm and Pro-Plum Farm. Some 103 peach, 96 nectarine, 15 plum and 9 apricot selections could be sampled and were evaluated. Currently there are 20 promising selections (13 peach, 7 nectarine, 0 plum, and 0 apricot) which will be re-evaluated in the 2015 season. Possible promotion to Phase 3 will be discussed in collaboration with Culdevco. A further 41 newly identified selections (15 peach, 15 nectarine, 11 plum, and 0 apricot selections) were planted in the Phase 2 evaluation trial blocks at Modimole (Ginger Gypsy site), and Mookghopong (Bufland Farm and Pro-Plum Farm)

Conclusion / Discussion

The Phase 2 and Phase 3 evaluations and fruit exhibitions on the co-evaluator sites should continue. Final decisions in cooperation with Culdevco need to be taken on the 20 promising selections in order to create a short list for possible cultivar releases to the summer rainfall producers.

PLANTING AND MAINTENANCE OF EXISTING AND NEW GERMPLASM OF POME FRUIT AND STONE FRUIT

W PIETERSE

Objectives & Rationale

The main objective is to maintain a clonal genebank of existing and newly imported cultivars, selections and species of pome and stone fruits, important to South African horticulture or research and especially as a source of breeding material for the ARC programmes to develop improved deciduous fruit cultivars.

Methods

As set out in previous reports.

Key Results

Accessions in E1 and DN7 apple genebanks were fingerprinted. The available information on the accessions in the pear germplasm block, WG2E, i.e. origin/country and parentage were added to the data base. Discrepancies between recorded and published data of accessions in the stone fruit genebank are still under investigation, but where false entries have already been identified, and no novel traits could be identified, the trees were removed. Four pear selections from Kazakhstan, with small fruit, were propagated on rootstocks and planted in the genebank. Eight apple accessions imported in vitro from the genebank at East Malling Research were transferred to a glasshouse and are awaiting inspection by DAFF Plant Health. Thirteen peach cultivars were identified and pollen was ordered from Italy. A source of Japanese apricot germplasm was identified.

Conclusion / Discussion

Progress has been made with sourcing of new pome fruit accessions from sources overseas i.e. East Malling Research and Kazakhstan, to extend the genebank collection. Khethani Mhelembe successfully completed his MSc on fingerprinting the apple and pear collections. Although the pear data base was updated with passport data there is still much room for improvement in this regard in both pome and stone fruit genebanks and a central database for genebanks should be established.

DETERMINATION OF CROSS POLLINATORS FOR PLUM VARIETIES

J DE KLERK

Objectives & Rationale

The goal of the project is to test the pollination requirements (cross- and/or self-pollination) of promising Japanese plum selections in Phase 3 and newly released cultivars and to update the plum cross-pollination chart with the new information obtained.

Methods

Two adjacent trees of the selection, PR06-30, were isolated in a mesh cage. A hive of bees and a bouquet of the commercial cultivar, Laetitia (the pollinator), was placed inside the cage. The cage and the bees were removed five days after the two trees were at the full bloom stage. The circumference of both trees was measured before the trial started.

Key Results

The cross-pollination compatibility of a promising selection, PR06-30 and the cultivar, Laetitia, was tested at Bien Donné Research Farm. All the bees that were place in the cage died within three days. The two relevant trees had no fruit. It is uncertain if this result is due to the fact that the bees did not have enough time to pollinate the flowers of the selection adequately or because the selection is not cross compatible with Laetitia. The general cross-pollination chart of Japanese plums planted in South Africa was updated.

Conclusion / Discussion

The cross-pollination trial with the selection PR06-30 should be repeated with the cultivar Laetitia as pollinator or/and with other cultivars that bloom at the same. Several factors may influenced the productivity or death of the bees that are placed inside the cage to pollinate the flowers of the relevant trees. These factors may sometimes detrimentally influence the execution of the pollination trials.

EVALUATION OF NEWLY DEVELOPED STONE FRUIT CULTIVARS AND TRAINING IN FRUIT GROWING FOR THE SECOND ECONOMY

T KOOPMAN

Objectives & Rationale

We evaluated new stone-fruit selections developed by the ARC Infruitec-Nietvoorbij breeding programmes for emerging and existing farmers of the second economy. Outcomes of this project assist small-scale farmers to enter the deciduous fruit producing sector and address the aim of food security within specific communities.

Methods

We liaised with two communities, Koekedou near Ceres and Mgwali in Eastern Cape, by giving them advice on cultural practices needed for successful stone-fruit growing and we helped them plant new cultivars to see which are suitable for their fruit growing region.

Key Results

Eight nectarines, two peaches and ten plums were evaluated at Koekedou, Ceres, during the past three seasons. The best performing cultivars were Alpine, Crimson Blaze, 17C-28-9 and Summer Prince nectarines, Summer Sun and 17C-13-7 peaches and the plums Sun Kiss, Sun Breeze, PR00-37 and PR00-29. One new hectare of peach or nectarine cultivars was planted during 2013/14 at each of six of these Koekedou farmers, funded by Department of Agriculture Forestry and Fisheries. One hundred trees of Bonni Gold, De Wet and Nova Donna were planted at Mgwali during the 2012/13 season. Fruit at Mgwali was eaten by birds and fruit set problems occur during 2013/14 which did not allow fruit evaluation at this site. Ongoing informal training on pruning and thinning was given at both sites.

Conclusion / Discussion

Informal training in management practices given to communities at Koekedou and Mgwali during the past season has helped the farmers with fruit production. The evaluation of fruit has identified cultivars suitable for second economy production. New plantings at Mgwali and Koekedou farms assist these farmers to produce deciduous fruit.

EVALUATION OF NEWLY DEVELOPED POME FRUIT CULTIVARS AND TRAINING IN FRUIT GROWING FOR THE SECOND ECONOMY

T KOOPMAN

Objectives & Rationale

We evaluated apple scion selections over three years from the ARC Infruitec-Nietvoorbij breeding programme for their suitability for producers from the South African second economy and training farmers in appropriate practices.

Methods

We liaised with communities at Koekedou Farmers in Ceres and Mgwali in Eastern Cape, by giving advice on cultural practices needed for growing pome-fruit, and helping with plantings of new pome-fruit selections. We evaluated these selections for adaption for the local regions.

Key Results

Twenty five apple selections were evaluated during the duration of the project (2012/13 -2014/15) at Koekedou, Ceres. Colour development was good during 2012/13 and 2014/15 and the best performing apple selections were the following summer apples, DN 1-12-113, DN 1-12-197 (Afri Sunrise), DN 1-12-180, DN 1-13-246, DN 2-4-81R, DN 4-22-69R, DN 4-35-78, DN 4-77-8R and 8E-10-31R, and the late ARC apple Elegant. One hectare of new plantings of apple and or pear cultivars was established for four Koekedou farmers, funded by Department of Agriculture Forestry and Fisheries. Informal training to communities at Koekedou and Mgwali was given on pruning and thinning during visits.

Conclusion / Discussion

Informal training in management practices given to communities at Koekedou and Mgwali during the past three season will help the communities with apple production. The evaluation of fruit at Koekedou has identified cultivars suitable for growing under those climatic conditions.

STUDENTSHIPS TO APPLY MOLECULAR MARKERS TO THE POME FRUIT AND STONE FRUIT BREEDING PROGRAMMES ESPECIALLY TO VERIFY AND CHARACTERISE GERMPLASM

K TOBUTT

Objectives & Rationale

This project aims to use molecular markers for verifying and characterising the ARC tree-fruit germplasm collections – in support of the programmes to breed new cultivars of stone-fruit and pome-fruit for South Africa – and, in the process, to train students in marker techniques in the context of fruit genetic resources and improvement.

Methods

DNA was extracted from young leaves collected from the tree-fruit genebank accessions. Samples were amplified with multiplexed sets of fluorescently labelled microsatellites primers for fingerprinting and products were sized in a sequencer. Subsets of accessions were amplified with primers for certain agronomic genes including S (incompatibility) RNases and sized in a sequencer or on agar.

Key Results

The fingerprinting showed that, of 197 pear accessions and 540 apple accessions, 22 and 78, respectively, were false. 106 apricots, 39 plums, 214 peaches and 31 almonds are in the process of being fingerprinted and the apricots and plums are being genotyped for S alleles. One student spent three months working at Edmund Mach Foundation, a fruit genomics lab in Italy, and the other two received training at ARC and at Stellenbosch University.

Conclusion / Discussion

The pome-fruit genebanks will be rationalised by discarding the falsely named accessions. Information on the genotypes of the apples for the ACS-1 gene involved in ripening was used when designing the apple crossing programme for good storage. One student completed his MSc on the fingerprinting and characterizing of the pome-fruit genebanks and the other two students are making steady progress on stone-fruit.

ETERMINATION OF APPLE SCAB RACES OCCURRING IN SOUTH AFRICAN APPLE GROWING REGIONS TO UNDERPIN BREEDING FOR RESISTANCE

T KOOPMAN

Objectives & Rationale

We are determining which races of apple scab *(Venturia inaequalis)* occur in the different apple growing regions of South Africa and are also investigating the population genetic structure and the pathogenicity and virulence of the pathogen on different apple cultivars.

Methods

We collected apple scab samples from four different apple growing regions. Apple differential cultivars with different resistance genes against apple scab have been imported. Single spored cultures were established and differential cultivars were inoculated to determine the races Fingerprinting of apple scab isolates was undertaken with seven SSR markers to determine differences between isolates from the different apple growing regions.

Key Results

Apple scab samples were collected from the Ceres, Elgin, and Lower and Upper Langkloof regions during the 2014/15 growing season for race identification. Nine differential cultivars were inoculated and it was found that the Rvi1 and Rvi12 resistance genes were overcome by the South African isolates. The 2013/14 apple scab isolates were genotyped with seven SSR markers. Genotyping results from the 2013/14 isolates were the same as in the 2012/13 growing season, indicating that minor population differences exist between Ceres and the Langkloof populations and moderate differences between the Elgin and other populations. This indicates that the Ceres and the Langkloof populations are more closely related to each other. Six different haplotypes were found in the ITS and ABC 2 gene regions of the fungal isolates.

Conclusion / Discussion

Inoculation of differential apple cultivars with apple scab isolates from the four growing regions showed that in all four regions the RVi1 and RVi12 resistant genes are ineffective. Single spore isolates also showed differences in virulence and can only infect certain cultivars, consistent with research work reported in Europe. Collection of the apple scab samples from the four apple growing regions enabled a population genetic study which indicated differences in the apple scab fungal populations between the different climatic regions and also indicated that the fungus adapted to the regions over time. Differences in the ABC 2 gene region of the fungus could be due to variation in virulence in the fungal isolates.

EVALUATION OF NEWLY BRED STONE FRUIT ROOTSTOCK HYBRIDS FOR FIRST AND SECOND ECONOMY

T KOOPMAN

Objectives & Rationale

The overall aim of the project is to evaluate under nursery and orchard conditions (Phase 2) the ARC-bred stone-fruit rootstock selections promoted from the Phase 1 breeding programme. The rootstock selections were promoted for having various resistances/tolerances in comparison with commercial rootstocks, especially nematodes.

Methods

In May 2014, cuttings from 8 ARC-bred hybrids and 7 commercial rootstock cultivars were rooted under standard nursery conditions at Bien Donné Research Farm. Four ARC-bred rootstock selections rooted in 2013 were budded with ‘Pioneer' and ‘Alpine' scion varieties in November 2014. The orchard field pilot trial planted in 2011 at Bien Donné Research Farm was monitored for yield and fruit numbers were recorded after two harvest seasons (2013/14 and 2014/15) by Dr Piet Stassen and team. Shoots were collected of the four promising rootstock selections identified by industry from this pilot trial for planting at different semi-commercial farms in 2015. A replica field trial was planted in 2014 in a field which was supposed to be infested with ring nematodes (Criconemoide xenoplax).

Key Results

The ARC-bred rootstock hybrids and commercial rootstocks cultivars rooted under standard nursery conditions showed inconclusive results due to water problems experienced at Bien Donné Research Farm during the summer season. The four ARC-bred rootstock selections budded in 2014 with 'Pioneer' did not show any signs of incompatibility when thumb test was applied. The orchard field pilot trial planted in 2011 with 'Pioneer' plum trees on different ARC-bred rootstock selections saw three of the ARC-bred rootstock selections showing no significant difference to Marianna, the standard commercial plum rootstock after two harvest seasons. Semi-commercial farms were identified for planting four promising ARC-bred rootstock selections in 2015, two in the Western Cape and two in the Transvaal. A replica field trial was planted successfully in winter 2014 but the ring nematode numbers were very low.

Conclusion / Discussion

Due to the water problems, no ARC-bred rootstock hybrids could be selected as having more than 70% rooting ability in the 2014/15 season. 'Pioneer' on the three ARC-bred rootstock selections in orchard trial did not differ significantly from trees on Marianna, the standard commercial plum rootstock in terms of yield, yield efficiency, number of fruit and cumulative yield. The replica field trial should be checked for ring nematode numbers during the summer when the temperatures in the soil start to increase.

BREEDING OF PEAR CULTIVARS

J HUMAN

Objectives & Rationale

The aim of this project is to provide the South African pear industry with new, locally adapted cultivars.

Methods

The project uses conventional breeding techniques to generate genetic variation, establish these seedlings in evaluation blocks and, once they started bearing, select the best selections for further evaluation in Phase 2.

Key Results

Budwood of 24 Phase 1 selections and three selections for Inter-Phase Evaluation (promoted the previous year) was supplied to SAPO. Eighteen new selections were harvested and, after storage evaluations, were reduced to 14 for Phase 2 evaluation. These comprised nine blush, two yellow, one blush-on-russet and one blush miniature selections. The best selection was the blush on russet selection, P15-8 (27 Jan) with average appearance, better than average colour, good texture and better than average taste, scoring 20/30. Cross pollinations produced 8 072 seeds, including 49% for blush, 5% for green, 14% for intergeneric and 32% for future genetic studies. About 3 685 seedlings generated last year will be kept in plastic bags under shade netting for future plantings. A Ph.D. student is using one of the seedling progenies at Drostersnes for his project on mapping the blush trait.

Conclusion / Discussion

A total of 13 selections (nine blush, one blush miniature, one blush on russet (tri-coloured) and two green/yellow) and one selection for Inter-Phase evaluation were promoted for further evaluation in Phase 2. One new selections P15-8, shows potential for the future and may follow the "fast track" route with the collaboration of Culdevco and co-operatives for further evaluation.

BREEDING OF NEW PEACH ROOTSTOCKS FOR THE FIRST AND SECOND ECONOMY

S BOOI

Objectives & Rationale

This project aims to provide the South African Stone-Fruit Industry with new, low-chill stone-fruit rootstocks resistant/tolerant to various. The two main objectives for the current study were to screen for tolerance to waterlogged conditions and to screen for resistance to a combination of ring nematode (Criconemoide xenoplax) and root-knot (Meloidogyne javanica) under glasshouse conditions.

Methods

Twenty three ARC-bred stone-fruit rootstock selections, mostly plums, peach and interspecies plus twenty two commercial rootstock cultivars were screened for nematode resistance in the Nematode Glasshouse at Bien Donné Research Farm along with three progenies from controlled crosses: Soldonne x Palsteyn (apricot), Soldonne x Supergold (apricot) and Nemared x Cinderella (peach), with seedling numbers of 8, 40 and 89 respectively. In another trial, eight ARC-bred stone-fruit rootstock selections and seven commercial rootstock cultivars were screened for tolerance to waterlogging under glasshouse conditions. Fifteen ARC-bred stone-fruit rootstock selections and ten commercial rootstock cultivars were tested for rooting under nursery conditions with forty cuttings per item. Two apricot cross combinations were made with the focus to raise progenies for resistance to root-knot nematodes, drought tolerance, and resistance to iron chlorosis along with compatibility.

Key Results

Due to unavailability of a reliable water supply at Bien Donné Research Farm during the summer season, most plants screened under glasshouse conditions for nematode resistance and waterlogging tolerance did not survive the drought stress conditions into which they were exposed, therefore no selections were selected for promotion to Phase 2. Likewise most of the cuttings died. A total of 2 325 apricot hand cross pollinations for two progenies were made yielding about 218 fruits in all.

Conclusion / Discussion

Now that water has been restored at Bien Donné Research Farm, the screening of ARC-bred rootstock selections will re-commence and more emphasis will be put on screening for nematode resistance. More ARC-bred rootstock selections from Phase I resistance breeding will be rooted and budded with scion varieties under nursery conditions to reduce the bottle neck of selections that still need to be assessed for rooting ability and compatibility.

PHASE 2 EVALUATIONS OF PLUM CULTIVARS IN THE WINTER RAINFALL REGION

C SMITH

Objectives & Rationale

The project evaluates ARC bred plum selections adapted to the South African growing conditions for the export industry.

Methods

Fruit samples were harvested each week from Decembr 2014 to February 2015 at Bien Donné and Robertson Research Farms as well as at a commercial farm, Uitkoms in Ceres. The fruit samples were subjected to cold storage trials at single and double temperature regimes at the Post Harvest and Wine Technology Division. Representative fruit samples were also collected to evaluate their external and internal traits and the data was captured on the MS Access data base.

Key Results

Two red skin and four yellow skin selections obtained ≥80% (cut-off point) in either the single or double temperature regimes or both in the cold storage evaluation. Ten new plum selections were planted at Bien Donne and Robertson Research Farms. At the request of Culdevco, several promising selections were given special attention regarding their horticultural traits. Three fruit exhibitions were held at ARC Infruitec-Nietvoorbij and was attended by a total of approximately 120 people from the fruit industry. Several meetings were held with Culdevco and its clients with regard to new plum varieties and planting guidelines. Support was given to the second economy projects in the Cultivar Development Division. There was regular liaison with the Deciduous fruit industry and technical support as well as technology transfer was given in South Africa and abroad.

Conclusion / Discussion

Horticulture and post-harvest evaluations as well as the fruit exhibitions will continue in 2015/16. If available new selections will be planted at the three evaluation sites. Selections not performing well after three years of evaluation will be removed from the evaluation blocks at Bien Donne and Robertson Research Farms.

EVALUATION OF NEWLY BRED STONE FRUIT ROOTSTOCK HYBRIDS FOR FIRST AND SECOND ECONOMY

S BOOI

Objectives & Rationale

The overall aim of the project is to evaluate under nursery and orchard conditions (Phase 2) the ARC-bred stone-fruit rootstock selections promoted from the Phase 1 breeding programme. The rootstock selections were promoted for having various resistances/tolerances in comparison with commercial rootstocks, especially nematodes.

Methods

In May 2014, cuttings from 8 ARC-bred hybrids and 7 commercial rootstock cultivars were rooted under standard nursery conditions at Bien Donné Research Farm. Four ARC-bred rootstock selections rooted in 2013 were budded with 'Pioneer' and 'Alpine' scion varieties in November 2014. The orchard field pilot trial planted in 2011 at Bien Donné Research Farm was monitored for yield and fruit numbers were recorded after two harvest seasons (2013/14 and 2014/15) by Dr Piet Stassen and team. Shoots were collected of the four promising rootstock selections identified by industry from this pilot trial for planting at different semi-commercial farms in 2015. A replica field trial was planted in 2014 in a field which was supposed to be infested with ring nematodes (Criconemoide xenoplax).

Key Results

The ARC-bred rootstock hybrids and commercial rootstocks cultivars rooted under standard nursery conditions showed inconclusive results due to water problems experienced at Bien Donné Research Farm during the summer season. The four ARC-bred rootstock selections budded in 2014 with 'Pioneer' did not show any signs of incompatibility when thumb test was applied. The orchard field pilot trial planted in 2011 with 'Pioneer' plum trees on different ARC-bred rootstock selections saw three of the ARC-bred rootstock selections showing no significant difference to Marianna, the standard commercial plum rootstock after two harvest seasons. Semi-commercial farms were identified for planting four promising ARC-bred rootstock selections in 2015, two in the Western Cape and two in the Transvaal. A replica field trial was planted successfully in winter 2014 but the ring nematode numbers were very low.

Conclusion / Discussion

Due to the water problems, no ARC-bred rootstock hybrids could be selected as having more than 70% rooting ability in the 2014/15 season. 'Pioneer' on the three ARC-bred rootstock selections in orchard trial did not differ significantly from trees on Marianna, the standard commercial plum rootstock in terms of yield, yield efficiency, number of fruit and cumulative yield. The replica field trial should be checked for ring nematode numbers during the summer when the temperatures in the soil start to increase.

PHASE II EVALUATION OF APPLES IN THE WESTERN CAPE

K SOEKER

Objectives & Rationale

The project aims to evaluate ARC bred apple selections in order to identify well adapted and promising apples which produce heavy crops of quality fruit acceptable to all market places, locally as well as overseas.

Methods

Selections from Phase 1 are planted in replicated trials and assessed for cropping and fruit characters after storage.

Key Results

A total of 51 selections were harvested from Phase 2 orchards at Elgin Experimental Farm and evaluated and tested for cold storage ability at the Post Harvest Division at ARC Infruitec-Nietvoorbij. Of these, 21 stored well, 11 showed average storage ability, 7 were below average, 11 had no storage potential and four needed to be re-evaluated due to decay. The best selections, after quality assessment, from each category were: 4-61-35, low chill, 77%; 4-64-4R, striped, 77%; 4-54-87, bi-colour, 78%; 4-13-23R, full red, 87% with balanced taste and excellent flavour and texture. No ARC bred selections were identified for removal as most, if not all, selections have only been evaluated for 2 years. Eight new selections were planted at Elgin Experimental Farm in November 2014. DNA was extracted from 120 selections. Of these, 96 have been screened with 12 SSR markers, as part of an on-going THRIP genotyping project. S-incompatibility studies on the Afri range of low chill apples showed that Afri Star, Afri Blush and Afri Coral are incompatible with each other, but compatible with Afri Rose and Afri Glo.

Conclusion / Discussion

Feedback from industry contacts during orchard walks and exhibitions led to nine new apple selections (one of which had the highest scores in its categories, viz. 4-54-87) being identified and these nine selections will be closely watched in the coming seasons. Industry consultants also provided valuable information on orchard management practices which are being implemented to improve the overall productivity of Elgin Research Farm.

PHASE II EVALUATION OF PEARS IN THE WESTERN CAPE

K SOEKER

Objectives & Rationale

The project aims to evaluate locally bred pear selections and industry standards to identify new pears suitable for local as well as overseas markets.

Methods

Selections from Phase 1 are planted in replicated trials and assessed for cropping and fruit characters after cold-storage.

Key Results

A total of 35 selections and cultivars were harvested from Phase 2 plots and evaluated and tested for cold storage ability at the Post Harvest Division at ARC-Infruitec Nietvoorbij after eight weeks in cold storage. Of these, 12 selections stored well, 14 did not store well, six were below average and 2 need to be re-evaluated. The best selections for each of the product types were as follows: P07-3 and P04-6, blush, scoring 78% for consumer traits; P04-28, full red, scoring 76%; P07-15, green, scoring 60%; and 11B-7-17, green/yellow, 76%. Eight selections were sent for canning this past season, of which three made it to final evaluation. P07-15 was the best canning selection, although it was average overall, scoring 51%. Four selections made it to the final drying evaluation, and P05-5 scored 83% with good drying ability. Twenty entries scored low marks (<60%) in the past season during quality assessments and, after comparison of evaluation data of the last five years, six of these received their 2nd and 3rd star in the discard process and will be discarded. Eighteen selections also showed inconsistency in their evaluation data and will also be discarded. Thus, in total, 24 selections will be discarded. Sixteen new Phase 2 selections were planted at Elgin Experimental Farm in 2014. Fifty-nine new selections (P11 series), whose DNA was extracted in 2014, are waiting be sent to CAF, Stellenbosch University, in 2015 for analysis of 12 SSR markers.

