CROP PRODUCTION PROGRAMME

Crop production programme research strategy

The research conducted in the crop production programme is primarily focused on the following areas stated in the strategy plan:

a. Production efficiency (volume of exportable fruit per unit area) through the use of rootstocks, technology and data systems
b. Climate change mitigation and water productivity
c. Plant material quality and availability.

Current crop production research needs per theme

1. Rootstock research

Stone fruit:

1.1. **Screen new stone fruit rootstocks that have not previously been screened for resistance to important nematode species.**

1.2. **Evaluate dwarfing stone fruit rootstocks in netted orchards.**

1.3. **Evaluate stone fruit rootstocks and scion cultivars for salinity tolerance.** Rootstock assessment: Utilise a recently completed rootstock evaluation trial and induce salinity stress by fertilising with salt. Scion assessment: Plant the most important scions at a suitable site, all on the same rootstock. Induce salinity stress by fertilising with salt. Consult technical advisors on which scion cultivars to include. A soil scientist and irrigation specialist should be involved or consulted on the project.

Pome fruit:

1.4. **Assess the impact of scion scheme viruses on graft strength and tree performance.** Consult Gennaro Fazio and Hugh Campbell before submission of a proposal.

1.5. **Assess the impact of wood rots on tree survival and performance.**

1.6. **Assess WAA susceptibility of apple rootstocks.** Plant ungrafted rootstocks at different nurseries in main production regions, do not treat for WAA and assess WAA damage and levels.

2. Irrigation and nutrition research

2.1. **A multi-disciplinary project is required to investigate the effect of plant/soil water status (under, optimal and over irrigation) and different irrigation practices such as pulsing irrigation to mitigate the effect of heat waves in apples and plums. The effect on internal heat damage (plums) and sunburn should be determined. The relationship between plant water status and shrivel susceptibility in plums can also be assessed as part of this project.** Consult with the programme manager during the conceptualization of this project. Separate proposals can be submitted for the two fruit types. The projects will require further scoping before finalization.

2.2. **Assess the effect of an over irrigation regime and flooding during the harvest time on tree physiology, production and growth, nutrition, fruit quality, profitability, postharvest storability and**

disorders etc. Conduct the research on a 'Cripps Pink' clone such as 'Rosy Glow' or 'Lady in Red'. The project will require further scoping before finalization.

2.3. **Determine the water use of peach/nectarine and cherry orchards.** These studies are dependent on funding by the Water Research Commission and proposals should only be submitted in response to WRC open calls.

2.4. **Study the effect of superficial sunburn damage, maturity and mixed maturity (linked to delayed foliation), crop load, cuticle composition and climate (using the Pro-Hort ecophys platform) on shrivel incidence in plums.**

3. Dormancy research

3.1. **Use completed apple rootstock evaluation sites and/or the Pro-Hort ecophys platform to study the following:**

- **Cambial dormancy and vascular reactivation**
- **Bud anatomy, and differences in growth and fruiting habit induced by rootstock.** Could involve determining fruit richness, fruiting alternation and alternation synchronization indexes.
- **Temperature thresholds for root growth of different rootstocks**
- **Difference in dormancy progression and budbreak induced by rootstock.**
- **Auxin transport** – Note that funding this part of the project will be dependent on the availability of a workable protocol.

The new rootstock plantings at Bossieveld and Greyton can also, in time, be utilized for this research.

3.2. **Effect of autumn, winter and growing season conditions on bud and flower quality, fruit anatomy and size, and possibly storability.**

4. Growing season climate research

4.1. **Assess the suitability of the risk assessment tool for bitterpit development in Golden Delicious used by the Dutoit Group for use to identify Big Bucks or Bingo orchards susceptible to lenticel disorders.**

4.2. **Study the effect of cuticle composition and development on shrivel susceptibility. Assess the effect of pre-harvest factors (climate, position on the tree etc.) by using the Pro-Hort ecophys platform.**

4.3. **Mine the FEMA database for factors that affect maturity parameters in Forelle.** Could also extend to other cultivars where large maturity databases are available.

5. Farming technology research

5.1. **Evaluate real-time remote sensing tools for assessment of plant water status.**

5.2. **Fertilizer application after differential application has addressed variation in zones.**

6. Reproductive biology research

6.1. **Assess the effect of leaving fruit on young trees on growth performance**. This multidisciplinary study should include a physiological component aimed at explaining the results observed. Questions to be answered include the number of fruit left, effect of rootstock, scion, etc. Further scoping will be needed.

6.2. **A knowledge/literature review to capture what is known on bee activity under nets and plastic.**

6.3. **Heat stress and fruit growth – the role of ABA in Ca-related disorders.**

6.4. **Assess the effect of late growth on return bloom and fruit storability in a Gala type apple.**

CROP PROTECTION PROGRAMME

Crop protection programme research strategy

The research conducted in the crop protection programme is primarily focused on the following area stated in the strategy plan:

a. Market access and management of phytosanitary and invasive pests and diseases.
b. Application of integrated pest management
c. Biological and non-chemical control of pests

The framework below addresses the current needs of the industry and therefore should not be regarded as comprehensive. Emphasis has been placed on developing sustainable crop protection solutions, which include biological control and non-chemical control of pests and disease. Research which allows for the integration of management methods is encouraged. The development of appropriate beneficial technologies for the pome and stone fruit industries is vital, and the industry is more than willing to support the research and development of such technologies.

Current crop protection research needs per theme
(High priority research needs are in bold)

1. Integrated pest management

1.1. **Loss of registered pesticides and fungicides: The loss of pesticides and fungicides, and the integration of alternatives is critical.**

1.2. **Assess results of the preliminary research on polyphagous shot hole borer and conduct additional research if needed**. Research framework is available.

