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

(High priority research needs are in bold)

1. Rootstock research

1.1. **Evaluate apple rootstocks for lower vigour scion cultivars like Nicoter, RDS and more commonly planted full red varieties.**

1.2. **Evaluate stone fruit rootstocks for salinity tolerance.** Establish trees at a suitable site in the Breede/Klein Karoo regions. Grow the trees until maturity and then induce salinity stress by fertilising with salt. A soil scientist should be involved or consulted.

1.3. **Quantify the cost of WAA, stem canker and nematode infestation in terms of impact on productivity using a threshold approach**.

1.1. **Screen stone fruit rootstocks for susceptibility to major nematode species of economic concern utilising completed and current rootstock evaluation sites.**

1.2. **Develop a screening procedure for incompatible and brittle graft unions, especially for new scion cultivars.**

1.3. Study the interaction between various biotic and abiotic stressors in combination with nematode and/or stem canker infection on survival and performance of stone fruit trees on different rootstocks.

2. Nursery tree research

2.1. **Compare the performance of tissue culture derived plants to those grown from layers (apple) and cuttings (stone fruit)**. The project should include an economical perspective. More than one planting over a number of years is envisioned to accommodate variation between sites.

2.2. Evaluate strategies for control of pests (WAA and nematodes) and diseases (*Phytophthora, Rosellinia*) in layer beds.

3. Irrigation and nutrition research

3.1. **A multi-disciplinary project is required to investigate the effect of 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.** Consult with the programme manager during the conceptualization of this project. Separate proposals can be submitted for the two fruit types.

3.2. **Assess the effect of over irrigation regime on tree physiology, production and growth, nutrition, fruit quality, profitability, post-harvest storability and disorders etc.** Conduct the research on a 'Cripps Pink' clone such as 'Rosy Glow' or 'Lady in Red'. The study could include the effect of flooding during the harvest time of Cripps Pink (and maybe also other late cultivars) on the post-harvest quality of fruit.

3.3. **Determine the water use of peach/nectarine, apricot and cherry orchards.** These studies will be dependent on co-funding by the Water Research Commission.

3.4. **Hortgro requires a survey of information available on the ground water resources and ground water use in main production regions.**

3.5. Conduct hydrological modelling for changes in run-off and potentially also ground water replenishment in main production regions. Could be combined with 3.4.

3.6. Assess the effect of an over irrigation regime on the growth performance and physiology of newly planted apple trees.

4. Dormancy research

4.1. **Continue the evaluation of rest breaking programmes in apple and expand to include stone fruit.** The effect of treatments on variation in harvest maturity should be assessed.

4.2. **Expand the current adaptability project to include the effect of climate on bud quality and fruit size.** See 7.1.

4.3. **Determine cambial dormancy and vascular reactivation in contrasting climatic areas. Also study bud anatomy.** Potentially utilize the different apple genotypes planted in the adaptability project.

4.4. Study the role of the fermentation pathway in dormancy.

4.5. Investigate practices to mitigate the effect of warm days in winter, such as evaporative cooling and nets (for example D Tech). These projects are seen as low hanging fruit.

4.6. Study the effect of autumn temperatures on endodormancy induction in apple using potted trees. A molecular approach may form part of this project.

4.7. Conduct dose response curves for field application of 6-BA + GA_{4+7}.

4.8. Determine temperature thresholds for root growth of various apple rootstocks. The adaptability trial sites and the Louterwater Granny Smith plantings (winter 2023) in low chill areas could be utilized.

5. Growing season climate research

5.1 **Develop crop suitability maps for various crops that could be grown in traditional deciduous fruit production areas. Emphasis on those crops that will fit in best with current infrastructure. Indicate change from current suitability to 30 years in the future.** Detailed climatic requirements/thresholds of different fruit types will be required to develop the maps.

5.2 **Investigate the effectiveness of sunburn protectants such as Raynox, Deccoshield etc. under existing shade nets (potentially at the Oak Valley OoF).**

5.3 **Study the effect of flat nets with open or closed sides on orchard, canopy and fruit temperature and relate to the incidence of heat damage in plums.**

5.4 **Verify the research of I Kritzinger on the effect of cuticle composition and hypodermis anatomy on shrivel susceptibility using a range of susceptible and tolerant cultivars. Study the effect of climate on cuticle development.** May include the assessment of the effect of ABA application on cuticle development/shrivel susceptibility.

5.5 **Effect of climate, harvest maturity, canopy position and superficial sunburn on cuticle development and hypodermis anatomy related to susceptibility to shrivel in plums. How is this affected by netting?** May form part of 5.4.

5.6 Quantify the effect of heat stress on fruit quality. Could form part of 3.1 or 5.3.

5.7 Evaluate draped nets on plums. Assess the effect on pollination in fruit finish.

5.8 Determine the role of climate prior to and during fruit development on pear susceptibility to cork spot. Study may involve correlating historic climatic data with cork spot incidence levels as recorded by packhouses/exporters.

6. Farming technology research

6.1 **Identification and visualization of between tree variation in orchards as relating to fruit quality and maturity. i) Establish effect on variability in postharvest quality and disorder incidence. ii) Use the info to inform selection of trees to use for MI sampling. iii) Assess the usefulness of measures to decrease variation** – see 4.1.