Conclusion / Discussion

Feedback from industry contacts during orchard walks and exhibitions have been very informative and early input on new pear selections has been positive. P07-3 shows the most promise after 3 years of evaluation and will be closely monitored in subsequent evaluations. Bud-wood was collected and delivered to SAPO to make 400 trees which will be planted in semi-commercial trials by different growers.

BREEDING OF JAPANESE PLUMS FOR COMMERCIAL AND EMERGING FARMERS

C HÖRSTMANN

Objectives & Rationale

This project aims to breed a full range of high quality yellow, red, and black Japanese plum cultivars ripening to extend the season, that are easy to grow and easy to sell, and which involves staying abreast of the latest developments in breeding practises and the stone-fruit industry.

Methods

Traditional breeding practices and genebank maintenance is complemented by THRIP funded marker work to fingerprint germplasm and applying marker-assisted selection.

Key Results

Budwood of the four promising selections from the 2013 season was provided to SAPO for propagation. Nine promising selections, of which six are red fleshed, were identified from Phase I orchards harvesting from week 47 to 1, and will be promoted to Phase II. Hand pollinations and open pollinated sources during the 2014 season yielded 1109 embryos. Under the complementary THRIP project, fingerprinting of the gene bank and certain advanced selections has progressed, and S-allele genotyping has started. The breeder presented a poster on the genetic survey of deciduous fruit genebanks at the 29th International Horticultural Congress, held in Brisbane, Australia.

Conclusion / Discussion

Significant progress has been made, especially in expanding the red fleshed plum range over the past season, and good selections were made despite some adverse conditions. Successful crosses were performed to generate progenies according to breeding programme objectives and for future genetic research. The progression of the THRIP funded research into molecular markers is benefitting the breeding programme.

BREEDING OF JAPANESE PLUMS FOR COMMERCIAL AND EMERGING FARMERS

C HÖRSTMANN

Objectives & Rationale

This project aims to breed a full range of canning, drying, dessert and multipurpose cultivars ripening to extend the season, that are easy to grow and easy to sell, by staying abreast of the latest developments in breeding practices and the stone-fruit industry.

Methods

Traditional breeding practices and genebank maintenance are complemented by THRIP funded marker work to fingerprint germplasm and applying marker-assisted selection.

Key Results

Budwood of the seven promising selections from the 2013 season was provided to SAPO for propagation. Thirteen promising selections, seven of which have excellent blush coverage and harvesting from week 45 to 48, were identified from Phase I orchards and will be promoted to Phase II. Hand pollinations during the 2014 season yielded 567 embryos. Under the complementary THRIP project, fingerprinting of the gene bank and certain advanced selections has progressed, and S-allele genotyping has started. The breeder presented a poster on the genetic survey of deciduous fruit genebanks at the 29th International Horticultural Congress, held in Brisbane, Australia.

Conclusion / Discussion

Significant progress has been made, especially in the expansion of the blush apricot range over the past season, and good selections were made despite experiencing some adverse conditions. Successful crosses were performed to generate progenies according to breeding programme objectives and for future genetic research. The progression of the THRIP funded research into molecular markers is benefitting the breeding programme.

EVALUATION OF NEWLY DEVELOPED POME FRUIT CULTIVARS AND TRAINING IN FRUIT GROWING FOR THE SECOND ECONOMY

T KOOPMAN

Objectives & Rationale

We evaluated apple scion selections over three years from the ARC Infruitec-Nietvoorbij breeding programme for their suitability for producers from the South African second economy and training farmers in appropriate practices.

Methods

We liaised with communities at Koekedou Farmers in Ceres and Mgwali in Eastern Cape, by giving advice on cultural practices needed for growing pome-fruit, and helping with plantings of new pome-fruit selections. We evaluated these selections for adaption for the local regions.

Key Results

Twenty five apple selections were evaluated during the duration of the project (2012/13 -2014/15) at Koekedou, Ceres. Colour development was good during 2012/13 and 2014/15 and the best performing apple selections were the following summer apples, DN 1-12-113, DN 1-12-197 (Afri Sunrise), DN 1-12-180, DN 1-13-246, DN 2-4-81R, DN 4-22-69R, DN 4-35-78, DN 4-77-8R and 8E-10-31R, and the late ARC apple Elegant. One hectare of new plantings of apple and or pear cultivars was established for four Koekedou farmers, funded by Department of Agriculture Forestry and Fisheries. Informal training to communities at Koekedou and Mgwali was given on pruning and thinning during visits.

Conclusion / Discussion

Informal training in management practices given to communities at Koekedou and Mgwali during the past three season will help the communities with apple production. The evaluation of fruit at Koekedou has identified cultivars suitable for growing under those climatic conditions.

EVALUATION OF NEWLY DEVELOPED STONE FRUIT CULTIVARS AND TRAINING IN FRUIT GROWING FOR THE SECOND ECONOMY

T KOOPMAN

Objectives & Rationale

We evaluated new stone-fruit selections developed by the ARC Infruitec-Nietvoorbij breeding programmes for emerging and existing farmers of the second economy. Outcomes of this project assist small-scale farmers to enter the deciduous fruit producing sector and address the aim of food security within specific communities.

Methods

We liaised with two communities, Koekedou near Ceres and Mgwali in Eastern Cape, by giving them advice on cultural practices needed for successful stone-fruit growing and we helped them plant new cultivars to see which are suitable for their fruit growing region.

Key Results

Eight nectarines, two peaches and ten plums were evaluated at Koekedou, Ceres, during the past three seasons. The best performing cultivars were Alpine, Crimson Blaze, 17C-28-9 and Summer Prince nectarines, Summer Sun and 17C-13-7 peaches and the plums Sun Kiss, Sun Breeze, PR00-37 and PR00-29. One new hectare of peach or nectarine cultivars was planted during 2013/14 at each of six of these Koekedou farmers, funded by Department of Agriculture Forestry and Fisheries. One hundred trees of Bonni Gold, De Wet and Nova Donna were planted at Mgwali during the 2012/13 season. Fruit at Mgwali was eaten by birds and fruit set problems occur during 2013/14 which did not allow fruit evaluation at this site. Ongoing informal training on pruning and thinning was given at both sites.

Conclusion / Discussion

Informal training in management practices given to communities at Koekedou and Mgwali during the past season has helped the farmers with fruit production. The evaluation of fruit has identified cultivars suitable for second economy production. New plantings at Mgwali and Koekedou farms assist these farmers to produce deciduous fruit.

COLD STORAGE CHARACTERISTICS OF NEW CULTIVARS AND SELECTIONS

E LOTZ

Objectives & Rationale

Good cold storage ability is a pre-requisite for all South African export fruit cultivars. New selections from the ARC Breeding programme are evaluated for cold storage ability during the evaluation phase of these new selections.

- To evaluate new stone and pome fruit cultivars and selections from the Cultivar Development Programme of ARC Infruitec-Nietvoobij for cold storage ability
- To supply the researchers of the Cultivar Development division with cold storage data and recommendations which will help them and other stakeholders to decide on the future of new selections
- To accumulate storage data of new selections in a database

Methods

- Each sample is stored according to a fruit kind specific cold storage protocol, designed in consultation with stakeholders
- Appropriate maturity and quality evaluations are performed according to protocol
- Data (for example harvesting maturity, maturity after storage, quality defects and general comments, etc.) are stored in MS Excel. Data is also integrated into the database of the Cultivar Development programme together with production data of new selections
- Photographs of fruit at final evaluation are also recorded

Key Results

- Fruit were received from 28 October 2014 to 21 April 2015
- A total number of 157 fruit samples were received for cold storage during the 2014/15 season. Data and recommendations were compiled in MS Excel datasheets and shared with Cultivar Development researchers
- Feedback aimed at improving production practices (decay, insect damage and harvesting maturity) were also shared

Conclusion / Discussion

Storage data and recommendations on the storage ability of 157 samples were made to the relevant researchers of the Cultivar Development division of ARC Infruitec-Nietvoorbij.

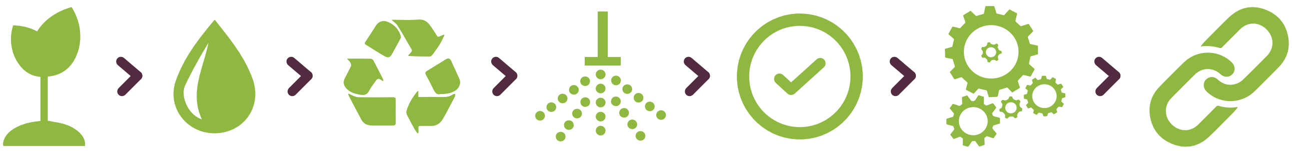
Crop Production

Research within the Crop Production programme not only addresses current problems experienced by fruit growers, but is also future-directed – research has a long lead time and it is important to build capacity and conduct research for the solutions that we will need in the future.

In this sense, the Crop Production research strategy is directed and aligned with the requirements and key risks to the Orchard of the Future Project. Hence, farming efficiency (of which rootstocks, plant quality and orchard efficiency are key components) as well as water- and climate-related research are the strategic priorities of this programme. The Crop Production research programme is structured into seven themes, viz. Dormancy, Farming efficiency, Irrigation and nutrition, Rootstocks, Soil Health, Summer Climate, and Yield. Research strategy for each theme is determined by a workgroup (a workgroup per theme) consisting out of fruit growers, technical advisors and researchers. When considering research strategy, the workgroups always keep in mind the changes we need to make to our orchards to remain internationally competitive as well as profitable. They also consider the major future risks, as identified within the overarching research strategy, that may jeopardise our profitability.

Four new projects were identified to initiate during the 2015/16 cycle. Two of these projects are aimed at addressing key questions raised by the Irrigation and Nutrition workgroup while the other two projects aim to increase our understanding of dormancy progression under our mild autumn and winter conditions and to determine the chill requirement of different apple cultivars and clones grown commercially in South Africa.

Why the focus on irrigation and dormancy? In terms of irrigation, water availability was rated the highest risk to the Orchard of the Future within the Crop Production programme. The Irrigation and Nutrition workgroup listed the following major outcomes of irrigation research and technology transfer:



The workgroup identified the following irrigation-related research and extension outcomes:

- **Increased young tree growth** resulting in faster filling of space and return on investment. This is particular importance when planting the Future Orchards on dwarfing rootstocks. We need info on irrigation-related factors that affect young tree root development.
- **Increased water use efficiency**, ergo irrigation efficiency, is a key target of the Orchard of the Future project. In a drying climate and with growing demand, it is becoming imperative to increase water use efficiency. We need info on how tree water status affects tree performance, we need to know how we can conserve water without negative impacts on tree performance, we need to know what to do when we have a drought, and we need to know how and when we can use water saving technologies.
- **Sustainability.** See the previous point. We need to save water. We also need to make money. This means we need to become better at irrigation system design and irrigation scheduling. We need trees/ rootstocks with beter water use efficiencies.
- **More effective irrigation management.** We need training at various levels, backed by data on how various soil, environmental, climate and tree factors affect water use.
- **Fruit quality (sunburn, fruit size, internal quality and taste).** We need to know how plant water status, ergo irrigation, affects fruit quality.
- **Production.** We need to know how plant water status and irrigation-related factors impact on tree productivity.
- **Collaboration throughout the water value chain.** We need information and material that will achieve high water use efficiency throughout the water value chain (water board, government, irrigation company, consultant, farmer, labourer, fruit tree growth and productivity, fruit quality, environmentalist).

The reasons for focusing research on dormancy might be less obvious to many fruit growers. Growers generally only have a vague notion of how lack of winter chill affects them.

The only direct dormancy-related cost is the effect of the rest breaking applications. **However, there are many indirect costs to lack of winter chill and these are:**

- Having to put trees in cold storage before planting.
- Nursery tree quality (hardening off trees).
- Effects on tree architecture – from this stems:
  - The cost of trunk renewal (in terms of ROI) in year 2.
  - Not being able to plant feathered trees (again ROI).
  - Losing our leaders (basal dominance) or battling to keep them going, which includes (although not the only reason) hesitancy in using dwarfing rootstocks, fighting too much vigour and inefficient tree designs.
- Variability in fruit maturity with downstream effects in the value chain.
- Asynchronicity between rootstock and scion growth due to differences in chill requirement.
- Ease and effectiveness of fruit thinning.
- Density of fruiting positions – having to leave more fruit in clusters rather than single to obtain a certain crop load.
- Poor flower quality and small fruit size.

These impacts are likely to become more severe as temperatures trend upwards in future. We also do not want to be in a position where fruit production in some areas becomes marginal due to future restrictions on the use of some rest breaking chemicals. Breeding low chill cultivars may offer a solution to lack of winter chill. However, this very long term solution considering that current low chill cultivars are all early season and have generally poor long-term storability.

What does the future hold for research within the Crop Production programme in 2015/16?

Nursery tree quality as key determinant of the success of the Orchard of the Future needs research and technology transfer. These needs will be determined by the Rootstock workgroup, which underwent a name change to the Rootstock and Nursery tree workgroup. A four article series on nursery tree quality is currently being published in the SA Fruit Journal. Rootstocks that are more yield efficient and adapted to South African conditions is a key priority and necessity for achieving the objectives of the Orchard of the Future. Screening of rootstocks will be stepped up with a set of key rootstock parameters that will be determined by the above-mentioned workgroup. Irrigation and climate-related research will remain a focus.

In terms of completed research, I just want to highlight one project, viz. "Cost effectiveness of picking platforms and the Hermes harvesting system relative to conventional labour intensive farming practise". The most insightful findings of this research related to the negative findings of this research by MSc-student Gerrit van der Merwe. The failure of harvesting systems and platforms to increase labourer productivity in South African orchards (pome fruit in particular), relates to our current orchard systems. Gerrit found that our labour is not inherently unproductive, but our orchard design and tree architecture does not allow the maximum expression of labourer productivity and also decreases the efficiency of various orchard practices. Also, our comparatively large proportion of 3rd grade fruit is one of our greatest inefficiencies. If increasing labourer and operational efficiency was to be a major drive for the South African orchard of the future, we would need to rethink the rootstocks we use, the way we train our trees, and the quality of fruit we produce.

Wiehann Steyn

TABLE 1. PROJECTS COMPLETED IN 2015

RESEARCHER	PROJECT TITLE
L Allderman - Apple / Pear / Plum	The response to and efficacy of rest breaking chemicals under laboratory conditions as a function of cultivar, chill unit accumulation, time of application and temperature after application
L Allderman - Apple / Pear	Determining the chill requirement of important rootstocks available to the South African apple industry.
Prof W Steyn - Apple / Pear Plum / Nectarine	Cost effectiveness of picking platforms and the Hermes harvesting system relative to conventional labour intensive farming practise
Dr M Schmeisser - Apple	Ecophysiological assessment of the effect of different apple rootstocks on scion performance
Prof W Steyn - Apple / Pear	Inherent and acquired resistance to fruit sunburn and poor colour in various apple and pear cultivars
Dr C Jarmain - Pome / Stone	Spatial FruitLook data: Uses and benefits to the Fruit Industry (Discussion document)

TABLE 2. FINAL PROJECT REPORTS DUE 2016

RESEARCHER	PROJECT TITLE
L Allderman - Peach / Plum / Apricot	Determining the chill requirement of important stone fruit rootstocks available to the South African fruit industry
Dr E Lötze - Apple	Apple root dynamics
Prof K Theron - Apple / Pear	Mechanical thinning of pome fruit
C Costa - Apple	Evaluation of new apple rootstocks for tolerance to woolly apple aphid
Dr P Stassen - Plum / Peach Nectarine / Apricot	Tolerance and susceptibility of commercial stone fruit rootstocks for plant parasitic nematodes
Dr M Jooste - Plum	The effect of climate on split pit in plums
Prof W Steyn - Plum	Heat stress in plums
Prof W Steyn - Apple / Pear	Water relations and sunburn in pome fruit
Prof K Theron - Peach Nectarine / Plum	Chemical thinning of stone fruit
W Kotze - Apple	Establish the effect of rest breaking agents on vegetative and reproductive development of apples in the Koue Bokkeveld/ Witzenberg valley

TABLE 3. RUNNING PROJECTS

RESEARCHER	*PROJECT TITLE*
Dr E Louw - Apple	Using the shoot assay to screen combinations and sequential application of existing and possible new rest breaking agents in apples
Dr E Louw - Apple	Physiological and molecular dynamics of dormancy in apples by comparing hormone levels, respiration rate and gene expression in areas with sufficient and insufficient winter chill and the effects of rest breaking agents
Dr X Siboza - Apple	Rest breaking programmes for warm winter regions
Dr S Dzikiti - Apple	Quantifying water use of high performing commercial apple orchards in the winter rainfall area of South Africa
Dr T Volschenk - Apple	Evaporation of high performance apple orchards
Dr X Siboza - Apple	Apple rootstock evaluation at Paardekloof, Witzenberg Valley
Dr X Siboza - Apple	Apple rootstock evaluation at Helderwater, Langkloof
Dr X Siboza - Apple	Apple rootstock evaluation at Oak Valley Estate, Grabouw
Dr X Siboza - Apple	Apple rootstock evaluation at Breëvlei, Grabouw
Dr P Stassen - Plum	Plum rootstock evaluation
Dr P Stassen - Peach / Nectarine	Evaluation of peach rootstocks
Dr P Stassen - Apricot	Evaluation of apricot rootstocks
K Bezuidenhout - Apple	Apple replant rootstock trials for determining a screening technique
Dr J Fourie - Apple	Effect of different cover crop management practices on the soil and performance of apple trees
S Storey - Apple	Nematode community structure and function as a bio-indicator of the effects of soil amendments on soil health
A Meyer - Apple	Validation of an enzyme-based soil alteration index for testing soil health in local apple orchard soils
Prof S Midgley - Apple	Acclimation of apple peel to light and temperature and the effect thereof on red colour development and tolerance to sunburn
Dr X Siboza - Apple	Chemical thinning of apples
Dr X Siboza - Pear	Chemical thinning of pears
Dr N Taylor - Peach / Pear	Stone fruit phenology and physiology in the Northern Province as related to orchard practices and productivity
Dr X Siboza - Apple / Pear	NAA and Ethephon to increase return bloom in apples and pears

TABLE 4. NEW PROJECTS APPROVED FOR 2016

RESEARCHER	PROJECT TITLE
Dr E Louw / L Allderman - Apple	Investigating the effects of different autumn temperatures on endodormancy induction
Dr E Louw / L Allderman - Apple	Determining the dormancy progression of apple cultivars and clones
Prof S Midgley - Apple	Establishing quantitative relationships between water relations, growth, yield and quality of high performing apple orchards
Dr E Hoffman - Apple	Effect of irrigation on the performance of young apple trees in newly established orchards

INTEGRATING SPATIAL FRUITLOOK DATA WITH GEOGRAPHICAL INFORMATION SYSTEM AND FIELD DATA

C JARMAIN

Objectives & Rationale

There is a need to optimise resource use (water, nutrients), increase the production of pome and stone fruits and hence the financial returns to producers and the fruit industry. Spatial data has the potential to assist in assessing and improving resource use, but spatial data and geographical information systems (GIS) are not widely used by the fruit industry. Exposure and technology transfer is needed for this new type of data sets to be integrated and adopted fully.

This project investigated how to integrate spatial FruitLook data with GIS and field data for improved pome and stone fruit production in the Western Cape.

Specifically, this project aimed to:

• Determine uses and benefits of integrating the spatial FruitLook data with GIS and field data through workshop discussions.
• Prepare a discussion document summarising the uses, benefits and limitations of integrating the spatial FruitLook data with other data sets, for improved pome and stone fruit production. Disseminate this learning to the fruit industry.

Methods

The methodology employed included:
• Literature reviews: an extensive literature review was performed on the use, benefits and limitations of remote sensing and GIS in agriculture and specifically horticulture. Literature was also reviewed and used to provide a description of remote sensing and GIS.
• Workshops and Interviews: a number of workshops were held and interviews conducted to obtain feedback from producers, researchers, managers, environmentalists on the use of remote sensing and GIS for horticulture, with specific reference to the existing FruitLook data base and Department of Agriculture (Western Cape) crop census database.
• Additional examples on remote sensing and GIS data use were generated to address the outset objectives.

Key Results

Both the literature reviews and the outcomes from stakeholder workshops indicate that the use of remote sensing and GIS holds benefits to pome and stone fruit production. However, the use of these spatial technologies are not widely adopted – neither locally nor internationally. Internationally research is ongoing in evaluating these technologies for applications related to water management and crop water stress detection, production estimation and pest and disease detection. Locally, research in this field is very limited. The value of locally available remote sensing derived datasets like FruitLook has been recognised in evaluating in-field and on-farm spatial variation, water management and in assisting producers and consultants in evaluating production problems. Linking the FruitLook database to the Department of Agriculture (Western Cape) GIS database on crop distribution provides a means of evaluating fruit production, crop actual ET, water management and efficiency of water use, spatially. These spatial statistical analysis could provide information required for setting benching standards for pome and stone fruit production.

Conclusion / Discussion

This project showcased a number of examples on the use of remote sensing data and GIS in evaluating aspects related to stone and pome fruit production. Wider adoption of this technology is needed, but this requires the involvement of horticultural scientists (a) to derive more concrete uses of remote sensing data and GIS and (b) to illustrate true benefits of this spatial technology.

DETERMINING THE CHILL REQUIREMENT OF IMPORTANT APPLE ROOTSTOCKS AVAILABLE TO THE SOUTH AFRICAN FRUIT INDUSTRY

L ALLDERMAN

Objectives & Rationale

We endeavoured to determine the dormancy status of various apple rootstocks by assessing their Progression of Dormancy and Chill Requirements.

Methods

Thirty six Dormancy Progression Curves were quantified using 10 rootstocks grown in two locations over two years. In 2013 Chill Requirements of all the rootstocks available at both locations were calculated. In 2014 Chill Requirements of M793 and G222 were calculated 5 times during the season using shoots at various depths of dormancy.

Key Results

Some samples fermented and died during forcing. Deaths were more prevalent in 2014 and certain rootstocks more susceptible.

Three distinct dormancy patterns were evident from the dormancy progression curves. GENEVA rootstocks entered dormancy rapidly, reaching maximum dormancy early in the season and exiting dormancy slowly. Malling and Merton rootstocks entered dormancy more slowly than the GEVEVA rootstocks. M7 and M9 reached maximum dormancy later than M793, M109 and M25 which seemed to enter and exit dormancy at similar rates. All rootstocks exited dormancy simultaneously. M7 and M9 exhibited shallow depth of dormancy. All the GENEVA and remaining MM rootstocks varied in depth of deepest dormancy. Some rootstocks went dormant before fruit harvest and apple scions, the impact of which is unknown. Chill Requirement calculations were higher in the colder location and varied according to the depth of dormancy of the shoots when collected. The Chill Requirement of G222 varied between 2013 and 2014.

Conclusion / Discussion

Under conditions of inadequate chill, the method widely used to determine Chill Requirement as absolute values is neither accurate nor reliable. The dormancy of rootstocks must rather be assessed generally using both Dormancy Progression and Chill Requirement data over numerous locations and seasons before rootstocks can be ranked from low to high chill.

DETERMINING THE CHILL REQUIREMENT OF IMPORTANT PEAR ROOTSTOCKS AVAILABLE TO THE SOUTH AFRICAN FRUIT INDUSTRY

L ALLDERMAN

Objectives & Rationale

We endeavoured to determine the dormancy status of various pear rootstocks by assessing their Progression of Dormancy and Chill Requirements.

Methods

Twenty Dormancy Progression Curves (DPC) were quantified using 6 rootstocks grown in two locations over two years. In 2013 Chill Requirements (CR) of all the rootstocks available at both locations were determined.