1.3. **Sucking insects and their associated damage has become a problem on apples and pears**. Research is needed on the integrated management of the various species involved.

1.4. **Phytophagous mites** are an increasing problem in the industry. The failure of biological control in orchards and the use of biological agents to manage mites needs to be assessed.

1.5. Quantification of the impact of pests, i.e., woolly apple aphid and nematodes on production.

1.6. Development of a framework to produce organic or low residue fruit.

2. Nematology

Plant parasitic nematodes in both pome and stone fruit are problematic. Research is needed on the integrated management of these species. Evaluation and integration of the use of EPN's into integrated pest management programmes is needed i.e. banded fruit weevil and mealybugs.

3. Plant pathology

3.1. ***Rosellinia*** in orchards is an increasing problem especially in the Langkloof and increasingly the EGVV. To date no fungicides have been registered locally.

3.2. ***Alternaria*** **has emerged as a significant problem in wet production areas.** Additional research is needed on the problem.

3.3. **Pack shed sanitation methods need to be assessed and improved**. The transference of disease-causing organisms from the orchard floor to the packhouse should be assessed.

3.4. Quantification of the impact of pathogens, i.e., **scheme viruses** and stem cankers on production.

3.5. Integrated management of apple scab is seen as important.

3.6. Postharvest decay control using alternatives (commercial products). Assessment needed.

3.7. Effects of orchard management practices on postharvest pathology.

3.8. Alternative treatments during blossom to replace lost fungicides.

4. Phytosanitary and biosecurity

4.1. **Mite-contaminated fruit entering packhouses is a major concern. Conduct a comprehensive study and include aspects such as miticide resistance, biological control and rapid identification methods.**

4.2. **Monitoring for invasive insects and diseases.**

5. Orchard soil ecology

5.1. **Conduct an analysis of cover crop management practices in the industry.** Identify what work and doesn't work, benefits and disadvantages observed, etc.

5.2. **Conduct a cost benefit analysis on the use of cover crops.** Emphasis must be placed on estimating the costs of establishing cover crops and accrued benefits over time i.e., nutrients and ecosystem services. Could form part of 5.1.

5.3. **Water use by cover crops and the ability to grow them in very dry areas i.e., using drip irrigation. Also assess cover crop nutrient needs and nutrient dynamics in orchards with cover crops.**

5.4. Assess the effects of cover crops on young tree performance.

5.5. Evaluate weed management strategies following an integrated approach.

5.6. Determine the impact of diversity (both animal and plant) on soil ecology in relation to fruit production and sustainability.

5.7. Assess and analyse the physical management of cover crops. Machinery to either cut, cultivate or roll cover crops and or weeds in the tree row (under trees) is needed. In addition, machinery is needed to transfer cut plant material from the work row to under the trees as a mulch.

6. Precision agriculture

6.1. Electronic data collection, analysis and dissemination of information.

6.2. Use of remote sensing and associated techniques to detect amongst others, tree stress, fungal and insect infestations.

6.3. Develop spray application guidelines for the pome and stone fruit industries.

6.4. There is need to quantify the persistence of chemical residues under nets and the possible accumulation of chemical residues on nets.

POSTHARVEST PROGRAMME

Postharvest programme research strategy

The research conducted in the postharvest programme is primarily focused on the following area stated in the strategy plan:

a. Maintenance of postharvest quality and reducing risk throughout the value chain
b. Finding effective replacements for plastic packaging

At a strategic meeting held in February 2024, the Store-It group determined the following broad focus areas for pome fruit postharvest research:

- The effect of pre-harvest conditions, climate change and factors such as crop load on postharvest aspects such as storability, ripening, and defect development.
- Loadshedding protocols for summer pears, RA periods, and for specific markets. The impact of loadshedding on quality should also be quantified.
- Packaging
- Sanitation and postharvest fungicides
- Storage protocol for new cultivars

In addition to the specific needs listed below, research proposals aimed at these broad focus areas will be considered for funding.

Current postharvest research needs per theme

1. **Defects research**

Pome fruit

1.1 **Quantification of inter- and intra-tree variation and the effect thereof on storability and incidence of disorders.**

1.2 **Study the effect of condensation on fruit on external CO_2 peel defects in Cripps' Pink, Golden Delicious and Forelle and when during storage this can be an issue.**

2. **Quality management research**

Pome fruit

2.1 **Determine best practice under non-perfect export chain conditions for managing summer pears.**

2.2 **How to store Forelle pears for 14 months to ensure a year-round supply of good quality fruit?** May involve assessing the characteristics of orchards that store well and determining reasons for their long storability.

Stone fruit

2.3 **Update the current stone fruit protocols according to the extreme circumstances that fruit are currently exposed to.**

2.4 **A collaborative project to develop a predictive analytical tool that can support cold chain decision-making under both load-shedding and normal conditions.**

3. **Packaging and logistics research**
   3.1. **Ground truth the cooling models developed by the SARCHi research team, optimize if and where necessary, and use to assess new loadshedding dispensations, and the effect load out temperatures on temperature maintenance under shipping delays and cooling interruptions.** Consult Henk Griessel and Johan Strydom in preparation of the concept proposal(s).
   3.2. **Determine the effect of packaging with or without plastic liners on fruit quality in pome and stone fruit.** Quantify effect on value, weight loss, yellowing and shrivelling. Also consider the impact of a non-perfect export chain.

4. **Storage techniques research**
   4.1. **Evaluate DCA storage on Fuji apples.**

LEARNING AND DEVELOPMENT RESEARCH GAPS

1. Determine the critical attributes and skills sets of highly successful production managers in the deciduous fruit industry.
2. Survey the operational limits (ha under management) of production managers in the deciduous fruit industry.