Key Results

From DPC it was determined that BP3, OH X F 40 and OH X F217 went into deeper dormancy than BP1, BA29 and C51. Dormancy in OH X F 40 and 217 as well as BA29 and C51 peaked early in the season while BP1 and BP3 showed a more gradual entrance into dormancy. OH X F 40 and 217 exited dormancy considerably later than the other rootstocks resulting in a much longer dormancy period.

CR results proved unreliable and contradictory. Differences in the dormancy status of the shoots used to determine CR proved to influence the results as did the location from which the shoots were sampled. Furthermore, the relatively low dormancy pattern of some of the pear rootstocks increased the possibility of inaccurate results.

Conclusion / Discussion

Under conditions of inadequate chill, the method used to determine CR is not reliable in its entirety. The dormancy status of rootstocks must rather be assessed generally and rootstocks ranked from low to high chill using both DPC and CR over numerous locations and seasons.

THE EFFICACY OF REST BREAKING CHEMICALS ON APPLES AS A FUNCTION OF CULTIVAR, CHILL UNIT ACCUMULATION, TIME OF APPLICATION AND TEMPERATURE, UNDER LABORATORY CONDITIONS

L ALLDERMAN

Objectives & Rationale

We studied the effect of rest breaking agents (RBA) on excised shoots under laboratory conditions to better understand the inconsistancies of RBA effectivity under field conditions year on year. This project is the first phase of a 5 phase project which will ultimately lead to increased efficiency of RBA in the field and concentrated on the methodology of the shoot assay. The methodology can also be used to screen new and combinations of chemicals for rest breaking properties.

Methods

One–year-old Fuji and Golden Delicious shoots +/- 35cm long were collected from two commercial orchards in the Elgin District prior to commercial rest breaking agent application. Various concentrations of rest breaking agents were applied to the shoots which were then placed in buckets containing a weak bleach solution and forced at different temperature regimes. A total of 196 treatments were screened over the

2 years period. Bud break was assessed by determining the number of shoots on which bud break occurred, the percentage bud break, the time interval until onset of bud break and the bud break period.

Key Results

Shoots treated with RBA outperformed non treated samples in both years, locations, temperature regimes and cultivars. However, no RBA treatment was able to improve bud break to the extent that is was comparable to excised shoots which had received sufficient cold. The effectivity of the RBA treatments varied according to the year in which the shoots were collected, the location, cultivar and the temperature regime to which the shoots were subjected.

Conclusion / Discussion

The methodology developed in the first phase of this project can be seen as a good proxy of the field situation. It can therefore be utilised effectively for the screening of numerous new and combinations of existing RBA under different temperature regimes, making it both a cheaper, faster and possibly less destructive option to field trials. The next phase of this project will be the verification of successful laboratory screening under field conditions before industry implementation can be considered.

THE EFFICACY OF REST BREAKING CHEMICALS ON PEARS AS A FUNCTION OF CULTIVAR, CHILL UNIT ACCUMULATION, TIME OF APPLICATION AND TEMPERATURE, UNDER LABORATORY CONDITIONS

L ALLDERMAN

Objectives & Rationale

We studied the effect of rest breaking agents (RBA) on excised shoots under laboratory conditions to better understand the inconsistancies of RBA effectivity under field conditions year on year. This project is the first phase of a 5 phase project which will ultimately lead to increased efficiency of RBA in the field and concentrated on the methodology of the shoot assay. The methodology can also be used to screen new and combinations of chemicals for rest breaking properties.

Methods

One–year-old Forelle and Packham's Triumph shoots 35cm +/- long were collected from two commercial orchards in the Elgin district prior to commercial rest breaking agent application. Various concentrations of rest breaking agents were applied to the shoots which were then placed in buckets containing a weak bleach solution and forced at different temperature regimes. A total of 196 treatments were screened over the 2 years period. Bud break was assessed by determining the number of shoots on which bud break occurred, the percentage bud break, the time interval until onset of bud break and the bud break period.

Key Results

Shoots treated with RBA outperformed non treated samples in both years, locations, temperature regimes and cultivars. However, no RBA treatment was able to improve bud break to the extent that is was comparable to excised shoots which had received sufficient cold. The effectivity of the RBA treatments varied according to the year in which the shoots were collected, the location, cultivar and the temperature regime to which the shoots were subjected.

Conclusion / Discussion

The methodology developed in the first phase of this project can be seen as a good proxy of the field situation. It can therefore be utilised effectively for the screening of numerous new and combinations of existing RBA under different temperature regimes, making it both a cheaper, faster and possibly less destructive option to field trials. The next phase of this project will be the verification of successful laboratory screening under field conditions before industry implementation can be considered.

APPLE ROOTSTOCK EVALUATION IN THE WITZENBERG VALLEY

X SIBOZA

Objectives & Rationale

The objective of this trial is to assess various new dwarfing, semi-dwarfing and semi-vigorous apple rootstocks from the GENEVA® range against the industry standards M793, M7, M25 and MM109. The performance of different M9 clones is also assessed.

Methods

Trees grafted to Rosy Glow were planted during winter 2010 at Paardekloof in the Witzenberg Valley. Dwarfing and semi-vigorous rootstocks were grouped together in two adjacent plots that are managed separately. Cepiland, GENEVA222, CG3007, GENEVA6210, Lancep, M793, M7, MM106, MM109/M9 and RN29 were planted in 5 blocks at 4 x 1.25 m spacing as the more dwarfing site while GENEVA222, GENEVA228, GENEVA778, GENEVA934, M25, M793, Maruba and MM109 were planted in 6 blocks at 4 x 1.5m spacing as the more vigorous site. Tree growth, yield – and fruit quality parameters are assessed annually.

Key Results

A general inverse relationship between tree size and yield efficiency is evident after three harvest seasons. Canopy size is beginning to affect fruit quality with less red colour development in larger canopies and more sunburn in smaller canopies. GENEVA778, RN29 and MM109/M9 trees are much more yield efficiency than expected from their size. Lancep trees are also very yield efficient but seem stunted and had smaller average fruit size in 2015 compared to other M9 clones.

Conclusion / Discussion

The performance of GENEVA778 is very encouraging and this rootstock seems to outperform industry standard MM109 in the same vigour class in terms of yield parameters. RN29 and MM109/M9 are performing better than other dwarfing rootstocks.

VALIDATION OF AN ENZYME-BASED SOIL ALTERATION INDEX FOR TESTING SOIL HEALTH IN LOCAL APPLE ORCHARD SOILS

A MEYER

Objectives & Rationale

The AI3 index, an enzyme-based soil alteration index, may prove to be an effective method for quantifying soil health in local apple orchards (Meyer et al., 2014a). This hypothesis was tested by evaluating AI3 in relation to (1) compost/mulch treatments, (2) ARD/fumigation treatments, and (3) different cover crop treatments, and to soil nutrient and apple tree data.

Methods

Compost tea and earthworm compost treatments combined with mulching were applied at Oak Valley (Grabouw), ARD and methyl bromide treatments at Vergelegen farm (Elgin), and different cover crop treatments at Vyeboom Boerdery. All trials followed a statistical design. Sampling and analyses commenced in October 2014. AI3 indices were generated using the formula by Puglisi et al. (2006).

Key Results

Better (lower) AI3 indices were shown in top- than subsoil layers. AI3 indices were better under mulching than bare soil, notably mulching plus earthworm compost. Better AI3 scores were observed in the treatment involving ARD than fumigation. Cover crop species with bio-fumigant properties had better overall AI3 scores than when no cover crop was sown.

Conclusion / Discussion

AI3 indices reflected gradients in mineralizable substrates across soil layers. AI3 confirmed the known positive effects of mulching on the soil, as well as soil health decline after soil fumigation, which is mainly due to suppression of microbial-mediated functions. AI3 was also able to detect differences between cover crop practices.

These findings attest to the usefulness of AI3 as an indicator of soil health in local apple orchards. Further substantiation is required.

QUANTIFYING WATER USE OF HIGH PERFORMING COMMERCIAL APPLE ORCHARDS IN THE WINTER RAINFALL AREA OF SOUTH AFRICA

S DZIKITI

Objectives & Rationale

Apple production for the export market is, in South Africa, entirely dependent on irrigation. In recent years, high performing orchards yielding up to 120 t/ha are becoming the norm. This raises important questions regarding the sustainability of the exceptionally high yields given the limited water resources. There is also no information on water use by apple orchards of different age groups thereby compromising efficient irrigation scheduling. This study seeks to close this information gap by quantifying the water use of high yielding apple orchards from planting to full-bearing.

Methods

Data on the actual amount of water transpired by apple orchards was collected in the Koue Bokkeveld during the 2014-2015 season. Two orchards were non-bearing planted to the 'Cripps' Pink' and 'Golden Delicious' cultivars while the other two were high yielding full-bearing orchards of these cultivars. Actual water use in full-bearing trees was measured using the heat pulse velocity sap flow method while thermal dissipation sap flow sensors were used in the young orchards. The orchard microclimate, soil water content, irrigation and other variables were also measured.

Key Results

The full-bearing 'Golden Delicious" orchard (22 yr. old) transpired 7 870 m3/ha/season compared with 5 890 m3/ha/season for the 9 yr. old 'Cripps' Pink' orchard. The non-bearing 'Cripps' Pink' (3 yr. old) transpired 2 710 compared to 1 990 m3/ha/season for the non-bearing 'Golden Delicious' (2 yr. old).

Conclusion / Discussion

The water use rates were strongly related to canopy size. Further studies are in progress to confirm the influence of crop load and cultivar on water use.

APPLE ROOT DYNAMICS

E LÖTZE

Objectives & Rationale

No root studies to quantify the timing and duration of root flushes of apple trees under local, commercial conditions are available. We quantified root growth dynamics during the growth season in Vyeboom, non-bearing trees in sandy soil and Elgin, bearing trees on heavy and sandy soil.

Methods

Translucent tubes (1m length) were installed at an angle (45°) in the planting row, 20-40 cm from a tree trunk. We used a CID-Root scanner to take root images in situ during the season. These images were analysed manually for the occurrence of white root tips. Physiological and fruit quality data was also accumulated in the orchard at Applegarth, while only physiological data was collected in the non-bearing orchard.

Key Results

Distinct peaks were found during early summer and autumn/winter in 3 bearing orchards in Elgin, but no distinct peaks were found in the young, non-bearing trees (Vyeboom). White root growth peaks in winter continued until at least end of July in Elgin. The autumn/winter peak was bigger than the summer peak.

Conclusion / Discussion

We established significant changes between root growth dynamics of white roots in young, non-bearing and bearing trees. There is no relationship between the occurrence of these root peaks and stem water potential, soil temperature or soil water content in bearing trees, whereas there may be a relationship between photosynthesis and white root dynamics in young trees. The root growth peaks in bearing trees in Elgin are similar between cultivars, but actual root numbers.

CARBON PARTITIONING IN LOW CHILL PEACH CULTIVARS: THE IMPACT ON YIELD IN SUMMER RAINFALL AREAS OF SOUTH AFRICA

N TAYLOR

Objectives & Rationale

The aim of the project is to establish whether the partitioning of carbon in low chill and early maturing cultivars in the summer rainfall area of South Africa will be affected by increased competition between organs for available carbohydrates and high spring temperatures.

Methods

Measurements were made on two farms and two cultivars, near Modimolle, in the summer rainfall area of South Africa. The dates for the progression of the cultivars through the various key phenological stages were noted and related to temperature through the calculation of growing degree days for the 2014/2015 season. This was then related to both shoot and fruit growth. Root growth measurements, through the use on a mini-rhizotron, were also made during winter and early spring in 2015.

Key Results

The periods of rapid fruit growth and shoot growth overlapped at the beginning of the season indicating competition between organs for a finite pool of stored reserves. As previously reported for low chill cultivars a double sigmoid fruit growth curve was not very evident, suggesting a very short or absent stage II of fruit growth, and therefore minimal slowing down of fruit growth during this stage. Root growth was also evident in late winter and early spring which will also place a demand on stored reserves.

Conclusion / Discussion

The overlapping fruit and shoot growth at the start of the season as implications for carbon partitioning in these cultivars, which in turn has implications for final fruit size and possibly even fruit quality.

PHYSIOLOGICAL DYNAMICS OF DORMANCY IN APPLE BUDS GROWN IN AREAS WITH INSUFFICIENT COLD

E LOUW

Objectives & Rationale

We are investigating three physiological aspects (respiration, oxidative stress and hormone concentration) of apple buds produced under inadequate winter chilling to gain fundamental knowledge on the changes brought about by such typical South African conditions.

Methods

Dormant apple buds from two contrasting climatic regions, Elgin (insufficient winter chill) and Koue Bokkeveld (sufficient winter chill) are compared in terms of their respiration rate and four different respiration pathways throughout the winter period. Similar testing is also done during the commercial application of RBAs to investigate the mechanisms of rest breaking. Method development is also underway to describe differences in the oxidative stress of such buds and the hormone concentrations and movement experienced during the winter period.

Key Results

We have established a reliable method to measure total respiration rate and the contribution of the TCA, PPP, Cyt and AOX respiration pathways in apple bud tissue. Testing this on buds from contrasting climatic areas indicated that their respiration pathways are affected by temperature changes and that buds lacking sufficient winter chill have a different respiratory potential. We have successfully collected a second season's plant material to conduct testing on the other two physiological aspects but a lack in human capacity hampers the development of suitable methods.

Conclusion / Discussion

The respiration objectives of the project is gaining momentum and showing interesting differences in the physiology of the buds. This aspect will be expanded on in the next season to include an investigation into the membrane composition and fluidity of the bud tissue exposed to warm winter conditions. To address the lack in capacity we are suggesting a collaboration to complete the oxidative stress objectives and we are requesting funds for a post doctorate fellow to assist in the development of the hormone assay. The project is adding value to the fundamental understanding of one of the South African apple production industries' biggest challenges.

USING THE SHOOT ASSAY TO SCREEN COMBINATIONS AND SEQUENTIAL APPLICATION OF EXISTING AND POSSIBLE NEW REST BREAKING AGENTS IN APPLES

E LOUW

Objectives & Rationale

The use of rest breaking agents (RBA) is essential for successful budburst in areas with insufficient winter chill. The use of Dormex and oil is currently the industry standard for rest breaking and although it is coming under continues scrutiny for its hazardous effects on man and environment it also results in a less vigorous vegetative growth during spring. We are investigating the use of PGRs to improve growth vigour of apple trees after treated with Dormex and oil as rest breaking agent. The second part of the study aims to investigate the rest breaking capabilities of nitric oxide (produced chemically and enzymatically) in the presence of oil as a safer more environmentally friendly alternative to Dormex.

Methods

We are using the laboratory shoot assay (developed in 2014) to test the efficacy of these PGRs and RBA alternatives. Statistical analysis from this will allow us to compare aspects such as date of onset of budburst, rate of budburst and percentage budburst for each of the treatments. Vigour will be measured using a scoring method involving the assessment of vegetative growth after bud burst.

Key Results

At the time of submission of this report (Aug 2015) it was the onset of spring and we were in the initial phases of data generation. No results were available to present or discuss.

Conclusion / Discussion

No direct conclusions or discussion could be made as the experimental trials have just started and no data was available yet.

ACCLIMATION OF APPLE PEEL TO LIGHT AND TEMPERATURE AND THE EFFECT THEREOF ON RED COLOUR DEVELOPMENT AND TOLERANCE TO SUNBURN

S MIDGLEY

Objectives & Rationale

We assessed the innate sensitivity of fruit developing on various new dwarfing and semi-dwarfing rootstocks, compared to the industry standards, to sunburn and poor red colour development.

Methods

Physiological in-field measurements were conducted at the trial site in Paardekloof. Two experiments were performed with picked fruit placed outside in natural sunlight. In both, whole fruit were subjected to high light (ca. 2000 umol m-2 s-1) and temperature (ca. 30°C) for one, two, three, four or five hours. Measurements to assess stress levels and peel damage were conducted immediately, and after fruit were brought into the lab, and repeated over the following four days. At harvest, fruit samples were assessed for maturity and quality.

Key Results

Physiological measurements in the orchard showed no differences between rootstocks. Similarly, there were no significant rootstock effects in both experiments. Duration of exposure to high light/temperature was the dominant factor giving rise to photostress and visible peel damage.

Conclusion / Discussion

Although differences in fruit red colour were found at harvest between the dwarfing/semi-dwarfing rootstocks, the experiments did not indicate inherent rootstock-related factors influencing the susceptibility for photostress and damage of the peel. All the fruit used were from sun-exposed positions on the tree, and showed similar responses to conditions of high light and temperature. Possibly the harvest sample included fruit which had experienced some shade relating to a larger canopy volume and leaf area index. The fact that M793 and CG6210, which had a greater canopy volume and LAI than the other rootstocks in the dwarfing site (personal visual assessment, to be corroborated) showed poorer red colour, appears to support this.

ECOPHYSIOLOGICAL ASSESSMENT OF THE EFFECT OF DIFFERENT APPLE ROOTSTOCKS ON SCION PERFORMANCE

M SCHMEISSER

Objectives & Rationale

Scions perform below expectation on some apple rootstocks under South African conditions compared to results achieved in other production regions. It is thought that this poor performance may be related to the poor adaptability of these rootstocks to local conditions.

The aim of this research is to study the effect of different dwarfing, semi-vigorous and non-dwarfing rootstocks on net photo-assimilation, water use efficiency and water status of 'Rosy Glow' grafted onto rootstocks that have recently become available.

Methods

Various ecophysiological and morphological measurements were conducted on dwarfing (Cepiland, RN29, CG222, CG307, CG6210, M793, MM106, MM109/M9, M7) and vigorous rootstocks (CG228, CG778, CG934, M25, M793, Maruba, MM109) planted as two separate blocks. M793 served as the industry standard in both plantings. Measurements taken included predawn and stem water potential, net photosynthesis, stomatal conductance, leaf area index, as well as leaf weight, stomatal density and a complete leaf mineral analysis.

Key Results

It was apparent that maximum rootstock influence on scion growth had not yet been attained by the time the study was conducted in 2013 and 2014, which made interpretation difficult.

None of the ecophysiological and/or morphological parameters measured could explain why rootstocks would potentially underperform under South African conditions.

Conclusion / Discussion

It is recommended that studies dealing with ecophysiological evaluations aiming to explain rootstock effects should be conducted on trees that are full bearing and the influence of the rootstock on scion growth is fully expressed. The fact that these orchards were optimally managed would further diminish the detectable differences in ecophysiological parameters and it is therefore suggested that future research should focus on creating stress contrasts between rootstocks to tease out how rootstocks differ with coping with sub-optimal or harsh climatic conditions. The effect of drought stress on growth and yield of a scion grafted onto various dwarfing and non-dwarfing rootstocks would provide an important contrast. Induced water stress would allow us to investigate whether rootstocks cause a difference in the time it takes before soil water deficits are manifested in the scion. Also, whether the type of rootstock influences the rate of recovery in terms of water status and photosynthetic rates after irrigation resumes? Both could have a potential impact on yield and fruit quality. This should be broadened out into a study investigating the impact of the magnitude and duration of water stress on yield of an identical scion on different rootstocks. Focusing on stress induced research in the future would provide a greater chance of pinpointing the cause of under-performance of rootstocks under South African conditions.

NEMATODE COMMUNITY STRUCTURE AND FUNCTION AS A BIO-INDICATOR OF THE EFFECTS OF SOIL AMENDMENTS ON SOIL HEALTH IN DECIDUOUS FRUIT ORCHARDS

S STOREY

Objectives & Rationale

Nematodes were extracted from soil samples collected at the Vyeboom trial site to determine the changes in population density and biodiversity due to cover crop management practices in the tree and work row.

Methods

The nematodes were quantified by extracting them from the 50 plots comprising of the 5 different treatments in the trial site. Nematodes were identified to family level and data interpreted using various indices.

Key Results

The soil health status of this orchard has drastically declined and the tree and work rows are currently experiencing stressed conditions with nutrient depletion. The condition of the soil food web in both of these systems is degraded. Bacterial feeding nematodes from the family Cephalobidae are the most abundant. There is a significant number of economically damaging plant-parasitic nematodes present in the tree row. These nematodes are *Pratylenchus* sp. from the family Pratylenchidae and Paratrichodorus from the family Trichodoridae. If levels keep exceeding the economic threshold levels action will need to be taken in order to prevent crop losses and even the loss of young trees in this orchard.

Conclusion / Discussion

The nematode community clearly responds to changes in the soil environment due to the cover crops and management thereof implemented in the orchard. The water management can also play a role in the nematode community and needs to be investigated further. The nematode community will influence the sequestration of carbon and nitrogen mineralization.
The orchard should be vigilantly monitored for the presence of plant-parasitic nematodes from the families Pratylenchidae and Trichodoridae.

EVALUATION OF APRICOT ROOTSTOCKS

P STASSEN

Objectives & Rationale

The aim of this project is to identify rootstocks for apricot trees in order to optimise the performance of the scion cultivar. Breakage at the bud union is an important aspect when selecting rootstocks for apricots. Currently only apricot seedling (Royal and Soldonne) are compatible with apricot scion cultivars. This puts a limitation on the choice of rootstocks available to cover aspects like high pH, nematode infested soil and horticultural traits.

Methods

Two trials using a randomised block design are planted in Mc Gregor and Bonnievale. Rustic trees on Atlas, Viking, Cadaman, GF 677, SAPO 778, Guardian, Marianna, Maridon and Tsukuba 4 with a Royal interstem are evaluated against Royal seedling.

Key Results

Two years after planting the trees at Tevrede, Bonnievale, no significant difference in trunk circumference occur between trees on Royal seedling as standard and on Atlas, Viking, Cadaman and GF 677 with a Royal interstem. Analysis show low to moderate numbers of root-lesion nematodes in this soils (36% clay and silt, pH (KCl) 6.3). The necessary cross pollinators have been planted. Trees on Royal seedling, Atlas, Viking, Cadaman, Guardian, GF 677 and SAPO 778 (all with a Royal interstems) do not differ significantly in trunk circumference from each other at Thornvilla, Mc Gregor (27% clay and silt, pH (KCl) 6.4). High numbers of ring nematodes occur in this soil. The necessary cross pollinators have been planted.

Conclusion / Discussion

These trial must give their first yield during 2015. Too early for any conclusions.

EVALUATION OF PEACH ROOTSTOCKS

P STASSEN

Objectives & Rationale

The main objective for this project is: To evaluate high potential imported and local rootstocks on different soil types and climatic conditions and to make recommendations that can complement yield and fruit quality of commercial peach and nectarine cultivars.

Methods

Six trials have been planted in different climatic conditions, soil textures and nematode numbers, using commercial pruning and training systems. All trials layouts are randomised complete block designs.

Key Results

Results indicate that the Flordaguard is the preferred rootstock for soils of 90% and more sand, for early scion cultivars and for warm regions (< 300 Richardson or 400 Infruitec cold units) as well as where root-knot nematodes are high. Trees on Flordaguard have a 50% higher yield and 14% better fruit weight than on the standard Kakamas seedling rootstock. Trees on Atlas, Viking, Garnem, Cadaman and GF 677 show promise on high pH soils and also where high numbers of ring nematodes occur, but more results are necessary. Trees on Kakamas seedling, Atlas, Viking and SAPO 778 perform well on soils with >20% silt and clay and no other limitations. Tree dieback occur with stress conditions like >95% sandy soil, high water tables and parasitic nematodes of trees on SAPO 778, Cadaman and Viking, due to fungal infestation. Trees on GF 677 are susceptible to over irrigation after plant.

Conclusion / Discussion

Soil texture, climatic and abiotic conditions as well as plant-parasitic nematodes play an important role in tree performance in terms of yield and fruit weight.

EVALUATION OF PLUM ROOTSTOCKS

P STASSEN

Objectives & Rationale

The main objectives for this project is: To evaluate high potential imported and local rootstocks on different soil types and climatic conditions and to make recommendations that can complement yield and fruit quality of commercial plum cultivars.

Methods

All experimental layouts are randomised complete block designs with different rootstocks planted in 10 blocks of single tree plots.

Key Results

After five harvest seasons African Delight plum trees perform well on Maridon on sandy soils with high water tables, but no standing water due to a good drainage system. High numbers of ring nematodes occur and are treated annually. After five harvest seasons African Delight trees on GF 677, Cadaman and Atlas perform well on high pH soil with high numbers of ring nematodes.

Conclusion / Discussion

For sandy soils with high water tables, ridges and draining systems are necessary to keep trees out of standing water. Maridon and Marianna are the favoured rootstocks if ring nematodes are treated annually, but SAPO 778 and Viking rootstocks can also be recommended. On high pH soil, trees on SAPO 778 (clone and seedling), Tsukuba 5 and Flordaguard show symptoms of chlorosis and poor performance in yield and fruit weight. Fruit of trees on Marianna and Maridon and also Viking have small fruit due to the high numbers of ring nematodes in this soil. Trees on Cadaman, Atlas and GF 677 are able to handle the condition of well. Trees on Marianna, Tsukuba 5, Maridon and GF 677 are hosts for ring nematodes.

INHERENT AND ACQUIRED RESISTANCE TO FRUIT SUNBURN AND POOR COLOUR IN VARIOUS APPLE/PEAR CULTIVARS

W STEYN

Objectives & Rationale

The objective of this project was to identify the anatomical, biochemical and physiological characteristics that offer photoprotection in apple and pear peel. We wanted to characterise the geographical, cultivar and maturity variation in these characteristics, and establish what the threshold conditions are for photothermal stress for different cultivars through the season. We also aimed to study the contribution of water availability, crop load and fruit flesh characteristics to sunburn.

Methods

The word limitation of the abstract doesn't allow the detailed description of all methodology (Please refer to theses and publications for detail).

Key Results

Previously sun-exposed peels of apple fruits were resistant to photodamage under high UV-B dosage throughout fruit development. However, the shaded peels of mature fruits incurred photodamage under UV-B stress.

Photodamage induced by heat and PAR stress during fruit development was not well correlated to fruit pigments, phenolic levels and peel anatomical characteristics. Repeated heat and PAR stress up to 9 hours did not induce any fruit sunburn symptoms. The poor correlation and inability to induce sunburn symptoms imply the involvement of more factors in fruit sunburn manifestation. Sunburn symptomology does not necessarily relate to the severity of the photodamage in a particular cultivar. Different cultivars did differ though in their dependence on the xanthophyll cycle for photoprotection under heat and PAR stress.

Sunburn increased with increasing moisture stress. Mulching had no effect on plant water status, but it enhanced plant photochemistry, reducing fruit surface temperature (FST) and sunburn.

Chemical and textural characteristics of exposed, but non-burned 'Cripps' Pink' apples were compared with that of fruit with induced and naturally occurring sunburn. Flesh firmness, TSS and TA of induced and naturally occurring sunburnt fruit did not differ from each other, but were significantly different from the non-burnt fruit. We concluded that sunburn induces textural and compositional changes in sunburnt fruit rather than some fruit being predisposed to develop sunburn due to their chemical composition. We found clear evidence that anthocyanin masks sunburn browning in blushed and red cultivars, but it does not seem to increase the susceptibility or protect these cultivars from sunburn.

Conclusion / Discussion

Heat stress causes the greatest damage to fruit photosystems, while UV-B and PAR have additive effects. Our data cast doubt on a primary role of UV-B in sunburn development in adapted, sun-exposed apple peel.

Our results further indicate that the level of sunburn symptomology does not necessarily relate to the level of stress that the peel of a particular cultivar experiences. Hence, cultivar expression of sunburn symptoms and cultivar photodamage sensitivity is not necessarily correlated.

The incidence of sunburn browning is likely to be underestimated in red and blushed cultivars, with compounding effects on comparative studies of cultivar sunburn susceptibility and sunburn physiology.

The increase in sunburn incidence towards harvest in apples is not due to an increase in TSS. Higher TSS and sunburn is correlated in sun-exposed apples but the relationship is not causal.
Water stress increases sunburn in apples due to an increase in fruit surface temperature.

EVALUATION OF NEW APPLE ROOTSTOCKS AND INTERSTEM COMBINATIONS IN GRABOUW (BREËVLEI).

X SIBOZA

Objectives & Rationale

The objective of this project is to assess the various new apple rootstocks (most from the Cornell Geneva range) that have recently become available against the industry standard M793, M7 and MM109. The use of GENEVA222 and M9 Emla as potential interstems will also be assessed.

Methods

More dwarfing (M9 Emla, NIC29, GENEVA222, M7, MM109/M9, MM109/GENEVA222, M793/M9, M793/GENEVA222, GENEVA778/M9, GENEVA778/GENEVA222) and more vigorous rootstocks (M7, GENEVA202, GENEVA778, M793, MM109, GENEVA228) were grouped together in two adjacent, but separate plantings. Trees were planted during spring 2013 using randomised complete block designs for both plantings. Trunk diameter and height increases were assessed as a measure of tree growth during winter 2015. Since all trees will again be trunk renewed, no crop is expected in 2016.

Key Results

There is not much to choose in tree height at the vigorous site although trees on CG228 are slightly shorter than the rest. However, it appears that trees on CG778 and CG228 are starting to grow more strongly, especially compared to M7. GENEVA rootstocks seem to invest less energy into xylem formation and are comparatively thinner than M-range rootstocks for trees of similar height. M7, CG778 interstem and CG222 trees at the dwarfing site seems to be growing more strongly while Nic29 and M793/M9 trees seem to be weaker. Trees at this weaker (poorer soil) site seem to invest more energy in xylem formation relative to vertical growth.

Conclusion / Discussion

None to date.

EVALUATION OF NEW APPLE ROOTSTOCKS AND INTERSTEM COMBINATIONS IN THE LANGKLOOF (HELDERWATER).

X SIBOZA

Objectives & Rationale

The objective of this project is to assess the various new apple rootstocks (most from the Cornell Geneva range) that have recently become available against the industry standard M793, M7 and MM109. The use of GENEVA222 and M9 Emla as potential interstems will also be assessed.

Methods

More dwarfing (M9 Emla, NIC29, GENEVA222, M7, MM109 / M9, MM109 / GENEVA222, M793 / M9, M793 / GENEVA222, GENEVA778 / M9, GENEVA778 / GENEVA222) and more vigorous rootstocks (M7, GENEVA202, GENEVA778, M793, MM109, GENEVA228) were grouped together in two adjacent, but separate plantings. Trees were planted during spring 2013 using randomised complete block designs for both plantings. Trunk diameter and height increases were assessed as a measure of tree growth during winter 2015. The first crop is expected in 2016.

Key Results

All trees were trunk renewed at the onset of the 2014/15 season. Excellent growth was achieved with all rootstocks in the trial for the second season in a row, despite a hail storm that severely damaged trees. The trend of GENEVA778 imparting more vigour to trees on dwarfing interstems seems to continue whereas the dwarfing effect of the M9 rootstocks seems to be strengthening. There is little difference between rootstocks in the vigorous planting, but M7 seems to be falling slightly behind in terms of growth. It also seems that GENEVA and M-range rootstocks might have different diameter: length ratios with the former generally being thinner for trees of the same height.

Conclusion / Discussion

None to date.

EVALUATION OF NEW APPLE ROOTSTOCKS AND INTERSTEM COMBINATIONS IN GRABOUW (OAK VALLEY).

X SIBOZA

Objectives & Rationale

The objective of this project is to assess the various new apple rootstocks (most from the Cornell Geneva range) that have recently become available against the industry standard M793, M7 and MM109. The use of GENEVA222 and M9 Emla as potential interstems will also be assessed.

Methods

More dwarfing (M9 Emla, NIC29, GENEVA222, M7, MM109/M9, MM109/GENEVA222, M793/M9, M793/GENEVA222, GENEVA778/M9, GENEVA778/GENEVA222) and more vigorous rootstocks (M7, GENEVA202, GENEVA778, M793, MM109, GENEVA228) were grouped together in two adjacent, but separate plantings. Trees were planted during spring 2013 using randomised complete block designs for both plantings. We measured scion diameter, tree height and number of shoots during winter 2015 as a measure of tree growth. Trees were not trunk renewed during winter 2014 and as a result, the first crop is expected in 2016.

Key Results

Data on the number of scaffold branches were probably affected by removal of overly strong lateral shoots during winter 2014 and need to be verified with data from the Breëvlei and Helderwater sites. CG778 trees were the tallest in the vigorous planting and also seem to impart considerable vigour to interstem trees in the dwarfing planting - M9 and CG222 interstem trees on CG778 were similar in size to trees on CG778. For trees of similar height in the vigorous planting, CG rootstocks generally seem to induce less diameter growth than trees on M-range rootstocks.

Conclusion / Discussion

None to date.

EVALUATION OF APPLE THINNING PROGRAMMES

X SIBOZA

Objectives & Rationale

The aim of this project is to evaluate chemical thinning agents and programmes over a number of seasons to develop an industry reference base on thinning results.

Methods

Thinning treatments in 2014/15:

Golden Delicious, Koue Bokkeveld

1. Control
2. Nevis @ 4mm fruit size
3. Nevis @ 14mm fruit size
4. 750 ml MaxCel @ 12mm fruit size

Fuji, Koue Bokkeveld

1. Control
2. Nevis @ 4mm fruit size & Nevis 7 days later
3. PoMaxa @ Petal drop & Nevis 7 days later
4. PoMaxa @ Petal drop, PoMaxa + MaxCel (500 ml) 7 days later, Sevin 3 days later
5. Nevis @ 4mm & MaxCel (750 ml) 7 days later

Key Results

Conditions for thinning treatment application and action were optimal. All three chemical thinning treatments significantly decreased Golden Delicious yield while increasing fruit size. Nevis @ 4 mm had the greatest effect on fruit size.

In Fuji, despite significant thinning, Nevis @ 4 mm & MaxCel (750 ml) 7 days later did not significantly decrease yield or yield efficiency compared to the control and also significantly increased fruit size.

Conclusion / Discussion

In Golden Delicious, all three chemical thinning treatments significantly decreased yield with a concomitant increase in

EVALUATE REST BREAKING PROGRAMMES FOR WARM WINTER REGIONS

X SIBOZA

Objectives & Rationale

The objective is to determine the effectiveness of RBA programmes to alleviate delayed foliation symptoms in the EGVV area and to assess effects on yield and fruit quality.

Methods

Thinning treatments in 2014/15:

Golden Delicious, Koue Bokkeveld

RBA treatments in 2014/15:

Fuji:

1. 3% Dormex
2. 0.5% Dormex + 3% Oil
3. 1% Dormex & 5% Oil 7 days later
4. 0.5% Lift + 1% Oil + 1% KNO3 + 0.5% Dormex
5. 2% LB Urea + 2% KNO3 & 0.5% Dormex + 3% Oil 7 days later

Golden Delicious Reinders®:

1. 1% Dormex + 4% Oil
2. 3% Dormex
3. 1% Dormex & 0.5 % Dormex + 4% oil 7 days later
4. 0.5% Lift + 1.5% Oil + 1% KNO3 + 0.5% Dormex

Key Results

Fuji

3% Dormex® had a fruit thinning effect. 2% LB Urea + 2% KNO3 & 7 days later 0.5% Dormex® + 3% Oil was as an effective rest breaking treatment and might have performed even better if conditions after the 2nd application date were warmer.

Golden Delicious Reinders®

1% Dormex® + 4% Oil was the most effective treatment but decreased yield. 0.5% Lift + 1.5% Oil + 1 % KNO3 + 0.5% Dormex was equally effective in stimulating vegetative bud break. 3% Dormex® advanced but decreased total bud break.

Conclusion / Discussion

Combinational "softer" treatments, e.g. 2% LB Urea + 2% KNO3 & 7 days later 0.5% Dormex® + 3% Oil, could be as effective as standard treatments in 'Fuji'. The potential thinning effect of Dormex® was noted.

APPLE REPLANT ROOTSTOCK TRIALS FOR DETERMINING A SCREENING TECHNIQUE

K BEZUIDENHOUT

Objectives & Rationale

The objective of this study is to quantify the variation in apple rootstock genotypes regarding resistance/tolerance to ARD.

Methods

Rootstocks from the Cornell Geneva range (CG3007, G778, G202) and standard industry rootstocks (M793, M7, MM109) were investigated under ARD conditions in field trials in Elgin.

Key Results

At Glen Fruin, MM109 and G778 planted in fumigated soil showed the most trunk growth. For both trunk and shoot growth, G222 and CG3007 in unfumigated soil performed worst. At Vergelegen, trunk growth differed significantly between rootstocks with the Malling rootstocks and G778 showing the most growth and G222, G202 and CG3007 showing the least. Total shoot growth did not show significant differences between rootstocks, but there was a clear trend for CG3007 showing the least growth.

At Glen Fruin no significant differences were noted in the percentage growth difference between the various rootstocks, but MM109, M793 and G778 seemed most susceptible. The percentage increase in trunk growth indicated possible tolerance for G222, G202 and CG3007 while the percentage increase in total growth indicated M7, CG3007 and G222 to be more tolerant to ARD. At Vergelegen the percentage increase in trunk growth showed MM109 to be most susceptible, while the increase in total growth showed CG3007 most susceptible. No clear trends could be deducted with regards to tolerance.

Conclusion / Discussion

From the percentage increase in growth, G222 and M7 seems to be more tolerant, while results with G778 varied at the two sites. MM109 and M793 seems most susceptible during the current trial.

THE EFFECT OF DIFFERENT COVER CROP MANAGEMENT PRACTICES ON THE SOIL AND PERFORMANCE OF APPLE TREES

J FOURIE

Objectives & Rationale

Industry indicated a need to improve the health of orchard soils. The study aims to supply guidelines for soil management practices that will improve soil health and promote sustainable apple production.

Methods

The nematode and soil nutrient status, cover crop performance and weed control efficacy, as well as tree performance and nutrient status, were monitored

Key Results

Cephalobidae (bacterial feeding nematodes) remained the most abundant in all treatments. The plant-parasitic nematodes *Pratylenchus* and Trichodoridae were frequent in the tree row of all treatments, with high numbers recorded where the legume Ornithopus sativus cv Emena was established as cover crop. Lower numbers of plant-parasitic nematodes in the work row than in the tree row indicated that the cover crops were not good hosts. The soil nutrient status indicated that P, K and N still needs to be applied. The annual cover crops tended to promote a faster build-up of organic C in the soil and created conditions under which inorganic N is more readily available to the trees during the growing season. Conyza bonariensis (flax-leaf fleabane), a herbicide-resistant broadleaf weed (annual), was first detected in all the treatments during September and dominated the spectrum in all treatments by March 2015. The trees were adequately supplied with nutrients (K, Ca, Fe and B were slightly below the norm). Tree growth did not differ between treatments. However, slight trends started developing.

Conclusion / Discussion

The project should continue, to determine whether the observed trends will manifest stronger over time.

COST EFFECTIVENESS OF WORKER PLATFORMS AND HARVESTING SYSTEMS RELATIVE TO CONVENTIONAL, LABOUR INTENSIVE FARMING PRACTISE

W STEYN

Objectives & Rationale

Farmers are experiencing a cost-price squeeze. Labour is the single biggest on-farm expense item. The future availability of labor is a further concern. The aim of the study was to determine how the use of harvesting systems and platforms could decrease input costs and increase profitability for SA deciduous fruit producers. We wanted to determine the realistic potential of these machines for various orchard and management practices and identify changes needed to facilitate automation in the orchard.

Methods

The impact of harvesting systems and laborer platforms on fruit quality were assessed when harvesting, as well as laborer productivity when performing orchard actions requiring the use of ladders. Harvesting systems and laborer platforms were compared to conventional labor practices. Trials were done on stone and pome fruit farms throughout the Western Cape.

Key Results

Harvesting systems showed potential to decrease bruising on hardy apple cultivars, but since conventional teams incur little bruising on these cultivars, the scope of improvement is small. Similar or even higher injury levels were obtained on more sensitive cultivars despite conventional teams also incurring higher injury levels on these cultivars, leaving much room for improvement.

Conventional teams achieve very high picking productivity for hardy cultivars whereas outputs are lower for sensitive cultivars. Harvesting systems reached an upper limit of 150 kg per picker per hour when strip picking, regardless of cultivar hardiness, due to a misalignment between orchard and machine design that result in a very inefficient picking action. The number of picking cycles that can be completed is limited, which in turn limits the weight of fruit that can be picked in that time. Furthermore, factors such as tree size, shape and uniformity, fruit distribution on the tree, fruit size and quality, orchard floor condition and aspect, labor team dynamics, harvesting incentives, bin condition, operational system employed and harvest logistics all affected the overall productivity and efficiency of the harvesting systems.

Laborer platform was substantially increased the productivity of summer pruning compared to laborers on ladders. Dormant pruning and fruit thinning with laborer platforms also showed productivity gains, but to smaller extent depending on the pruning/ thinning strategy employed and tree architecture. In general, narrower and younger trees showed larger productivity gains.

Conclusion / Discussion

Laborer platforms can increase laborer productivity for certain orchard tasks but substantial gains in harvesting productivity through mechanization are not a possibility in the near future. Producing, and more specifically, harvesting deciduous fruit for the fresh market will likely remain a labor intensive process. Producers should focus on investing in labor-related factors such as laborer training, motivation and satisfaction together with the careful implementation of new technologies such as laborer platforms. Simplified pruning and thinning strategies would maximize productivity gains when using laborer platforms. More simplified tree structures, possibly on more dwarfing rootstocks and with concomitant improvement in fruit quality could substantially increase labor productivity local orchards, with or without mechanization. Current orchard systems, particularly in the case of pome fruit, are quite ineffective.

SCREENING OF APPLE ROOTSTOCKS FOR RESISTANCE TO WOOLLY APPLE APHID

C COSTA

Objectives & Rationale

The objective of this year's work was to obtain and prepare the remainder of the range of apple rootstocks via micro-propagation for pot trials under controlled conditions in order to determine their comparative resistance and/or tolerance to woolly apple aphid (WAA).

Methods

Methodology entails the bulking up of plants via in vitro technique from mother plants, rooting of genotypes, establishment and hardening off under greenhouse conditions, then transplanting into larger bags and transferring to netted shade-house for inoculation with WAA samples collected in specific orchards. Trees of at least 40 cm high are inoculated with WAA to ensure accurate measure of resistance and tolerance.

Key Results

To date we have succeeded in establishing the originally selected 24 genotypes in vitro, 2 of which are recalcitrant and still in the proliferation stage, while 22 have passed the rooting stage and 21 have been transplanted into planting bags. Of these, 20 had reached sufficient size to be inoculated with WAA in autumn 2015. Counts and growth measurements to determine infestation have still to be done, since trees have entered dormancy during winter, with WAA inactive.

Conclusion / Discussion

The work plan has already been extended by a year because of difficulty in propagating some of the selections. Another year will be required to complete the work, although additional funding from industry will not be required since funds will be carried over from the previous year for completion..

CHEMICAL THINNING OF PEARS

X SIBOZA

Objectives & Rationale

The objective is to develop chemical thinning programmes for pears that would minimize hand thinning and result in regular, good quality yields.

Methods

Thinning treatments in 2014/15:

'Abate Fetel' orchard in the Ceres region: Nevis @ 4mm, Nevis @ 14mm, Nevis @ 4mm + Nevis @ 14mm, PoMaxa @ petal drop + MaxCel 7 days later, and a control (hand thinning). 'Forelle' orchard in the Wolseley region: Nevis @ 4mm, Nevis @ 4mm & Nevis @ 12mm, Nevis @ 4mm & MaxCel @ 12mm, PoMaxa @ petal drop & MaxCel 7 days late, and a control (hand thinning).

Key Results

Chemical thinning was ineffective in 'Abate Fetel'. Despite none of the treatments affecting fruit set, hand thinning requirement of yield, a single of two Nevis applications increased fruit size in 'Forelle'. Return bloom was not affected by treatments.

Conclusion / Discussion

Chemical thinning of 'Abate Fetel' was ineffective. Chemical thinning with Nevis @ 4 mm increased fruit size in 'Forelle' without a discernible thinning effect, which might be due to the very protracted thinning effect (i.e., fruit drop) observed in pears.

EVAPOTRANSPIRATION OF HIGH PERFORMANCE APPLE TREE ORCHARDS

T VOLSCHENK

Objectives & Rationale

Information on orchard water use is crucial for irrigation scheduling and on-farm water management to ensure growth and sustainability of the fruit industry. The WRC/HORTGROScience study proposes a multi-disciplinary approach to establish water use by high performing orchards and orchards at different growth stages from planting to full-bearing age and to develop models to extrapolate the results of the study to other apple cultivars and growing regions in the country.

Methods

Determine soil physical properties (texture and chemical analysis, soil water retention curves) of four orchards. Install and calibrate soil water content sensors, monitor soil water content throughout the season and calculate evapotranspiration according to a soil water balance for unstressed young non-bearing and full-bearing Golden Delicious apple orchards in the Koue Bokkeveld and EGVV regions over three seasons.

Key Results

During 2014/15 in the Koue Bokkeveld, orchard ET reached a maximum of c. 4.6 and c. 5.5 mm/d for the non-bearing and full bearing Golden Delicious orchards, respectively, on sandy loam soils. In the full-bearing orchard maximum tree row and work row ET (evaporation, transpiration of the tree, cover crops and weeds) amounted to c. 6.7 mm/d and 7.7 mm/d, respectively. Maximum ET in the non-bearing tree row was c. 6.3 mm/d during the season and 3 mm/d in the work row (weeds). Periodic excessively wet or water deficit conditions may have decreased ET below the optimum.

Conclusion / Discussion

Soil water status should be taken into account when the evapotranspiration data collected through Eddy covariance and sap flow techniques are interpreted and reported.

Crop Protection

The Crop Protection research program has been successful in many ways during the past season. A number of significant research projects were completed and current research projects are yielding good results.

The research projects underway are listed in Table 1. The projects include research on nematology, plant pathology and entomology. A number of projects are addressing urgent market access and Post Harvest pathology issues. What is of interest is the development of a number of projects that are now multidisciplinary and are linked to research aspects in both Post Harvest and crop production.

TABLE 1. RUNNING PROJECTS

RESEARCHER	*PROJECT TITLE*
Entomology	
Dr C Weldon	Dispersal capacity of *Bactrocera invadens*
Dr A Malan	Incorporating of entomopathogenic nematodes and fungi in an integrated pest management system for the control of codling moth
Dr A Malan	Ring nematode *(Criconemoides xenoplax)* distribution, characterisation and culture methods
Prof J Terblanche	Thermal physiology and population dynamics of bollworm *(Helicoverpa armigera)* in South African fruit orchards
Dr P Addison	Forecasting *Bactrocera invadens* invasion potential using trait-based modelling approaches
Dr P Addison	Integration of GIS and spatial analysis with monitoring data of major pests for the purposes of area-wide pest management
E Allsopp	Investigating the use of semiochemicals for IPM of western flower thrips
Dr J Heunis	Biological control : Banded fruit weevil *(Phlyctinus callosus)* culture methods
Dr J Heunis	Chemical control : Determination of insecticide resistance levels in mealy bug populations
Dr J Heunis	Monitoring of mites in pear orchards
Dr K Pringle	*Bactrocera invadens:* Pest Risk Analysis for the deciduous fruit industry in the South Western Cape
M Addison	Integrated use of sterile codling moths and fruit flies in apple and pear orchards
M Addison	Inundative release of *Trichogrammatoidea lutea* in apple and pear orchards treated with sterile codling moth
M Addison	Pest and disease monitoring in orchards under shade net

TABLE 1. RUNNING PROJECTS CONTINUED

RESEARCHER	PROJECT TITLE
	Entomology
Dr S Johnson	Grain chinch bug *(Macchiademus diplopterus)* thermal biology and the implications for Post Harvest control measures
Dr S Johnson	Controlled atmosphere temperature treatment system (CATTS) as a Post Harvest treatment for phytosanitary pests of deciduous fruit
S van Zyl	Factors affecting chemical application to improve pome and stone fruit disease and pest management
	Nematology
Dr A Malan	Bin and orchard treatment with entomopathogenic nematodes and short and long term monitoring for codling moth
Dr A Malan	Bioprospecting of natural ecosystems for entomopathogenic nematodes
N Stokwe	Potential control of the woolly apple aphid *(Eriosoma lanigerum)* using entomopathogenic nematodes
S Storey	Nematode community structure and function as a bio-indicator of the effects of soil amendments on soil health
Dr A de Klerk	Control and management of lesion nematodes in apple layer beds and nurseries
Prof J Terblanche	Entomopathogenic nematode thermal tolerance and performance: experimental manipulation for increased efficacy
	Plant pathology
Prof A McLeod	Determining the rainfastness of mancozeb on apple leaves, and its correlation with fluorescent pigment particle deposition and suppression of apple scab
K Bezuidenhout	Screening apple rootstocks for tolerance to Phytophthora crown rot
Dr L Mostert	Survey of stem cankers and dieback symptom of young apple trees and possible inoculum sources
Dr C Lennox	Development of a fungicide resistance monitoring service for SA pome fruit pathogens
Prof A McLeod	Identification of inoculum sources of oomycetes, a major contributor to apple replant disease, and the management thereof
Dr C Lennox	Development of a fungicide resistance monitoring service for SA pome fruit pathogens
Dr C Lennox	Incidence and epidemiology of bull's eye rot of apples in South Africa. Ext request to Sep 2014
T Koopman	Determination of apple scab races occurring in South African apple growing regions to underpin breeding

The number of new research project that were proposed this season was impressive, and the selection and prioritization process was active. The end result was that 10 new projects were funded. New entomology projects include initial research on the use of entomopathogenic nematodes and fungi to control orchard pests, the assessment of new apple scab management methods and detailed research on lesion nematodes. False codling moth is also receiving attention as it is emerging as an important phytosanitary pest on overseas markets. The culture and maintenance of insect colonies is seen as a critical element in the applied research programme.

TABLE 2. PROPOSED INDUSTRY FUNDED PROJECTS FOR 2016

RESEARCHER	*PROJECT TITLE*
	Entomology
Dr D Stenekamp	Maintaining and rearing of insect cultures
Dr D Stenekamp	Control of false codling moth, *Thaumatotibia leucotreta*, on stone fruit with mating disruption
Dr M de Villiers	Phytosanitary status of false codling moth, *Thaumatotibia leucotreta (Meyrick) (Lepidoptera: Tortricidae)* on pears
Dr P Addison	Using biological control (fungi and nematodes) against two sporadic pests in vineyards and orchards
Dr P Addison	Integrated management of the control of false codling moth, *Thaumatotibia leucotreta*, on deciduous fruit, with focus on biological control
Dr P Addison	Biological control of fruit flies using entomopathogenic fungi and nematodes as well as parasitic wasps
Dr S Johnson	CATTS as a postharvest treatment for chill sensitive plum cultivars and associated phytosanitary insect pests
Dr S Johnson	Investigating the potential of ethyl formate fumigation for phytosanitary control of the grain chinch bug on pome and stone fruit
	Nematology
L van der Walt	A survey to determine the *Pratylenchus spp.* present in South African apple orchards
	Plant pathology
Prof A McLeod	Evaluating an ascospore release forecasting model and orchard disease monitoring methods for improving apple scab management

As noted previously, the demands on crop protection research are high. The threat posed by *Bactrocera dorsalis* and the phytosanitary status of false codling moth are concerning. The spread and effects of American Foul Brood on local honey bee populations is being monitored. The disease poses a significant risk to the bee industry and may result in reduced pollination. The integration of research into broader research themes is encouraging. Soil health is one such theme which is developing rapidly, the results of the research will be of great relevance to the industry.

I would like to thank both SAAPPA and SASPA for their support during the past year, without which the above would have been impossible. I would also like to thank all of those involved in the Crop Protection research programme for their hard work and dedication.

Matthew Addison

RING NEMATODE (CRICONEMOIDES XENOPLAX), DISTRIBUTION, CHARACTERIZATION AND CULTURE METHODS (PPN-1) - (NEW PROJECT)

A MALAN

In the Western Cape, ring nematode, *Criconemoides xenoplax*, is regarded as the most important nematode pest of grapevine and stone fruit. Although the family *Criconematidae consists* of many species, agricultural activity favours high numbers of ring nematode in vineyards and orchards. As these nematodes are difficult to control chemically, there is a drive toward the search for resistance as a solution to the problem. However, little is known either of the occurrence, or of the molecular and morphological differences, of ring nematodes in the different deciduous fruit-producing regions. As the nematode in question is unique, it is also difficult to culture in large numbers.

We are currently in the process of reviewing all available literature regarding different aspects of *Criconemoides xenoplax* (ring nematode) on stone fruit. Information of soil sample analysis for nematode numbers of ring nematode of Nemlab and Infruitec-Nietvoorbij are in the process of being analysed. An Access database of results of Nemlab sample analysis has been designed and currently the data of starting form 2015 backwards are imported, sorted and combine. A correspondence analysis will be applied to the data using main factors of variance.

DETERMINING THE RAIN FASTNESS OF MANCOZEB ON APPLE LEAVES AND THE DEVELOPMENT OF A BENCHMARK SPRAY DEPOSITION MODEL FOR APPLE SCAB

A MCLEOD

Objectives & Rationale

The contact fungicide mancozeb forms an integral part of apple scab *(Venturia inaequalis)* management in South Africa. Effective fungicide spray deposition is required for optimal disease management. It is important to link spray deposition to biological activity by developing a spray deposition benchmark model. Rainfall is an important factor that influences disease control by foliar applied pesticides. The objectives of this study will be to first develop a spray deposition benchmark model for apple scab and mancozeb using macrophotography, fluorometry and image analyses. The second objective will be to investigate the rain fastness of two different manocozeb products, and one mancozeb product to which a sticker (Nu-film) has been added.

Methods

The in vitro production of *V. inaequalis conidia* was investigated using a cellophane technique. The inoculation and quantification of *V. inaequalis* infection on apple seedling leaves were done using a sprayed conidial suspensions, staining and digital macrophotography. The rain fastness of the two mancozeb products was studied by quantifying the percentage fluorescent pigment loss using macorphotography, fluorometry and image analyses and the percentage loss in mancozeb residues.

Key Results

The most important factor influencing the viability and quantity of in vitro produced *V. inaequalis conidia* seems to be the time of incubation. An inoculation and quantification method of *V. inaequalis* on apple seedlings has been develop that shows potential for use in the development of the benchmark model. Preliminary studies showed that mancozeb seems to be relative rain fast, irrespective of the type of mancozeb product used, when a volume of 1mm of rain is applied at heavy rain intensity (5mm/h). However, at a rain volume of 5mm, the loss almost doubles, where after is remains more or less stable after 10 or 15mm of rain.

Conclusion / Discussion

The cellophane technique shows promise for the in vitro production of *V. inaequalis conidia*, which is required for the development of a benchmark model. A deposition benchmark model for apple scab and mancozeb has not been developed, due to problems with the identification of a robust laboratory method for inoculating and quantifying *V. inaequalis* infections on apple seedling leaves. Preliminary results show that mancozeb is relative rain fast when 1mm of rain is applied, but after 5mm of heavy rain (5mm/h), some substantial loss occurs.

IDENTIFICATION OF INOCULUM SOURCES OF OOMYCETES, A MAJOR CONTRIBUTOR TO APPLE REPLANT DISEASE, AND THE MANAGEMENT THEREOF

A MCLEOD

Objectives & Rationale

Only a few surveys for the occurrence and distribution of entomopathogenic nematodes (EPNs) in South Africa have been conducted. In each survey new species and new rapports of EPNs have being found. The aim of this study is to determine the occurrence, and the distribution, of EPNs in South Africa. The objectives that are aimed at in this study include finding new, low-temperature-adapted EPN isolates to be used against key pests (especially codling moth), during the winter months.

Methods

EPNs are trapped from soil samples using hosts such as mealworm, wax moth, codling moth and false codling moth larvae. Positive samples are placed on White traps and infective juveniles were collected, stored and periodically recycled till a positive identification has being made. DNA is extracted from a first generation female or hermaphrodite and the sequences generated are blasted on Genbank. New species are being described in full using both molecular, SEM, morphometric and morphological techniques.

Key Results

New species isolated and being published a full descriptions include S. sacchari Nthenga, Knoetze, Berry, Tiedt & Malan, 2014, H. noenieputensis Malan, Knoetze & Tied, 2015, *S. jeffreyense* Malan, Knoetze & Tied, 2015 and a further three new *Steinernema* species are in the process of being described.

Conclusion / Discussion

Commercially available species, such as *S. feltiae*, *S. carpocapsae*, and *H. megidis* have not yet been isolated from any of our soils. South Africa seems to be very diverse regarding the occurrence of entomopathogenic nematodes, which needs to be isolated, identified and tested for their potential as pathogens of key deciduous fruit pest insects.

BIOPROSPECTING OF NATURAL ECOSYSTEMS FOR ENTOMOPATHOGENIC NEMATODES

A MALAN

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FIELD AND BIN APPLICATION OF ENTOMOPATHOGENIC NEMATODES FOR THE CONTROL OF CODLING MOTH (CYDIA POMONELLA, LEPIDOPTERA: TORTRICIDAE)

A MALAN

Objectives & Rationale

The aim of this project is to control codling moth (CM) in the South African pome fruit, in an environmentally friendly way, using entomopathogenic nematodes (EPNs). To this end, environmental factors influencing EPN efficacy were investigated in the field and laboratory. The first objective was to identify which nematode isolates effectively control diapausing CM larvae under field conditions, while the second objective was to assess the effect of spray application, and the last objective was to investigate the potential of two imported, and one local, EPN species to disinfest wooden fruit bins of CM larvae.

Methods

Apple orchard field trials were conducted at the Welgevallen Experimental Farm in Stellenbosch. Cages that were filled with apple bark and CM larvae were used as an evaluation method. After having been kept moist by spraying with water every 2 h for the first 6 h, they were removed from the field after 24 h. In laboratory trials, after the cages were pre-wet, they were either dipped in, or sprayed with, inoculum. They were then placed in a growth chamber following a cycle of 22°C for 4h, 10°C for 12h, and 22°C for 8h at 100% humidity. After the pre-wetting of miniature wooden fruit bins and planks, made from old bin wood and infested with CM larvae, they were dipped into the nematode suspension, and placed in separate 2-L plastic containers lined with moist paper towels, which were then closed with a lid. The containers were then placed in a growth chamber at 25°C for 3 days.

Key Results

In vivo produced *Steinernema yirgalemense* resulted in a higher CM control (>90%) than did *H. bacteriophora*, while *S. feltiae* gave better control than did *S. yirgalemense* and *Heterorhabditis bacteriophora* in both field and laboratory trials. Humidity seemed to be the most important factor affecting EPN efficacy against the CM. It can, therefore, be concluded that *H. bacteriophora* will not be suitable for the field control of CM. *Steinernema feltiae* were found to perform better at lower temperatures. This study has highlighted the biocontrol potential of *S. jeffreyense* in a field trial. In the bin trials, using low nematode concentrations, the highest percentage of control was obtained using *S. feltiae* (75%) followed by *S. yirgalemense* (57%), and then by *H. bacteriophora* (28%). The addition of adjuvants significantly increased *S. feltiae* infectivity to >95%, whereas it did not result in a significant increase in levels of *H. bacteriophora* or *S. yirgalemense* infectivity.

Conclusion / Discussion

Relative humidity and temperature are the main factors influencing the effectiveness of EPNs in the Western Cape province. *Steinernema feltiae* proved to be the most effective candidate for the control of diapausing CM, as it is climatically better adapted to lower temperature regimes. *Steinernema yirgalemense* and *S. jeffreyense* are the most promising local candidates, and future studies should compare their efficacy with that of *S. feltiae. H. bacteriophora* is not recommended for use in the Western Cape, as it resulted in poor control of CM larvae. Further research should aim at identifying a suitable EPN application technique for use in orchards, which will not only be compatible with the EPN isolate used, but which will also ensure good coverage of fruit trees.

INCORPORATING ENTOMOPATHOGENIC NEMATODES AND FUNGI IN AN INTEGRATED PEST MANAGEMENT SYSTEM FOR THE CONTROL OF CODLING MOTH

A MALAN

Codling moth (CM), *Cydia pomonella (L.)*, is the most important insect pest of apples and pears in South Africa. Currently, mating disruption and chemical control is currently the standard practice of control. The use of entomopathogenic fungi (EPF) as an additional biological tool for the control of CM has not yet been fully exploited in South Africa. Further research into the use of EPNs under suboptimal environmental field conditions, and into the use of EPF in an integrated pest management (IPM) system, is required. Promising isolates will be obtained from the ARC in Bethlehem and commercial formulations of fungi will be obtained of *Metarhizium anisopliae* and *Beauveria bassiana*. Soil samples will be trapped by using codling moth, mealworm and wax moth larvae. All fungi and nematodes will be isolated, purified and identified using morphological and molecular techniques. Different bioassays with nematodes and fungi together or inoculations at different time intervals will be conducted. Lethal dose assays and environmental conditions requirement with regard to temperature and humidity will be further investigated. Semi field trials will be done with fungi alone and in combination with EPNs. These trials will consist of four treatments with eight tree replicates per treatment in a complete randomized design.

This is a new project is still in the preparation phase and no results are yet available.

IDENTIFICATION OF INOCULUM SOURCES OF OOMYCETES, A MAJOR CONTRIBUTOR TO APPLE REPLANT DISEASE, AND THE MANAGEMENT THEREOF

A MCLEOD

Objectives & Rationale

The major apple replant disease (ARD) pathogens in South Africa consist of oomycetes, with plant parasitic nematodes also sometimes being involved. The project will determine whether nursery trees and irrigation water are inoculum sources of replant pathogens. The second aim will be to determine whether semi-selective chemicals (phenylamides, fenamiphos and phosphonates) can increase tree performance in orchards established on ARD non-fumigated and fumigated soils. The third aim will be to determine the best time and method of application for phosphonate treatment of non-bearing apple trees, and whether oomycete replant pathogens are sensitive to phosphite.

Methods

Inoculum sources will be investigated using conventional isolation and DNA based methods. The efficacy of ARD management with phenylamides, fenamiphos and phosphonates (semi-selective chemicals) will be evaluated under orchard conditions using tree growth performance and pathogen quantification. The effect of timing and method of phosphonate applications will be evaluated by measuring root phosphite concentrations. The sensitivity of different oomycete ARD pathogens to phosphite will be determined in vitro and in a root-bioassays.

Key Results

Nursery trees were frequently associated with the known replant pathogens *Pythium* irregulare and *Pratylenchus spp.*, but *Pratylenchus* contamination was much lower than in the 2013 survey. Although weakly and moderately virulent *Pythium* species were detected in irrigation dams and drip/sprinkler systems within orchards, the frequency was very low, especially within orchards. Based on the results of two field trials that are now in their second year of growth, the application of semi-selective chemicals show potential for managing ARD on non-fumigated soil. This response in only evident in the second year of tree growth, but not within the first year.

Conclusion / Discussion

Nursery trees are a source of apple replant pathogens, specifically *P. irregulare* and *Pratylenchus spp.* Irrigation water is not a major source of apple replant pathogens. Semi-selective chemicals may have potential for managing ARD, but continued tree growth measurements are required since the trees are now only in their second year of growth.

DETERMINING THE RAIN FASTNESS OF MANCOZEB ON APPLE LEAVES AND THE DEVELOPMENT OF A BENCHMARK SPRAY DEPOSITION MODEL FOR APPLE SCAB

A MCLEOD

Objectives & Rationale

The contact fungicide mancozeb forms an integral part of apple scab *(Venturia inaequalis)* management in South Africa. Effective fungicide spray deposition is required for optimal disease management. It is important to link spray deposition to biological activity by developing a spray deposition benchmark model. Rainfall is an important factor that influences disease control by foliar applied pesticides. The objectives of this study will be to first develop a spray deposition benchmark model for apple scab and mancozeb using macrophotography, fluorometry and image analyses. The second objective will be to investigate the rain fastness of two different manocozeb products, and one mancozeb product to which a sticker (Nu-film) has been added.

Methods

The in vitro production of *V. inaequalis conidia* was investigated using a cellophane technique. The inoculation and quantification of *V. inaequalis* infection on apple seedling leaves were done using a sprayed conidial suspensions, staining and digital macrophotography. The rain fastness of the two mancozeb products was studied by quantifying the percentage fluorescent pigment loss using macorphotography, fluorometry and image analyses and the percentage loss in mancozeb residues.

Key Results

The most important factor influencing the viability and quantity of in vitro produced *V. inaequalis conidia* seems to be the time of incubation. An inoculation and quantification method of *V. inaequalis* on apple seedlings has been develop that shows potential for use in the development of the benchmark model. Preliminary studies showed that mancozeb seems to be relative rain fast, irrespective of the type of mancozeb product used, when a volume of 1mm of rain is applied at heavy rain intensity (5mm/h). However, at a rain volume of 5mm, the loss almost doubles, where after is remains more or less stable after 10 or 15mm of rain.

Conclusion / Discussion

The cellophane technique shows promise for the in vitro production of *V. inaequalis conidia*, which is required for the development of a benchmark model. A deposition benchmark model for apple scab and mancozeb has not been developed, due to problems with the identification of a robust laboratory method for inoculating and quantifying *V. inaequalis* infections on apple seedling leaves. Preliminary results show that mancozeb is relative rain fast when 1mm of rain is applied, but after 5mm of heavy rain (5mm/h), some substantial loss occurs.

SCREENING APPLE ROOTSTOCKS FOR TOLERANCE TO PHYTOPHTHORA CROWN ROT

K BEZUIDENHOUT

Objectives & Rationale

This project aims to test apple rootstocks for tolerance to crown rot (Phytophthora cactorum) as part of an integrated disease management strategy.

Methods

We tested the viability of isolates using an excised shoot technique. Shoots from a resistant rootstock (MM109) and a susceptible rootstock (MM106) were cut in 20cm lengths and were wound inoculated. The shoots were incubated in the laboratory and lesion lengths were measured after 14 days. Re-isolations were performed to confirm the presence of the pathogen.

Key Results

No results are available since the testing is still underway.

Conclusion / Discussion

No conclusion can be made since the project has only been running for four months.

DISPERSAL CAPACITY OF BACTROCERA DORSALIS

C WELDON

Objectives & Rationale

This project will establish the dispersal capacity of an invasive fruit fly, *Bactrocera dorsalis*. Knowledge of dispersal capacity represents is important for determining the size of buffer zones surrounding pest-free areas.

Methods

Two research objectives are currently being addressed: to determine the best pigment dose and colours for marking *B. dorsalis* in dispersal experiments, and to establish the dispersal capacity of *B. dorsalis* in relation to sex, maturity and environmental variables. In addition, flight mills have been built to address how flight of *B. dorsalis* is affected by temperature to aid in understanding field dispersal results.

Key Results

Research to date indicates that a pigment dose of at least 2 g/L pupae is suitable for marking *B. dorsalis* for at least two weeks before beginning to fade. The first of four releases for the dispersal study has been completed. Two shipments of 30,000 sterile *B. dorsalis* pupae of African origin were received from the International Atomic Energy Agency, marked with fluorescent pigments (2g/L), and released at three sites near Louis Trichardt, South Africa. Recaptures indicate a typical dispersal curve, with recaptures high at the origin and declining with distance, but with recaptures being caught further out with time.

Conclusion / Discussion

The optimal dose of fluorescent pigment for marking *B. dorsalis* is 2g/L, which remains visible in field-released flies for at least two weeks. This pigment dose is now being used to mark flies released for dispersal studies.

MONITORING PHYTOPHAGOUS MITES IN PEAR ORCHARDS IN THE CERES AREA

J HEUNIS

Objectives & Rationale

Farmers reported difficulty with the control of pest mites on pears in the Ceres area. To determine when and if insecticides must be applied the development of *phytophagous* mite populations on different pear cultivars needed to be investigated for the development of an action threshold.

Methods

Phytophagous mites (Tetranychus urticae and Panonychus ulmi) and their predators were monitored as described by Pringle & Giliomee (1992). Monitoring was done in Bosc, Packham's Triumph and Early *Bon Chretien* pear orchards to investigate the development of scorching of pear leaves in different susceptible pear cultivars. During the first season monitoring was done every second week but thereafter every week as mite numbers can increase to damaging levels in a short period. The degree of leaf scorching was also noted on the susceptible pear cultivars.

Key Results

The number of *phytophagous* and predatory mites differed between seasons, cultivars and orchards indicating why it is important to use a monitoring system for their management. For the efficient control of mites orchardists have to monitor their mites regularly and only spray when necessary depending on the activity of predatory mites and if high temperatures are expected. Correct irrigation of orchards can minimise the development of scorching and the development of high mite numbers as they develop faster in trees under stress. The management of the cover crop is also important as spraying herbicides at the wrong time can cause high mite numbers early in the season in the pear trees which will lead to the development of early scorching and probably leaf drop. When severe this could have an influence on the crop of the following season.

Conclusion / Discussion

As different pear cultivars are not all equally susceptible to the development of scorching as a result of mite feeding, these cultivars have to be monitored over few seasons with more replicates to develop a reliable action threshold for the control of mites.

BIOLOGICAL CONTROL: BANDED FRUIT WEEVIL (PHLYCTINUS CALLOSUS) CULTURE METHODS

J HEUNIS

Objectives & Rationale

The development of a rearing technique for the production of large numbers of banded fruit weevil (BFW) is necessary before different biological control measures of BFW can be investigated.

Methods

Adult BFW were collected from corrugated carton strips secured around apple trees. Adults were kept on Coprosma plants in Perspex cages according to the method of Ferreira (2010) at room temperature in the laboratory at 23°C. Eggs were collected from moistened cotton wool disks placed with adults twice a week. All eggs were removed from disks under a microscope and placed on a moist filter paper disk inside a petri dish. Eggs were kept in a cool room under 5 °C until enough eggs were collected and then placed in the laboratory at room temperatures for emergence. After emergence larvae were placed onto carrots (Ferreira 2010) planted in course river sand. Final instar larvae or pupae were removed from the sand and kept in peat moss (Horne & Stackpoole 1989) until adults emerged.

Rearing larvae from emergence on carrots placed on peat moss was examined with different treatments. Dipping carrots into Sporekill to postpone fungal growth on carrots was tested to see whether or not there was an effect on the survival of BFW larvae. Survival of different numbers of larvae per container was also investigated.

Key Results

The number BFW that developed after they emerged from the egg to final instar larvae with carrots planted in sand was very low (at most 60%). Low survival in this experiment could be due to desiccation or not enough food as the carrots started rotting without it being visible above ground.

Fruit weevil larvae that were placed on carrots on top of peat moss were reared successfully from emergence up to the adult stage but survival varied. Larvae and pupae reared during these experiments were supplied for preliminary bioassays with entomopathogenic nematodes (EPN's).

Conclusion / Discussion

Adult weevils must be collected from November to January when most adults are present in the apple trees.

Rearing larvae on carrots on peat moss for biological control experiments have the following advantages:

1. The food source can easily be replaced without disturbing most of the larvae.
2. It is clear when the food source must be replaced.
3. Collection of the larvae is easy and not time consuming.
4. Larvae are not easily damaged when collected.
5. Larvae of the same size can be selected for experiments to minimise variability and smaller larvae placed back with carrots.
6. It is easy to determine what size larvae reached as they are visible under carrots without having to wash them out of sand.
7. When pupae are needed for testing pupae can easily be spotted in pupal cells on the bottom of the containers.

CHEMICAL CONTROL: DETERMINATION OF INSECTICIDE RESISTANCE LEVELS IN MEALYBUG POPULATIONS

J HEUNIS

Objectives & Rationale

To examine if insecticide resistance is the reason for increasing obscure mealybug *(Pseudococcus viburni)* populations in the pome and stone fruit orchards mealybug colonies need to be reared successfully in sufficient numbers to use in bioassays with different insecticides used for their control.

Methods

Mealybugs from apples collected from an old neglected orchard on the Elgin Experimental farm were used to start a colony susceptible to insecticides. A colony was also started from apples with mealybugs from the Molteno farm in Elgin in 2014 to test for resistance. Mealybugs were reared on butternuts as rearing medium (Mudavanhu 2009) inside a Perspex cage.

A bioassay method where mealybugs were established on small sprouted potatoes was developed and tested.
First instar crawlers were allowed to develop until the 3rd to 4th instar stage. Five replicates were used for each concentration of the insecticide tested and water was used as control. Each insecticide was tested at 5 different concentrations (1/4x, ½x, 1x, 2X and 5x the concentration recommended for mealybug control). Each potato with 10 mealybugs was dipped in the insecticide concentrations or water for 5 seconds. Mortality was evaluated 24h and 48 hours after treatment. *Chlorpyrifos* and acetamiprid was tested with all five concentrations and the control on both the susceptible and Molteno mealybug colony simultaneously.

Key Results

The susceptible mealybugs were very sensitive to *Chlorpyrifos* (Dursban), with most mealybugs dead after 24 hours at all concentrations. The Molteno colony was less sensitive to *Chlorpyrifos* as more survived within the first 24 hours at ¼, ½ and with the field concentration. LC50 and LC90 could not be determined for the susceptible colony from this experiment as they were too sensitive to the *Chlorpyrifos* treatment.

There was no statistical difference between the susceptible and Molteno mealybug colonies for the contact effect of acetamiprid (Maintain 200 SP) at all the concentrations. However, a probit regression analysis indicated that at the time of testing the Molteno colony had a slightly higher LD 50 than the susceptible colony at 24 hours indicating that they are slightly less affected by the treatment. However at 48 hours the probit regression lines were the same and therefore the acetamiprid has the same LD50 and LD 90 for both mealybug colonies.

Conclusion / Discussion

This bioassay method can be used to determine resistance of mealybugs to different insecticides. However it only tests the contact effect of an insecticide and therefore a bioassay method to test systemic insecticides must still be investigated.

DETERMINATION OF APPLE SCAB RACES OCCURRING IN SOUTH AFRICAN APPLE GROWING REGIONS TO UNDERPIN BREEDING FOR RESISTANCE

T KOOPMAN

Objectives & Rationale

We are determining which races of apple scab *(Venturia inaequalis)* occur in the different apple growing regions of South Africa and are also investigating the population genetic structure and the pathogenicity and virulence of the pathogen on different apple cultivars.

Methods

We collected apple scab samples from four different apple growing regions. Apple differential cultivars with different resistance genes against apple scab have been imported. Single spored cultures were established and differential cultivars were inoculated to determine the races Fingerprinting of apple scab isolates was undertaken with seven SSR markers to determine differences between isolates from the different apple growing regions.

Key Results

Apple scab samples were collected from the Ceres, Elgin, and Lower and Upper Langkloof regions during the 2014/15 growing season for race identification. Nine differential cultivars were inoculated and it was found that the Rvi1 and Rvi12 resistance genes were overcome by the South African isolates. The 2013/14 apple scab isolates were genotyped with seven SSR markers. Genotyping results from the 2013/14 isolates were the same as in the 2012/13 growing season, indicating that minor population differences exist between Ceres and the Langkloof populations and moderate differences between the Elgin and other populations. This indicates that the Ceres and the Langkloof populations are more closely related to each other. Six different haplotypes were found in the ITS and ABC 2 gene regions of the fungal isolates.

Conclusion / Discussion

Inoculation of differential apple cultivars with apple scab isolates from the four growing regions showed that in all four regions the RVi1 and RVi12 resistant genes are ineffective. Single spore isolates also showed differences in virulence and can only infect certain cultivars, consistent with research work reported in Europe. Collection of the apple scab samples from the four apple growing regions enabled a population genetic study which indicated differences in the apple scab fungal populations between the different climatic regions and also indicated that the fungus adapted to the regions over time. Differences in the ABC 2 gene region of the fungus could be due to variation in virulence in the fungal isolates.

EVALUATION OF NEWLY DEVELOPED POME FRUIT CULTIVARS AND TRAINING IN FRUIT GROWING FOR THE SECOND ECONOMY

T KOOPMAN

Objectives & Rationale

We evaluated apple scion selections over three years from the ARC Infruitec-Nietvoorbij breeding programme for their suitability for producers from the South African second economy and training farmers in appropriate practices.

Methods

We liaised with communities at Koekedou Farmers in Ceres and Mgwali in Eastern Cape, by giving advice on cultural practices needed for growing pome-fruit, and helping with plantings of new pome-fruit selections. We evaluated these selections for adaption for the local regions.

Key Results

Twenty five apple selections were evaluated during the duration of the project (2012/13 -2014/15) at Koekedou, Ceres. Colour development was good during 2012/13 and 2014/15 and the best performing apple selections were the following summer apples, DN 1-12-113, DN 1-12-197 (Afri Sunrise), DN 1-12-180, DN 1-13-246, DN 2-4-81R, DN 4-22-69R, DN 4-35-78, DN 4-77-8R and 8E-10-31R, and the late ARC apple Elegant. One hectare of new plantings of apple and or pear cultivars was established for four Koekedou farmers, funded by Department of Agriculture Forestry and Fisheries. Informal training to communities at Koekedou and Mgwali was given on pruning and thinning during visits.

Conclusion / Discussion

Informal training in management practices given to communities at Koekedou and Mgwali during the past three season will help the communities with apple production. The evaluation of fruit at Koekedou has identified cultivars suitable for growing under those climatic conditions.

MONITORING INSECT PEST ACTIVITY IN APPLE ORCHARDS UNDER CODLING MOTH STERILE INSECT RELEASES

K PRINGLE AND J HEUNIS

Objectives & Rationale

Sprays applied against codling moth are thought to be detrimental to the biological control of other pests. Pest populations were monitored for nine seasons under differing intensities of codling moth spray programmes.

Methods

Pest population and infestation levels were monitored in an area of approximately 35 ha. Orchards were divided into blocks of approximately 2 ha. In these blocks 24 to 25 evenly spaced trees were identified as sampling trees. On each of these trees five shoot tips and five fruit clusters were examined for the presence of pests or damage symptoms; two leaves per tree were examined for the presence of mites; and one half of each tree was examined for the presence of parasitised or unparasitised woolly apple aphid colonies in leaf axils. Just prior to thinning and harvest five fruit clusters were examined for the presence of fruit damage. The fruit were counted to obtain an estimate of the per cent damage and one fruit from each cluster was cut to reveal any organism sheltering in the core of the fruit.

Key Results

Pests causing direct damage to fruit. An outside source of codling moth infestation resulted in codling moth damage for four seasons. If reduced codling moth spray programmes are to be used, it is essential to prevent outside sources of infestation, including infestations from bins. There was very little fruit fly infestation. Fruit weevil infestation increased from the 2011/2012 season onwards. This coincided with the removal of the stem barriers. Bollworm damage was the highest of all the insect pests. It was biased by high levels (19.40 %) during the 2006/2007 season. The occurrence of bollworm was sporadic, with peak activity levels during the 2006/2007 and 2011/2012 seasons. Timing of spray applications is critical, and to this end a suitable monitoring system based on egg counts has been developed. Pansy spot caused by thrips was only recorded at significant levels during the 2014/2015 season.

Pests of potential phytosanitary importance. Only *Pseudococcus viburni* was recorded. Fruit infestation increased from the 2012/2013 season onwards. Because of its cryptic nature infestation levels need to be based on fruit cutting.

Pests not infesting fruit. These pests are good targets for biological control as reasonable infestation levels can be tolerated without economic loss. Aphids, mites and leafrollers were under good biological control for the duration of the study. Woolly apple aphid infestations did not exceed economic thresholds for the duration of the study.

Conclusion / Discussion

1. Codling moth can be controlled using mating disruption, SIR and reduced spray programmes, on condition that there are no sources of outside infestation.
2. The removal of fruit weevil stem barriers resulted in increased levels of fruit damage.
3. The timing of spray applications against bollworm is important. It can be based on monitoring egg numbers.
4. The intensity of spray programmes did not appear to affect the success of biological control of aphids, mites or leafrollers.
5. Mealybug fruit infestations are cryptic and should be determined by cutting fruit.

BACTROCERA DORSALIS: PEST RISK ANALYSIS FOR THE DECIDUOUS FRUIT INDUSTRY IN THE SOUTH WESTERN CAPE

K PRINGLE

Objectives & Rationale

The probability of entry and establishment of *Bactrocera dorsalis* in the Western Cape was estimated.

Methods

The probability of survival of *B. dorsalis* during harvest packaging and transport in consignments of commercially produced mangoes and citrus was modelled using PERT distributions, while Beta General distributions were used to model the number of *B. dorsalis*/kg entering the Western Cape in consignments of mangoes and citrus for a range of possible maximum infestation levels. These data were then used to obtain estimates of the number of *B. dorsalis*/kg of fruit that could be delivered to supermarkets and discarded by supermarkets. For establishment a mating pair needs to be present at any given time. Using the estimates of the volume of discarded fruit by individual supermarkets the probability of a mating pair was estimated.

Key Results

Bactrocera dorsalis could establish in the Western Cape as a result of Mangifera indica (mango) and Citrus spp (citrus) imports from Mpumalanga and Limpopo. The probability of survival in these fruit types during harvest, packaging and transport is high. At present infestation levels an estimated 12.30 *B. dorsalis*/week could enter the Western Cape in mangoes and an estimated 11.96/week in citrus.

The probability of a mating pair being present, and therefore establishment, at current infestations levels in orchards is extremely low, but could become unacceptably high if maximum infestation levels increase to about 0.4 *B. dorsalis*/kg.

Conclusion / Discussion

At present the low infestation levels in mango (0.01 *B. dorsalis*/kg) and citrus (0.001 *B. dorsalis*/Kg) orchards in Mpumalanga and Limpopo result in an extremely low probability of establishment of *B. dorsalis* in the Western Cape as a result of commercial fruit imports from these provinces. This is based on formal trade and does not take informal trade into account as a result of lack of data on the latter.

DEVELOPMENT OF A FUNGICIDE SENSITIVITY MONITORING SERVICE FOR SA POME FRUIT PATHOGENS

C LENNOX

Objectives & Rationale

The objective was to verify protocols for monitoring of fungicide sensitivity of apple scab and pear gray mould from apple and pear growing regions in SA, in order to provide the pome fruit industry with a more rapid and cost effective fungicide sensitivity monitoring service.

Methods

We measured fungicide sensitivity using mycelial growth tests of four fungicide classes, namely anilinopyrimidine, demethylation inhibitor and guanidine for *Venturia inaequalis*, and dicarboximide, and anilinopyrimidine for *Botrytis cinerea* through EC50 and EC90 evaluations of apple scab and pear gray mould, respectively. Fungicide sensitivity of fungal spores of *Botrytis cinerea* isolates from two baseline populations was further evaluated using a microtiter plate reader. Molecular methods (PCR and PCR-RFLP) for candidate fungicide resistance screening are being tested.

Key Results

For *Botrytis cinerea* the mean baseline sensitivities were as follows EC50(benomyl)= 0.14 mg/L, EC50(fludioxonil)= 0.16 mg/L, EC50(iprodione)= 0.28 mg/L, EC50(pyrimethanil)= 0.22 mg/L,. The mean EC50 of the *V. inaequalis* baseline population from Greyton for sensitivity towards the DMI flusilazole was at 0.22 mg/L, whereby 87% of the tested isolates were categorised as sensitive. Baseline sensitivity for cyprodinil and dodine have been tested and analysis is in progress.

Conclusion / Discussion

Baseline sensitivity of the tested *B. cinerea* and *V. inaequalis* populations show similar ranges as previously reported from the USA, although some fungicides such as the phenylpyrrole fludioxonil appeared to be shifted approximately ten-fold towards resistance. This has also been observed in a parallel study on another apple pathogen, thus cross-resistance to other fungicides is expected from this fungicide group.

SURVEY OF STEM CANKERS AND DIEBACK SYMPTOMS OF YOUNG APPLE TREES AND POSSIBLE INOCULUM SOURCES

L MOSTERT

Objectives & Rationale

Scion mother block orchards were sampled for the occurrence of canker/ dieback pathogens. Also, the sampling of 1-3 year old commercial orchards were started to determine the pathogens associated with cankers on young trees.

Methods

Cankers and pruning wounds from 250 scion mother block trees were sampled from the three plant improvement organisations. Isolations were made from the cankers and pruning wounds and the fungal taxa identified. Forty 1-year-old trees showing symptoms of dieback or cankers were collected from young orchards and analysed in a similar way.

Key Results

Young orchards

Seventeen of the 40 1-year-old trees were infected with canker pathogens. Different stem canker and wood rot fungi were isolated from typical canker symptoms on the scion shoot of the trees.

Scion mother block orchards

Fifty-six percent of the scion mother block trees investigated is infected with canker/ dieback pathogens. Trees in older orchards (Golden Delicious and Early Red One) had a higher infection level than younger orchards (Rosy Glow). Forty different fungal taxa were isolated from pruning wounds and cankers. *Eutypa lata* was isolated the most frequently from all three cultivars. The level of infection of buds of green shoots was low (0.9% of 2000 buds analysed). *Basidiomycetes* fruiting structures were found on dead wood of trees in some of the scion mother block orchards. The presence of white rot in cankers, that develop from pruning wounds, show that spores are dispersed from *Basidiomycetes* fruiting structures and can infect pruning wounds.

Conclusion / Discussion

Cankers and dead trees need to be removed and destroyed to minimize pathogen inoculum in orchards.

SCREENING APPLE ROOTSTOCKS FOR TOLERANCE TO PHYTOPHTHORA CROWN ROT

K BEZUIDENHOUT

Objectives & Rationale

This project aims to test apple rootstocks for tolerance to crown rot (Phytophthora cactorum) as part of an integrated disease management strategy.

Methods

We tested the viability of isolates using an excised shoot technique. Shoots from a resistant rootstock (MM109) and a susceptible rootstock (MM106) were cut in 20cm lengths and were wound inoculated. The shoots were incubated in the laboratory and lesion lengths were measured after 14 days. Re-isolations were performed to confirm the presence of the pathogen.

Key Results

No results are available since the testing is still underway.

Conclusion / Discussion

No conclusion can be made since the project has only been running for four months.

CONTINUE EVALUATING COMMERCIAL SPRAY APPLICATION AND DEVELOPMENT/USE OF PROTOCOLS TO DEPOSIT FUNGICIDE RESIDUES OF REQUIRED AMOUNTS, FOR EFFECTIVE PATHOGEN CONTROL ON POME FRUIT.

S VAN ZYL

Objectives & Rationale

The aim of this project was to conduct research on commercial spray application and the development of analysis protocols or guidelines that could in future optimise the application of fungicide sprays on leaves and fruit at various phenological development stages, in order to deposit the required residue for effective pathogen control on pome and stone fruit surfaces.

Methods

Different deposition assessment methods were compared to assess droplets reaching the spray target. A quantitative and qualitative assessment method was identified and developed to measure spray deposition qualitatively. This method was studied and correlated to residue recovery and biological efficacy. Quantitative and qualitative deposition was assessed to evaluate and ascertain the effect of applicator type and various factors such as phenological stage on spray deposition on natural leaf and fruit surfaces in the orchard.

Key Results

Significant and good correlation was indicated between various assessment methods. Image analyses of deposition quantity showed strong correlation with analysis of water-sensitive paper, and visual droplet rating using the Furness deposition chart and the Rapid deposit indication method. The correlation study between spray fungicide treatments, deposition assessment vs. residue recovery and biological efficacy, clearly demonstrated a decrease of biological efficacy with reduced quantitative spray deposition and residue detected, as result of increased run-off associated with higher spray coatings. Applications in the orchard, using commercial applicators, demonstrated the effect of spray applicator technologies and factors such as phenological stage of the target (leaves and fruit) and canopy positions (Inner vs outer target areas).

Conclusion / Discussion

Using an existing and modified tool of spray deposition assessment, it was shown that applicator type and various other parameters such as spray volume, energy delivery, ground speed, and phenological stage could affect the deposition of an active ingredient on fruit and leaf surfaces, with further differences related to inner and outer, as well as top and bottom canopy position of the target surface. The phenological stage (early and late fruit and leaves, canopy size and microstructure of the target surface) at time of application, may also affect the uptake and distribution of the spray deposit. The tool assessed may in future assist producers to quantify and qualify the deposition of spray material, and hence the efficacy for disease and pest management.

Post Harvest

The essence of this programme is to support and enhance the processes across the supply-chain to ensure that intrinsic product integrity is maintained, and that a quality product is available to the end-consumer in local and distant global markets. The objective of this Investment Focus Area (IFA) is to increase the marketable tons of fruit delivered per ton of fruit loaded.

2015 Product Integrity through the Chain Programme

The themes of this programme include:

- Protocols and fruit quality maintenance
- Storage techniques
- Market access
- Decay control
- Fruit quality prediction
- Chemical residue reduction / alternatives
- Packaging
- Transportation systems

A great deal of effort has gone into the latest Post Harvest Innovation (PHI) programme to ensure additional funding and projects for the industry. This time, PHI required a 1:1 funding ratio for their two-year (2015/16) sector plan. Additional project funding secured from PHI amounted to R3,7 million. Bursary funding amounted to a further approximate R1,5 million, though this is dependent on the availability of students.

GENERAL

A new PHI project of Koos Bouwer has been motivated via the Packhouse Action Group to optimise cargo freight capacity utilisation (space, mass, packaging, refrigeration) in refrigerated shipping containers to reduce logistical costs while maintaining product quality. The move toward containerisation and the introduction of hi-cube pallets are only two of the most significant changes in logistical handling and shipping. Two honours students in logistics are doing research in road freight constraints and regulations locally and for some of the overseas export destination countries.

STONE FRUIT

The study on broken stones on plums has been concluded and we are awaiting the final report. Climate has an effect on the incidence. A combination of rapid fruit growth and a softer stone in susceptible cultivars result in the stone being pulled apart by the mesocarp. Cultivars differ in their susceptibility on a seasonal basis. Calcium nitrate and potassium silicate sprays or root drenches did not reduce the incidence. The research has nevertheless been used to substantiate a favourable interpretation of the export standard. In the longer term, broken stone needs to be a hurdle in the breeding programme to eliminate susceptible cultivars.

Regarding decay control, Fludioxonil was fully fungicidal for control of *B. cinerea* and M. laxa on plums. Results for nectarines indicated full grey mould control by Fludioxonil and Iprodione at all concentrations tested. Decay control was also exhibited by chlorine, however significantly less effective than Fludioxonil and Iprodione. Treatment with chlorine could

probably be optimised to increase efficacy.
Electrostatic sprays (ESS), as well as high volume sprays were not viable options to improve the application of Post Harvest fungicides such as Iprodione for improved decay control. The standard dosage rate applied with a standard atomiser using Fludioxanil proved to be the best alternative to improve decay control, compared to the standard volume and dosage rate using Iprodione. A further advantage was reduced MRL levels.

An Experico trial into uncooled apricots transported from Ladismith to Paarl, versus field heat removal and forced air cooled (FAC) apricots suggest that FAC on site and cold transport may have a beneficial effect on apricot quality in terms of fewer internal disorders compared to field heat removed and uncooled apricots transported in refrigerated trucks.

Fruit quality data of a similar trial on plums suggests that FAC, as well as field heat removal to 10°C, may be beneficial in terms of flesh firmness, moisture loss and shrivel, compared to uncooled plums transported in refrigerated trucks.

A moisture loss trial on nectarines by Dr Mariana Jooste highlighted that it is important to handle fruit according to protocol and not to have fruit stand at elevated temperatures or low RH which would cause excessive moisture loss after harvest. The peel permeabilities of all the tested cultivars increased with an increase in fruit maturity. The water vapour permeance of August Red was the highest in the later harvesting weeks of the cultivars tested. The VPD-trial indicated that it is best to pack and place nectarines under cooling within 6 hours after harvest to reduce moisture loss. It is strongly recommended that August Red nectarines should be packed and placed under FAC as soon as possible (within 6 hours) after harvest to prevent excessive moisture loss after harvest. HDPE bags and XtendR bags controlled moisture loss significantly better compared to shrivel sheets in August Red nectarines. Silicate treatments did not decrease split pit or shrivel in Southern Glo nectarines.
Experico is conducting a project to establish if SmartFresh^{SM} application and warming treatments utilizing during cold storage can counter quality losses which may develop during cold-steri treatment of traditional dual-temperature stored plums. Quality maintenance of African Rose and Sunkiss plums were best maintained by applying SmartFresh^{SM} before the accumulation period, followed by 10 days warming at 7.5°C before shipping. Quality maintenance of Fortune, Ruby Red and Sapphire plums were best maintained by applying SmartFresh^{SM} before the accumulation period, followed by no warming before shipping.

A joint project between Experico and WestCape Biotech is

Kobus van der Merwe and his team at ARC Infruitec-Nietvoorbij continued with research into alternatives to DPA, including Dynamic Controlled Atmosphere (DCA) technology. ILOS+CA and DCA were the only storage protocols tested which successfully inhibited the development of superficial scald on Granny Smith for 16 weeks storage followed by a handling and shipment period of 6 weeks.

looking at the prevalence of *Botrytis cinerea* in plums. *B. cinerea* was present in plum tissue throughout the growth season and during storage, with the levels of *B. cinerea* DNA increasing consistently over the storage period. Presence and relative quantities of DNA coincided with the presence of weeds. Thus, weed control may support grey mold decay control. Molecular technology holds great potential as a tool for better understanding of *B. cinerea* and subsequent advancement of decay control strategies.

A new PHI project has commenced on the biological control of postharvest phytopathogens in stone fruit by Prof Kim Clarke of Process Engineering at Stellenbosch University. This builds on a previous PHI project to develop the techniques.

POME FRUIT

DCA storage successfully inhibited superficial scald on Packham's Triumph pears. Current research is focussing on the length of DCA storage required to control scald, as well as the length of the post DCA RA storage period before scald re-emerges. Scald has been found after 10 weeks RA post DCA in Chile. Six weeks RA after DCA, including shelf-life, has been found to be scald free locally. Kobus van der Merwe of the Agricultural Research Council (ARC) found that storage of Abate Fetel at high O2 concentrations (6-8% O2 + 0% CO2) gave the best results for inhibiting superficial or soft scald, but fruit were significantly more yellow than fruit stored at lower O2 concentrations (1.5% O2 + 0-1% CO2). Currently he recommends CA conditions of 1.5% O2 + <1% CO2 for storage of Abate Fetel pears. Previously, in 2013, the best post storage quality for Abate Fetel pears after a storage period of 4 months and a simulated storage period of 4 weeks RA at -0.5°C from both the Grabouw and Ceres production areas was achieved with a CA regime of 1.5% O2 + 1% CO2.

Kobus retired in June 2015, and his successor, Anel Botes will be continuing with CA research. A new project was registered in her name for the continuation of Abate Fetel CA storage trials.

A study on Abate Fetel by Experico found that the pears are susceptible to CO2 breakdown in CA (1% O2 and 1-1.5% CO2) storage. Fruit looked appealing on the outside, but were not acceptable for consumption due to the internal browning and CO2 breakdown incidence. Fruit treated with SmartFresh^{SM} did not develop to eating ripe quality during the shelf life period. Their interim recommendation is that RA storage up to 5 months, though not without its problems, should rather be considered for Abate Fetel pears over CA storage. This trial was repeated in 2015.

The Forelle Early Market Access (FEMA) programme quota limit was removed last season and approximately 1 450 000 cartons were successfully exported this year. Based on an economists' view of a R20/carton premium, the 3,78 million cartons exported in the first four years yielded a return on investment of R75,6 million. For every Rand spent on Forelle research since 2000 - 2014, this amounts to a return of R10 at the time of full commercialisation. Alternatively stated, the annual return (R29 million) exceeds the total pome research budget. Various other FEMA related trials to look at the maximum delay for 1-MCP application, minimum firmness levels and applying the principle on other cultivars are still in process.

An Experico project is looking at the application of SmartFresh^{SM} to Williams' Bon Chretien and Abate Fetel pears harvested up to two weeks after optimum maturity resulted in crisp fruit (firmness ≥ 4.8 kg) at the end of shelf life. Concerns are that consumers might not be attracted to firm and crisp pears usually marketed as soft and juicy. Only Williams' Bon Chretien harvested three weeks after optimum (harvest 4) and stored for 8 weeks or longer ripened below 4.0 kg during shelf life. However, these fruit exhibited much higher colour loss.

The impact of a delay in the application of SmartFresh^{SM} to Forelle, on parameters such as flesh firmness, mealiness and internal ethylene levels, was demonstrated. Acceptable efficacy was obtained up to 21 days after harvest. The study into mealiness of Forelle by Dr Elke Crouch showed that mealiness is associated with larger cells, larger intercellular spaces and soluble solids content. Near Infra Red (NIR) spectroscopy and X-ray computed tomography can detect and predict mealiness, laying the foundation for non-destructive mealiness pre-sorting.

In research on internal browning on Cripps Pink, Stellenbosch University showed that low K content and low ratios of Ca:Mg and K:Mg was associated with increased incidence of browning. The effect of temperature during fruit growth and development could possibly predispose the fruit to browning development. NIR spectroscopy can successfully be used to predict TSS and internal browning, but needs to be evaluated on a commercial line.

Recommendations following the Experico trial into internal browning in Cripps Pink revealed that:

1. Subjecting Cripps Pink apples to step cooling plus SmartFresh^{SM} result in firmer, more intense red skin fruit. Fruit however exhibit a more advanced skin ground colour.
2. Storing fruit at elevated temperatures might reduce the internal browning development potential (2.0°C vs. -0.5°C).
3. Fruit should be not be harvested at post optimum maturity to reduce the internal browning development potential.
4. Should fruit be harvested at post optimum maturity it is advised to not exceed a storage period of longer than 4 months CA to avoid internal browning development.
5. Special care should be taken not to harvest fruit at post optimum maturity of orchards known to have a high acidity, since they are more prone to internal browning development.

Dr Cheryl Lennox concluded the initial study on bulls eye rot (BER) on Cripps Pink apples. Neofabraea alba is the causal agent and is present in five growing regions in the Western Cape. N. alba was successfully detected as early as December. The average disease incidence of BER on 'Cripps Pink' apple was variable over seasons. N. alba was found on Hillieri crab apple, used as a pollinator, and the presence of N. alba on this cultivar could increase the level of disease incidence. In vitro studies of fludioxonil showed that the fungicide was ineffective in controlling N. alba mycelial growth. It was determined that current methodologies are not suitable for the in vitro evaluation of N. alba sensitivity towards pyrimethanil. From observations made in this study, in vitro testing of N. alba towards pyrimethanil is not a suitable method for determining fungicide efficacy. In vivo and field trials should be done to provide a more accurate representation of fludioxonil and pyrimethanil efficacy on N. alba of 'Cripps Pink' orchards as laboratory results do not necessarily dictate field efficacy. Pyrimethanil could control the population, albeit at a very high concentration. Although a management strategy specific to this pathogen is not yet in place, information gained in this study will contribute to its development. A spray programme should be followed the whole season, with focus in the final month before harvest as inoculum are the most abundant and fruit highly susceptible during this stage.

The European Union (EU) is considering the restriction of the import of fruit with chlorate and perchlorate residues higher than 0.01mg/ kg, as it is thought that these substances could be harmful to human health. A pilot study conducted by Dr Ida Paul of Experico indicated that, while chlorates were present in water, from both the source water, and water amended with chlorine products in the pack-house flume, with one exception, no chlorates were found in the fruit. Perchlorate residues were not detected in any of the fruit and water samples analysed.

A study on Abate Fetel by Experico found that the pears are susceptible to CO_2 breakdown in CA (1% O_2 and 1-1.5% CO_2) storage. Fruit looked appealing on the outside, but were not acceptable for consumption due to the internal browning and CO_2 breakdown incidence. Fruit treated with SmartFresh^{SM} did not develop to eating ripe quality during the shelf life period. Their interim recommendation is that RA storage, up to 5 months, should rather be considered for Abate Fetel pears over CA storage.

Experico has commenced work on establishing a physiological profile of Cheeky with particular reference to the effects of harvest maturity and storage duration on fruit quality, and expression of astringency and internal browning.

The Experico DPA cross-contamination and risk management trial has illustrated the risk of DPA exceedances.

Initial findings include: cold store early-optimum fruit for longer than 4 weeks to ensure normal ripening post shelf life. Do not store optimum and post optimum fruit for longer than 8 weeks RA to prevent skin ground colour break (≥ 3.0).

WestCape Biotech is conducting a project on detection and quantification of *Botrytis cinerea* in pear fruit. The results show the sensitivity and accuracy of the detection and quantification method on pear blossoms and the calyx-end of fruit and confirm its application as a method to monitor *B. cinerea* inoculum levels in stored pear fruit. A method to monitor *Botrytis cinerea* inoculum levels will greatly assist in the management of the Botrytis rot in pears.

ACKNOWLEDGEMENTS

Considering the past financial year regarding Post Harvest research, we can conclude that exciting and promising research results were generated which will, and are, benefiting the pome and stone fruit industries. We commend the researchers from the different research organisations who contributed to the Post Harvest programme for their outstanding work. The invaluable contribution made by the members of the Post Harvest Peer Work Group and Technical Advisory Committee, who make constructive criticisms of the numerous project proposals and reports, is gratefully recognised. The significant contribution of the Postharvest Innovation Programme of the Department of Science and Technology to innovation in the Post Harvest field is acknowledged.

Richard Hurndall

TABLE 1. PROJECTS COMPLETED IN 2015

RESEARCHER	PROJECT TITLE
Dr M Jooste	Broken Stones in plums
Dr M Jooste	Heat damage in plums
Dr M Jooste	Moisture loss studies in Japanese plums
H Viljoen	Conducting scanning trials on additional dual-temperature regime plums, to enable successful shipping at a single temperature
A Kock	Alternative application methods of Iprodione for Post Harvest control of botrytis decay on plums
Dr I Paul	Decay control of tree fruit: Testing of different control options using fungicides, sanitizers, soft chemicals and biological agents, to identify methods for use on stone fruit
Dr I Paul	Decay control of tree fruit: Testing of different control options using fungicides, sanitizers, soft chemicals and biological control agents, to identify methods for use on pome fruit
Dr E Crouch	The influence of cell number and size and cell wall bound and free calcium on the development of Forelle pear, as well as the evaluation of NIR as an early detection method for mealiness
Dr E Crouch / H Bosman	Internal browning (IB) of Cripps Pink
Kobus van der Merwe	Determine optimum controlled atmosphere storage conditions for Abate Fetel pears
Dr I Crouch	Assessment of DPA levels on untreated fruit and possible related sources of contamination
Dr I Paul	Monitor chlorate and perchlorate residue levels in fruit

TABLE 2. RUNNING PROJECTS

RESEARCHER	PROJECT TITLE
H Viljoen	Utilisation of SmartFresh^{SM} to enable successful shipping of dual-temperature plums at a single temperature of -0.6 °C for 24 days to adhere to cold-sterilisation protocols for phytosanitary markets
Dr I Paul	Investigation on product residue levels, and product efficacy for decay control, of Monilinia and Botrytis, dependent on method of application, product concentration and spray volume for two registered products on plums, nectarines and peaches
Dr I Paul	The prevalence of Botrytis spp. In and on plums, and alternative host plant tissue: A preliminary investigation on the occurrence of the fungus pre-and Post Harvest, using molecular technology, in order to elucidate pathogen ecology, for new decay control strategies
Dr M Jooste	Moisture loss studies in nectarines

TABLE 2. RUNNING PROJECTS CONTINUED

RESEARCHER	PROJECT TITLE
A de Kock	Revision of temperature tolerance at loading for plums
A de Kock	Optimum cooling and transport temperatures for plums from areas situated far from cooling facilities / deports
A de Kock	The effect of temperature from orchard to cold store on apricot quality, specific to areas removed from cold storage facilities
Prof K Clarke	Production of antimicrobial lipopeptides by Bacillus spp.for biological control of postharvest phytopathogens in the perishable fruit industry
K Bouwer	The development of the industrialisation process for various ideas towards optimisation of cargo freight capacity utilisation (space, mass, packaging, refrigeration) in refrigerated shipping containers to reduce logistic costs while maintaining product quality
K van der Merwe	Alternatives for the use of DPA: determining the critical minimum DCA storage exposure periods to inhibit superficial scald and the effects of CA storage and RA storage periods following DCA storage on superficial scald development on Granny Smith apples
Dr S Ferreira	Detection and quantification of *Botrytis cinerea* incidence and severity in harvested pears for the development of a monitoring system to support commercial exports
K van der Merwe	Determine the effects of Initial Low Oxygen Stress (ILOS) treatment followed by controlled atmosphere storage (CA) and regular atmosphere storage (RA) on superficial scald control of Packham's Triumph pears
K van der Merwe	Determine the critical minimum dynamic controlled atmosphere (DCA) storage exposure periods to inhibit superficial scald and the effects of CA and RA storage periods following DCA storage on superficial scald development of Packham's Triumph pears
Dr I Crouch	Extended cold storage of Abate Fetel pears for EU market
A Botes	Non-chemical storage technologies for apple and pear superficial scald prevention
Dr I Crouch	Assessment of accumulation DPA residues throughout storage and packing facilities
Dr I Crouch	Identification of factors involved and control of astringency in pears
Dr E Crouch	Postharvest 'Forelle' meliness development, detected at harvest by CT-X ray scanning and semi-commercial colour pre-sorting influenced by canopy position at harvest as well as pollination
Dr E Crouch	The influence of cell number and size (cell division) and cell wall bound and free CA2+ on the development of mealiness of Forelle pear, as well as the evaluation of NIR as an early detection method for mealiness
D Viljoen	To determine if pear cultivars, other than Forelle, can be successfully cold stored using the FEMA model by harvesting fruit at a more advanced maturity and then retarding ripening through the use of SmartFresh^{SM}

TABLE 2. RUNNING PROJECTS CONTINUED

RESEARCHER	PROJECT TITLE
D Viljoen	To determine the maximum delay in SmartFresh^{SM} application from harvest to room filling for fruit destined for the FEMA programme*
H Bergman	Physiological profiling on Rosy Glow apples harvested at different maturities, with special reference to internal browning development potential
Dr E Crouch	Harvest and storage conditions duration influencing internal browning and fruit quality of Rosy Glow
D Viljoen	To determine the minimum flesh firmness that FEMA fruit can be exported without becoming overripe after storage, and to determine the effect of extended storage of FEMA fruit (stock rolling)*
D Viljoen	Determine the effect of sugar/acid ratio and other maturity indices on the eating quality of Forelle pears destined for the FEMA programme, as a means of improving the FEMA release criteria*

***Funded by Forelle Producer Association levy**

TABLE 3. NEW PROJECTS APPROVED FOR 2016

RESEARCHER	PROJECT TITLE
A de Kock	7 mm plunger for nectarines
A de Kock	Monitoring Temp and RH in Quest containers
Dr E Lotze	Moisture loss in plums
Prof K Theron	Peel permeabilities in plums
Dr A Botes	Optimum CA storage of Abate Fetel pears
D Viljoen	Internal browning in Fuji
D Moelich	Effect of bag perforations on forced-air cooling of apples
D Viljoen	Harvista to control scald on Packham's Triumph pears

THE MAXIMUM DELAY IN SMARTFRESH^{SM} APPLICATION FROM HARVEST TO ROOM FILLING FOR FRUIT DESTINED FOR THE FEMA PROGRAM

D VILJOEN

Objectives & Rationale

The volume of Forelle Early Market Access (FEMA) fruit increased drastically since 2013. An unexpected outcome from the increased volumes was the sometimes limited availability of SmartFresh^{SM} treatment rooms, and the rate of filling of these rooms within the 7 day protocol.

The aim of this study was therefore to determine the maximum delay in SmartFresh^{SM} application from harvest to room filling for fruit destined for the FEMA programme, without softening of the fruit and the expression of mealiness.

Methods

Forelle pears from two populations sourced from the Ceres and Grabouw regions were treated 7, 9, 14 and 21 days after harvest with SmartFresh^{SM} (600 ppb) and stored for 6 weeks at -0.5°C. Post storage quality of fruit was evaluated at the end of the cold storage period and after a simulated shelf-life of 7 days at 20°C.

Key Results

Standard efficacy results indicated that successful treatments were obtained in both populations and that the SmartFresh^{SM} application was effective up to 21 days after harvest.

After cold storage and shelf life, regardless of treatment time, fruit treated with SmartFresh^{SM} were of exceptional eating quality. SmartFresh^{SM} treated fruit were firmer with lower internal ethylene levels and no incidence of mealiness compared to untreated control fruit. No astringency was found, regardless of population, treatment or examination stage.

Conclusion / Discussion

These results indicate a time tolerance for producers not able to accumulate enough fruit to fill a room within the 7 day SmartFresh^{SM} protocol. Producers with high volumes of Forelle not able to SmartFresh^{SM} fruit within 7 days after harvest due to limited treatment facilities will be able to treat fruit up to 21 days of harvest.

THE EFFECT OF TEMPERATURE FROM ORCHARD TO COLD STORE ON APRICOT QUALITY, SPECIFIC TO AREAS FAR AWAY FROM COLD STORAGE FACILITIES

A DE KOCK

Objectives & Rationale

Temperature profiles of uncooled apricots and apricots force-air cooled (FAC) on site (at the farm) and transported in refrigerated trucks, from Ladismith to Paarl were recorded in two separate consignments. These temperature profiles as well as field-heat removal (FHR) was simulated under laboratory conditions. The objective was to obtain typical temperature profiles for different cooling and transport methods and to quantify the effect of these temperature profiles, as well as FHR on apricot quality.

Methods

The temperature profile of FAC and uncooled apricots transported from the production area (Ladismith) in refrigerated trucks, to the cooling/ loading facilities (Paarl area), were determined by data collection with loggers, from packing until the end of forced air cooling. Fruit pulp and air temperatures were recorded in three commercial pallets during each transport leg. These temperature profiles as well as FHR were simulated under laboratory conditions to determine the effect on apricot quality.

Key Results

Pulp temperatures in FAC apricots were maintained during transport but were not reduced in uncooled apricots transported in refrigerated trucks from Ladismith to Paarl. Flesh firmness was similar in FAC apricots, and uncooled apricots transported cold, but were lower in apricots subjected to FHR. There was a trend for less internal disorders in the FAC apricots compared to uncooled apricots and apricots subjected to FHR.

Conclusion / Discussion

Paarl may have a beneficial effect on apricot quality in terms of less internal disorders compared to uncooled apricots transported in refrigerated trucks. FHR had a negative effect on flesh firmness compared to FAC and uncooled apricots.
This will have to be verified in 2016.

UTILISATION OF SMARTFRESH^{SM} AND /OR PRE-RIPENING TO ENABLE SUCCESSFUL SHIPPING OF DUAL-TEMPERATURE REGIME PLUMS AT A SINGLE TEMPERATURE OF -0.55°C FOR 24 DAYS FOR COLD-STERILIZATION PURPOSES

H VILJOEN

Objectives & Rationale

This project was conducted to establish if SmartFresh^{SM} application and warming treatments utilizing during cold storage can counter quality losses which may develop during cold-steri treatment of traditional dual-temperature stored plums.

Methods

Five cultivars were sourced from Franschhoek and Montagu, and subjected to the different treatments and temperature regimes as indicated in the report. The fruit were evaluated after cold storage and after a shelf life period of 5 days at 10°C.

Key Results

Cultivar differences were expressed. However, quality maintenance of African Rose, Sunkiss and Sapphire (based end of cold storage results of Sapphire) plums were best maintained by applying SmartFresh^{SM} before the accumulation period, followed by 10days warming at 7.5°C before shipping [T1]. Quality maintenance of Fortune, Ruby Red and Sapphire (based end of shelf life results of Sapphire) plums were best maintained by applying SmartFresh^{SM} before the accumulation period, followed by no warming before shipping [T6]. Quality maintenance was worst by not applying SmartFresh^{SM} before the accumulation period, followed by no warming or 3d warming at 20°C before shipping [T7 and T5, respectively], or by applying SmartFresh^{SM} before the accumulation period, but warming the fruit for 14d at 7.5°C before shipping [T2].

Conclusion / Discussion

The results obtained in this year's project needs to be confirmed, since growing conditions across seasons may affect the reaction of the fruit to the treatments along with the cold-steri conditions.

REVISION OF TEMPERATURE TOLERANCE AT LOADING FOR EXPORT PLUMS

A DE KOCK

Objectives & Rationale

The effect of temperature during the accumulation phase, from packing to loading of plums for shipment to offshore markets, was tested. Temperatures selected were -0.5°C (recommended pulp temperature at loading), 2°C (0.5°C higher than the current maximum permissible temperature) and 4°C. Accumulation periods of 7 days and 10 days were used. The objective was to determine if maximum temperature at loading of plums can be adjusted upwards without negatively effecting quality at the end of cold storage.

Methods

Sapphire and Sunkiss plums, not cooled before packing, were obtained from a commercial pack house in Franschhoek. Each cultivars' fruit was divided into 6 treatments. The variables were accumulation periods of 7 and 10 days and accumulation temperatures (-0.5°C, 2°C and 4°C). After accumulation, the plums were stored at dual-temperature regimes of 2 days at -0.5°C, 7 days at 7.5°C and 16 or 19 days at -0.5°C, depending on the accumulation period. The plums were evaluated for flesh firmness, decay, shrivel and internal disorders after cold storage, as well as after 5 days shelf life at 10°C.

Key Results

No significant differences in quality occurred between plums accumulated at -0.5°and 2°C. Plums accumulated at 4°C were softer than at -0.5°C or 2°C, and where the accumulation period was extended to 10 days, gel breakdown and over-ripeness developed in the Sapphire plums. Internal disorders did not differ between treatments in the Sunkiss plums.

Conclusion / Discussion

The results indicated that storage of Sapphire and Sunkiss plums for the first 7 or 10 days at 2°C instead of -0.5°C does not have a negative effect on quality. However, at 4°C the plums were approximately 1 kg softer than at -0.5°C and 2°C. At 4°C internal disorders in Sapphire plums (gel breakdown and over-ripeness) was induced at the longer accumulation period of 10 days. Provided that softer plums are acceptable, the maximum accumulation period at 4°C on Sapphire plums appears to be 7 days, while it can possibly be extended to 10 days in the case of Sunkiss plums. This research must be confirmed using more populations of various cultivars of plums, sourced from different production areas, before an amendment to the current regulation can be made.

OPTIMUM COOLING AND TRANSPORT TEMPERATURES FOR PLUMS FROM AREAS SITUATED FAR FROM COOLING FACILITIES/DEPOTS.

ARRIE DE KOCK

Objectives & Rationale

Temperature profiles of uncooled plums and force-air cooled (FAC) plums on site (at the farm) and transported in refrigerated trucks, from Ladismith to Paarl were recorded in two separate consignments. These temperature profiles were simulated under laboratory conditions and a field-heat removal (FHR) treatment was added. The objective was to obtain typical temperature profiles for different cooling and transport methods and to quantify the effect of these temperature profiles, as well as FHR on plum quality.

Methods

The temperature profile of uncooled plums transported in refrigerated trucks, to the cooling/ loading facilities (Paarl area), as well as FAC plums in the production area (Ladismith) were determined by data collection with loggers, from packing until the end of forced air cooling. Fruit pulp and air temperature were recorded in three commercial pallets during each transport leg. These temperature profiles were simulated under laboratory conditions and a field heat removal (FHR) treatment was added, to ascertain the effect on plum quality.

Key Results

Pulp temperatures of uncooled plums, in standard 5kg boxes, loaded at 24.4°C to 17.9°C were not reduced during transport at 2°C. The exception was plums packed in punnets, where pulp temperatures were reduced by 5.5°C. In FAC plums, pulp temperatures were maintained. Flesh firmness was similar in FAC and FHR plums, but was softer in uncooled plums after cold storage. Decay, shrivel, internal disorders and mass loss was not affected significantly by the treatments. However, albeit non-significant, mass loss and shrivel was higher in plums transported warm, compared to FAC and FHR plums.

Conclusion / Discussion

Fruit quality data suggest that FAC, as well as field heat removal to 10°C, may be beneficial in terms of flesh firmness, moisture loss and shrivel, compared to uncooled plums transported in refrigerated trucks.

TO DETERMINE THE EFFECT OF SUGAR/ ACID RATIO AND OTHER MATURITY INDICES ON THE EATING QUALITY OF FORELLE PEARS DESTINED FOR THE FEMA PROGRAMME, AS A MEANS OF IMPROVING THE FEMA RELEASE CRITERIA

D VILJOEN

Objectives & Rationale

One of the major challenges with FEMA Forelle pears is that in many instances the two major release parameters, flesh firmness and sugar levels may remain constant and not change over 2 or 3 weeks. This has led to scrutiny of other parameters, and in particular the sugar/acid ratio as a possible means of an alternative and more accurate means of releasing an orchard under these circumstances.

The aim of this study is therefore to assess sugar and acid levels and their ratio, on the eating quality of FEMA fruit, and to determine if this could be used as an additional means of releasing an orchard in years when flesh firmness does not drop as quickly as expected.

Methods

Forelle pears harvested at different maturities from the four major growing areas were treated with SmartFresh^{SM} 5 days after harvest and stored for 5 weeks at -0.5°C. Evaluations conducted were maturity at harvest, SmartFresh^{SM} efficacy testing, start of shelf life after cold storage and end of shelf life after a simulated shelf life at 20°C for 7 days after cold storage. Fruit were also subjected to a basic sensory evaluation.

Key Results

Generally, the sugar/acid ratio at time of harvest increased with delay in harvest time. SmartFresh^{SM} treated fruit were of acceptable quality after cold storage and shelf life, regardless of time of harvest or population.

Conclusion / Discussion

2015 results indicated acceptable eating quality of FEMA fruit regardless of sugar/acid ratio. However, later harvests generally exhibited higher sugar/acid ratio values. The parameter's usefulness of this index as an additional release parameter can only be determined over several seasons, especially in instances when TSS levels are below 14%, and flesh firmness is above the FEMA release criteria, or alternatively there is marked firmness loss without a corresponding increase in TSS levels. Historic data indicated similar sugar/acid ratio trends, but indicated marked index differences between seasons.

TO DETERMINE IF PEAR CULTIVARS, OTHER THAN FORELLE CAN BE SUCCESSFULLY COLD STORED USING THE FEMA MODEL BY HARVESTING FRUIT AT A MORE ADVANCED MATURITY AND THEN RETARDING RIPENING THROUGH THE USE OF SMARTFRESH^{SM}

D VILJOEN

Objectives & Rationale

To determine if pear cultivars, other than Forelle can be successfully cold stored using the FEMA model by harvesting fruit at a more advanced maturity and then retarding ripening through the use of SmartFresh^{SM}.

Methods

Williams'Bon Chretien and Abate Fetel pears were harvested from optimum each week thereafter for two more weeks (3 weeks for Williams'Bon Chretien pears). Pears were subjected to a 600 ppb SmartFresh^{SM} application within 7 days after harvest and stored for 6, 8 and 12 weeks. After storage pears were subjected to a 7 day shelf life at 20°C. Evaluations were conducted after cold storage and at the end of shelf life.

Key Results

Flesh firmness of Williams' Bon Chretien pears dropped from 9.0 kg to 7.4 kg between Harvest 1 and 4. Fruit of the first three harvests treated with SmartFresh^{SM} did not ripen below 6.9 kg after shelf life, regardless of storage time. Only fruit harvested three weeks after optimum (harvest 4) stored for 8 weeks or longer ripened below 4.0 kg during shelf life. However, these fruit exhibited much higher colour loss. Firmness' of Abate Fetel pears (two populations) varied between different harvests. Regardless of harvest time and storage time, fruit treated with SmartFresh^{SM} did not ripen to firmness' below 4.8 kg during shelf life.

Conclusion / Discussion

The application of SmartFresh^{SM} to Williams' Bon Chretien and Abate Fetel pears harvested up to two weeks after optimum maturity resulted in crisp fruit (firmness ≥ 4.8 kg) at the end of shelf life. Concerns are that consumers might not be attracted to firm and crisp pears usually marketed as soft and juicy. Consumer studies are required to ascertain if the fruit would be acceptable to different markets, and in particular those of the EU and the Middle and Far East.

IDENTIFICATION OF FACTORS INVOLVED AND CONTROL OF ASTRINGENCY IN PEARS

I CROUCH / H BERGMAN

Objectives & Rationale

The revised objective of this study is to continue work on establishing a physiological profile of Cheeky with particular reference to the effects of harvest maturity and storage duration on fruit quality, and expression of astringency and internal browning. Since commencement of this study, important changes have occurred which have reduced the incidence of astringency in Forelle (FEMA). Initial assessment of carbon dioxide spiking to reduce astringency in both Cheeky and Forelle resulted in the development of carbon dioxide damage and the presence of cavities in the fruit, confirming that these cultivars are intolerant to carbon dioxide. At the request of the TAC, astringency work on Forelle was stopped and resources rather utilized to learn more about the correct harvest maturity of Cheeky, especially as trees are becoming older and producing higher yields.

Methods

Fruit from four orchards in two areas were harvested at 3 or 4 different maturities and cold stored at -0.5°C RA for 4, 8, 12 and 16 weeks, to assess the effect of harvest maturity and storage duration on the expression of astringency and internal browning.

Key Results

No internal browning and very little astringency exhibited in the 2015 season. Astringency was only detected in Ceres fruit of optimal maturity, cold stored for 8 weeks, not before or after this storage time or for any other harvest maturity. Acceptable flesh firmness was exhibited up to 16 weeks storage and fruit almost always ripened normally after a shelf life period. Cold store early-optimum fruit for longer than 4 weeks to ensure normal ripening post shelf life. Do not store optimum and post optimum fruit for longer than 8 weeks RA to prevent skin ground colour break (≥ 3.0). TSS maintained relatively well for 16 weeks across harvest maturities, but MA declined. Possibly more decay, shrivel and internal disorders with extended storage and later harvests. Mealiness in optimum harvested fruit when cold stored for 8 weeks, but none exhibited before or after this time.

Conclusion / Discussion

Clear trends are coming to light following the 2015 study and must be confirmed by repeating the work in 2016.

TO DETERMINE THE MINIMUM FLESH FIRMNESS THAT FEMA FRUIT CAN BE EXPORTED WITHOUT BECOMING OVERRIPE AFTER STORAGE, AND TO DETERMINE THE EFFECT OF EXTENDED STORAGE OF FEMA FRUIT (STOCK ROLLING)

D VILJOEN

Objectives & Rationale

To determine the effect of FEMA fruit packed at 4.0 kg on fruit quality after 4-6 weeks cold storage, and to determine the maximum storage period from harvest at a range of packing firmness's before fruit quality is compromised.

Methods

A FEMA orchard in Vyeboom was harvested first at FEMA release followed by two more harvests, one and two weeks after release respectively. Fruit were subjected to a standard 600 ppb SmartFresh^{SM} treatment and stored for 5, 8, 12 and 14 weeks at -0.5°C. Evaluations were conducted at the end of cold storage and after a simulated shelf life of 7 days at 20°C.

Key Results

Fruit firmness at harvest remained constant between the harvests, but fruit became more yellow and TSS levels increased the later fruit were harvested. Fruit were of acceptable quality after 7 days shelf life regardless of storage duration. Mealiness and generally astringency was not expressed in treated fruit, regardless of storage duration and harvest.

Conclusion / Discussion

Due to seasonal factors fruit firmness did not drop. Subsequently fruit were not harvested at the desired firmness of 4.0 kg. Fruit colour reached the maximum acceptable level of 3.0 according to the standard industry colour charts at Harvest 3, thus not making it worthwhile to harvest more mature fruit. Post shelf life fruit quality was acceptable even after 14 weeks cold storage. SmartFresh^{SM} effectively prevented ripening resulting in a sweet, crisp fruit with supressed mealiness expression. If fruit can be accepted for export at a yellower skin colour, then it may be easier to reach the targeted firmness levels in 2016.

THE PREVALENCE OF BOTRYTIS CINEREA IN AND ON PLUMS, AND ALTERNATIVE HOST PLANT TISSUE: A PRELIMINARY INVESTIGATION ON THE OCCURRENCE OF THE FUNGUS PRE-AND-POST HARVEST IN ORDER TO ELUCIDATE PATHOGEN ECOLOGY, FOR NEW DECAY CONTROL STRATEGIES

I PAUL / S FERREIRA

Objectives & Rationale

Despite control measures, losses due to Botrytis grey mold decay on plums occur in industry. The aim of this study was to elucidate aspects of *Botrytis cinerea* ecology in an industry representative plum orchard, by screening for the presence of the fungus in plum host tissues and other hosts throughout the growing season.

Methods

An orchard with a known high incidence of Botrytis grey mold, and high weed infestation, was identified. Pre- and Post Harvest samples of 25 plum trees, as well as of weeds, and blossoms of a non-stone fruit tree were analysed with quantitative real time PCR (qRT-PCR) for the presence of *B. cinerea*. Comparative isolations from fruit tissue of mature fruit were made onto Potato Dextrose Agar (PDA), of the same fruit used for molecular analyses.

Key Results

- *B. cinerea* was found in 95% of the blossom samples.
- This coincided with a high presence of weeds, with a presence of *B. cinerea* DNA in weeds.
- A non-stone fruit tree was a host for *B. cinerea*, seemingly contributing to the infection of blossoms.
- Immature fruit, fruit at harvest and stored mature fruit, harboured *B. cinerea*, with DNA quantities increasing over time, despite pre-and-post harvest control measures applied.
- No fruit exhibited visual symptoms of grey mold.
- Both qRT-PCR and isolation of fungi on potato dextrose agar successfully detected *B. cinerea* in the orchard
- Results could be the foundation for further studies on the development of a prediction method, to predict the likelihood of Post Harvest decay, from information obtained in the orchard prior to harvest.

Conclusion / Discussion

B. cinerea was present in plum tissue throughout the growth season and during storage, with the levels of *B. cinerea* DNA increasing consistently over the storage period. Presence and relative quantities of DNA coincided with the presence of weeds. Thus, weed control may support grey mold decay control. Studies to confirm findings will be done in 2016. qRT-PCR holds great potential as a tool for better understanding of *B. cinerea* and subsequent advancement of decay control strategies.

DETECTION AND QUANTIFICATION OF BOTRYTIS CINEREA INCIDENCE AND SEVERITY IN HARVESTED PEARS FOR THE DEVELOPMENT OF A MONITORING SYSTEM TO SUPPORT COMMERCIAL EXPORTS

S FERREIRA

Objectives & Rationale

A method to monitor *Botrytis cinerea* inoculum levels will greatly assist in the management of the Botrytis rot in pears. The objective of this project is to develop a system to continuously detect and quantify *B. cinerea* levels in orchards, packhouses and packed fruit. In this report the milestones aimed at the development and optimisation of the detection method is reported on.

Methods

Pear blossoms and fruit were harvested from orchards at full bloom and optimal harvest maturity respectively. These samples were either artificially inoculated with known amounts of *B. cinerea* spores or left un-inoculated. From these samples genomic DNA was extracted and used in a quantitative Real-Time PCR (qRT-PCR) reaction to determine the relative *B. cinerea* DNA content present in pear blossoms and the calyx-end of fruit at specific time-points.

Key Results

1. *B. cinerea* DNA was detectable in a) blossoms at full bloom and b) the calyx-end of fruit harvested at optimal maturity.
2. There was a strong correlation between the *B. cinerea* DNA content and the number of spores artificially inoculated in both blossoms and the calyx-end of fruit.
3. 15 Fruit per sample pool is an adequate sample size and produces reproducible results.
4. The developed method could be used monitor the increase in *B. cinerea* DNA in the calyx-end of pear fruit in storage.
5. There was a reduction in the *B. cinerea* DNA content after chlorine flume treatment.

Conclusion / Discussion

The results show the sensitivity and accuracy of the detection and quantification method on pear blossoms and the calyx-end of fruit and confirm its application as a method to monitor *B. cinerea* inoculum levels in stored pear fruit.

SUPPORT STRUCTURES / ADVISORY COMMITTEES

HORTGRO Science is dependent on its extensive support structures that are made up of colleagues and role-players in the deciduous fruit industry who tirelessly give of their time, intellect and passion to serve the needs of the industry. The various committees that service the needs of HORTGRO Science are noted below. We extend our heartfelt thanks to each one of these individuals who have contributed to HORTGRO Science. A quick tally of participation in our different work groups shows that we have in the order of 200 different individuals involved in our different work groups:

- 6 Peer Work Groups – 34 scientists
- 5 Technical Advisory Committees – 66 technical / growers
- 30 focus workgroups – 100 scientists / technical / growers

PEER WORK GROUPS (PWG'S)

Objectives of PWG:

- Evaluate the scientific correctness of prioritised new research proposals
- Evaluate scientific standard of progress and final reports

Breeding & Evaluation:

Richard Hurndall - HORTGRO Science
Hugh Campbell - HORTGRO Science
Prof Wiehann Steyn - HORTGRO Science
Prof Karen Theron - US Horticulture
Dr Leon von Mollendorff - Culdevco
Dr Willem Botes - US Genetics
Dr Klaus Pakendorf - ARC

Horticulture:

Richard Hurndall - HORTGRO Science
Hugh Campbell - HORTGRO Science
Prof Wiehann Steyn - HORTGRO Science
Dr Nigel Cook - Prophyta
Prof Gerard Jacobs - US Horticulture
Prof Karen Theron - US Horticulture
Dr Nicky Taylor - University of Pretoria
Dr Piet Stassen - Consultant

Soil Science:

Richard Hurndall - HORTGRO Science
Hugh Campbell - HORTGRO Science
Prof Wiehann Steyn - HORTGRO Science
Dr Eduard Hoffmann - US Soil Science
Dr Pieter Raath - Bemlab
Dr Nigel Cook - Prophyta
Dr Nicky Taylor - University of Pretoria
Dr Johan van Zyl - US Soil Science

Entomology & Nematology:

Richard Hurndall - HORTGRO Science
Hugh Campbell - HORTGRO Science
Matthew Addison - HORTGRO Science/US Entomology
Dr Ken Pringle - HORTGRO Science/US Entomology
Dr Brian Barnes - Consultant

Dr Ruan Veldsman - SANBI
Welma Pieterse - DAFF
Prof Schalk Louw - University of Freestate
Prof Martin Hill - Rhodes University

Pathology:
Richard Hurndall - HORTGRO Science
Hugh Campbell - HORTGRO Science
Lindi Benic - HORTGRO
Prof Lise Korsten - University of Pretoria
Prof Altus Viljoen - US Pathology
Dr Johan Fourie - ExperiCo
Ferdi van Zyl - SAPO

Pierre du Plooy - Consultant
Andrew Hacking - Ad Lucem
De Kock Hamman - CFG
Hannes Laubscher - Dutoit Group
Christo Strydom - Wolfpack Pears
Chris Jurisch - Arbor Tech
Willie Kotze - Dutoit Group
Prof Wiehann Steyn - HORTGRO Science
Daan Brink - Two-A-Day
Nelius Kapp - Prophyta
Mico Stander -Agrimotion
Louis Reynolds -Fruitful Crop
Xolani Siboza -HORTGRO Science

Post Harvest:
Richard Hurndall - HORTGRO Science
Hugh Campbell - HORTGRO Science
Dr Marius Huysamer - Consultant
Prof Karen Theron - US Horticulture
Prof Linus Opara - Research Chair in Post HarvestTechnology (US)
Dr Paul Cronje - Citrus Research International
Dr Mariana Jooste - HORTGRO Science / US Hort

TECHNICAL ADVISORY COMMITTEES (TAC'S)

Objectives of TAC's:
- Identify industry research needs or gaps
- Determine relevance of concept proposals
- Prioritise new project proposals
- Evaluate technical merits of progress and final reports
- Identify technology transfer opportunities
- Advisory to HORTGRO Science

Production TAC:
Stephen Rabe - Grower / HORTGRO Science Director (Chairman)
Graeme Krige - Two-a-Day
Anton Muller - KROMCO
Tobie van Rooyen - Techways
Peter Dall - Peter Dall Consultancy
Dr Nigel Cook - Prophyta

Fruit Route (Breeding) Advisory Committee:
Prof Bongani Ndimba - ARC
Ken Tobutt - ARC
Dr Leon von Mollendorff - CULDEVCO
Hugh Campbell - HORTGRO Science (SAAPPA & SASPA)
Dappie Smit - DFPTS
Wiehann Victor - CFPA
Tarryn Wettergreen - SATI

Crop Protection TAC:
Richard Hurndall - HORTGRO Science (Chairman)
Matthew Addison - HORTGRO Science
Lindi Benic - HORTGRO Science
Anton Muller - KROMCO
Bekker Wessels - ProCrop Trust
Andrew Hacking - Ad Lucem
Nico Ferreira - Two-a-Day
Dr Ken Pringle - HORTGRO Science / US Entomology
Fanie van der Merwe - Dow AgroSciences

Post Harvest TAC:
Grant Smuts - Grower / HORTGRO Science Director
Charl Stander - Franschhoek Marketing
Richard Hurndall - HORTGRO Science
Jacques du Preez - HORTGRO
Dr Malcolm Dodd - Consultant
Henk Griessel - TruCape
Jaco Moelich - Fruitways

Angelique Marais - Fruitways
Petro Conradie - Dutoit Group
Margaret Reineke - Bayer
Karin van Rensburg - Capespan
Elizabeth Downes - Capespan
Pieter Neethling - Two-a-day
Dr Mdunzi Ngcobo - PPECB (now ARC)
Petru du Plessis - Consultant
Anton Gouws - KROMCO

Technology Transfer Advisory Committee:
Hugh Campbell - HORTGRO Science (Chairman)
Stephen Rabe - Grower / HORTGRO Science Adv council
Erin Morkel - HORTGRO Science (until March 14)
Elise-Marie Steenkamp - HORTGRO Science
Matthew Addison - HORTGRO Science
Prof Wiehann Steyn - HORTGRO Science
Peter Dall - Peter Dall Consultancy
Keith Bradley - Grower
Robert Zulch - Grower
Linde du Toit - Grower
Pierre du Plooy - Consultant
Dr Nigel Cook - Prophyta
Graeme Krige - Two-a-Day
Dr Ian Crouch - ExperiCo
Charl Stander - Franschhoek Marketing
Christo Strydom - Wolfpack
Marinus van der Merwe - Future4Growers
Tobie van Rooyen - Techways

ADVISORY / FOCUS GROUPS

Objectives of Advisory Groups:
- Assist programme with formulation of strategic research planning in defined areas of research
- Identify new technologies of relevance
- Seek collaborative research opportunities across local and international research/technical organisations
- Seek funding opportunities to ensure inputs into targeted research focus areas
- Meetings as required
- Advisory to programme manager

Objectives of Focus Groups:
- Convene specific expertise to deal with specific industry issues
- Identify research requirements
- Evaluate research findings and make recommendations
- Identify technology transfer opportunities and communicate findings to industry via appropriate forums

Groupings:
The following advisory and focus groups are in place and are made up of experts in each field (researchers, technical advisors, growers). The list is large – between 90 and 110 individuals. We are indeed indebted to each one of these individuals for their contributions.

Crop Production:
Soil health
Dormancy
Reproductive Biology
Rootstock Evaluation Committee
Rootstock and Nursery Tree
Growing Season Climate
Irrigation and Nutrition
Farming efficiency
Orchard of the future
Rest breaking and Fruit thinning
Water Availability Committee

Breeding:
Culdevco Advisory - Pome fruit
Culdevco Advisor - Stone fruit

Crop Protection:
IPM Group
Crop Protection Advisory Group (Market Access)
Spraying systems Advisory Group

Post Harvest:
Physiology / Horticultural Science
Post Harvest pathology
Packaging and cold chain management
CA Group
Forelle research focus group
DPA focus group

General:
Confronting Climate Change Steering Committee
Pome Fruit Technical Forum
Stone Fruit Technical Forum
Packhouse Action Group
Deciduous Plant Improvement Association Technical Committee

SAFJ PUBLICATIONS LIST

Dec/Jan 2015

The Art of Mutualism, pg. 8 – 11. E. Steenkamp
Tour Down Under, pg. 14 – 15,18 E. Steenkamp & W.Steyn.
Research on Track: Mechanical Blossom Thinning, pg. 16 & 18.E. Steenkamp
Gebreekte Pit in Pruime pg. 17,18. E. Steenkamp
Profiles: Pg. 69 -70 E. Steenkamp.
Rootstocks for early nectarines in low chill region as well as plums where high water tables and calcareous soil plus ring nematodes occur, pg. 72 – 75. P. Stassen.

Do shade nets ease the burn or do they burn a hole in your pocket? D. Brink, Willie Kotze, Wiehann Steyn, pg. 79 -81
Historic Pests, pg. 82 – 83 E. Steenkamp
Om 'n appeltjie te skil, 88- 89 E. Steenkamp

Feb/Martch 2015

EPN – our Biological Superweapon, pg. 44-45. E. Steenkamp
Fruit Fly Symposium Thailand, pg. 46 – 49 M. Addison
International Horticultural Society Congress Brisbane, pg. 52 – 55, R Hurndall
Poland Apple Industry, pg. 57 H. Campbell & P. Dall
A rose by any other name, pg.59 A. Mala

April/Mei 2015

HORTGRO Science sak af na die Langkloof, pg. 49, 52, 53. W Steyn,
Fieldmen's shaping Western Cape Fruit industry, pg., 50, 51. E. Duvenage
Knowledge must be shared, Tienie du Preez, pg., 52. E. Duvenage
Power Fungi, pg. 54. E. Steenkamp.
Profiles: pg. 56 – 57. E. Steenkamp.
Nuwe US leerstoel – pg. 59. E. Steenkamp.
Developing an Apple Scab Management Programme, pg. 62 – 66, W. Machardy, S. Von dietz, C. Lennox,
Kalsium en boor saam goeie sonskerm vir Golden Delicious appels. pg., 69. E. Lotze
Know to Grow, pg. 75 W Steyn.

June/July 2015

Crystal balling storage life: The DPA Dilemma, pg. 14 - 17 E. Steenkamp
HORTGRO Science Student Showcase, pg. 56 – 60 E. Steenkamp
Researcher Profile: pg. 61 E. Steenkamp
Effective Post Harvest eradication of EBI tolerant Ventura inaequalis with EBI fungicides in SA – W Schwabe, pg. 62 – 65
The Fruit Doctor – E Steenkamp pg. 67
Shredding leaves in autumn lowers apple scab levels in the next season, S von Diest, W Machardy, C Lennox, pg. 68, 69
Lessons learned – Orchards of the future – E Steenkamp, pg. 70, 71
Is mechanical blossom thinning a viable alternative to hand thinning for stone fruit?, K Theron, G de Villiers, W Steyn, pg. 72 – 73

Aug/Sept 2015

Record-breaking Symposium, pg. 6 – 16. E. Steenkamp & E. Duvenage.
HORTGRO Science Researchers, pg. 74 – 75. E. Steenkamp.
Verwydering van blare op boordvloer help keer appelskurf, pg. 76. J. Meitz-Hopkins
Does foliar application of BA increase fruit size in pears? pg. 78 – 79. K. Theron
Pink Lady Report – Chile, pg. 80 – 83. R. Hurndall, E. Crouch

Oct/Nov2015

Bigger & better through Research, pg. 19 – 22. E. Steenkamp
Growing fruit with less water, pg. 49 – 51. S. Dzikiti.
HORTGRO Sc Profiele, pg. 53. E. Steenkamp
CCC Wins prestigious award, pg. 54, E. Steenkamp
Wat jy moet weet om 'n suksesvolle boord te vestig, pg. 57 – 61. E Steenkamp.
What are the physical characteristics of a good nursery tree? pg. 63 – 65. K. Theron, W Steyn.

FRESH NOTES

ARTICLE NUMBER	*TITLE*	*DATE*
Fresh Notes 100	Twig Die Back Under Investigation	October 2014
Fresh Notes 101	New US Chair	November 2014
Fresh Notes 102	Industry Guideline Information on Restrictions on the Use of Plant Protection Products	December 2014
Fresh Notes 103	New Appointments and Changes at HORTGRO Science	December 2014
Fresh Notes 104	Reducing Post Harvest shrivel in "African Delight" plums	January 2015
Fresh Notes 105	Optimum harvest maturity determination for African Delight plums planted in different production areas	January 2015
Fresh Notes 106	Post Harvest Seminar Report back	January 2015
Fresh Notes 107	Name change of invasive Fruit Fly	February 2015
Fresh Notes 108	PAG	April 2015
Fresh Notes 109	MRL Notification	July 2015
Fresh Notes 110	Internal Browning Fuji	August 2015
Fresh Notes 111	PAG	August 2015
Fresh Notes 112	Derogations for deciduous fruit crops	September 2015
Fresh Notes 113	Besproeiingsriglyne ten tye van watertekorte	October 2015
Fresh Notes 114	Industry Guideline Information on Restrictions on the Use of Plant Protection Products	October 2015

EVENTS

DATE	*EVENT*	*WHERE*	*ATTENDANCE*
26.11.14	Researcher Thank-You Breakfast	Stellenbosch	88
03.12.14	Langkloof Field Day and Orchard Walk	Langkloof	39
22.01.15	Post Harvest Seminar	Stellenbosch	57
02.06.15	Pome Field Day	Ceres	247
05.06.15	Stone Fruit Workshop	Worcester	159
03.06.15	Symposium Day 1	Drakenstein	392
04.06.15	Symposium Day 2	Drakenstein	375
06.08.15	Free State Apple Symposium	Bethlehem	65
07.08.15	Free State Field Day	Bethlehem	65
31.08.15 - (01/02/14-16.09.15)	Horticultural Short Course	Elgin	35
08.09.15	Information Session	Drakenstein	
16.09.15	Crop Protection Seminar	Stellenbosch	128
29.09.15	Information Session	Tulbagh	
13.10.15	Information Session	Piketberg	

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