6.2 **Conduct a preliminary study in the EGVV area using TerraClim data to identify the most suitable sites for certain apple cultivars based on the site-specific data of highly productive orchards.** Potentially combine with a study aimed at identifying the most productive/profitable orchards of different fruit types in the different regions or at different packhouses and analyse the orchard components that contribute to performance.

7. Reproductive biology research

7.1. **Assess the levels and degradation of starch in apple fruit situated on different positions in a tree and correlate to other parameters of fruit maturity.** Assess the relationship between starch levels and storability. Inner canopy apples show faster starch degradation, but this could be due to having lower starch levels and might not relate to maturity or storability.

7.2. Assess the effect of leaving fruit on young trees on dwarfing and semi-dwarfing rootstocks on growth performance. The study should include a physiological component aimed at explaining the results observed.

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.

The framework below addresses the current needs of the industry and therefore should not be regarded as comprehensive. Emphasis has been placed on aspects such as biological control and non-chemical control of pests and disease. Furthermore, 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. **Determine the identity of the bugs causing the damage (attributed to stinkbug) in orchards, their biology and management.**

1.2. Assess results of the preliminary research on polyphagous shot hole borer and conduct additional research if needed.

1.3. Additional research is needed on the pre-harvest control of grain chinch bug in the field and the development of area wide control strategies.

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.

Additional research is required in the biological and integrated management of mealybug in apple and pear, both pre- and post-harvest.

2. Nematology

Research is currently in progress on nematode susceptibility of rootstocks and cover crops. EPN research is also ongoing. However, 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. **Assess strategies to prevent the infection of stone fruit rootstock cuttings by pathogens during planting.**

3.2. *Rosellinia* in orchards is an ongoing problem especially in the Langkloof. To date no fungicides have been registered locally.

3.3. Replant in stone fruit orchards is a developing problem and should be assessed.

4. Phytosanitary and biosecurity

4.1. **The use of methyl bromide has been suggested as a phytosanitary measure for pome export markets. The effects of the treatment on organisms of phytosanitary importance and on fruit quality need to be assessed.**

4.2. **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.** .

5. Orchard soil ecology

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

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.

5.3. **Assess the effects of cover crops on young tree performance.**

5.4. **Conduct a study on the carbon footprints of orchards over their life time.** In-orchard measurements are needed and other nutrients and factors need to be measured. The fate of carbon and ecological status of soils during replant of an orchard was also raised. This project can form part of an orchard of the future project aimed at maximising soil carbon levels.

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. It was noted that due attention should be paid to management.

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. Assess the impact of fixed nets on pest and disease control effectiveness. Assess the effect of fixed nets on spray efficiency.

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

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.

POST-HARVEST PROGRAMME

Post-harvest programme research strategy

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

a. Maintenance of post-harvest quality and reducing risk throughout the value chain

Current post-harvest research needs per theme

(High priority research needs are in bold)

1. Defects research

Pome fruit

1.1 **Quantification of inter- and intra-tree variation and the effect thereof on storability and incidence of disorders.** Also see crop production 6.1.

1.2 **Determine whether winter climate affects flower quality, fruit internal quality, storability and susceptibility to defects.**

1.3 Role of climate prior to and during fruit development on pear susceptibility to corky spot.

1.4 "Blue sky" – non-destructive assessment of starch breakdown.

Stone fruit

1.5 Develop a prediction model for pitburn/heat damage in plums. Determine the effect of different temperatures at different stages of fruit development on pitburn in susceptible plum cultivars. Maybe also assess the effect of step down cooling on the incidence of pitburn/heat damage in susceptible plum cultivars. See crop production 5.6.

2. Quality management research

Pome fruit

2.1 **Determine the relationship between starch reserves and the rate of starch breakdown and harvest maturity**. Also determine how starch reserves correlates to DMC. See Crop production 7.1.

2.2 **Evaluate non-plastic packaging.** Assess effect on fruit quality.

2.3 **Study the link between climate and TA levels in pears (Forelle and Packham's Triumph). Also assess the effect of TA levels on taste and storability. The correlation of TSS/TA ratio on eating quality should also be studied.** Sensory and consumer studies will be required. Hortec's database on FEMA and Forelle pears could be used**.**

2.4 **Determine the physiology behind the working of step down cooling in preventing/reducing the incidence of internal browning in apples**. May also assess the effect of step down cooling on the incidence of pitburn/heat damage in susceptible plum cultivars.

2.5 Ascertain the link between harvest temperatures and scuff marks in Cape Rose pears in a look and see project.

2.6 Study how better relative humidity management during storage may affect green colour retention in Golden Delicious and Granny Smith. Learn from the management of Conference in Europe.

2.7 Determining how tree variability influences green colour variability and whether selective harvesting could improve the situation. Is it more of an issue in warmer compared to colder winters with more condensed flowering?

2.8 Assess packhouse and cold store compliance with protocols – similar project as done for fungicide application in stone fruit packhouses

Stone fruit

2.9 **Finding effective replacements for plastic packaging** is an overarching focus of Hortgro Science's stone fruit post-harvest programme. The following research needs exist within this focus area:

2.9.1 Continue the evaluation of edible coatings on plums and expand to nectarines. Edible coatings used in other exporting countries should receive priority.

2.9.2 Conduct a literature study on plastic replacements based on the ExperiCo survey.

2.10 **Verify the research of I Kritzinger on the effect of cuticle composition and hypodermis anatomy on shrivel susceptibility using a range of susceptible and tolerant cultivars.** See crop production 5.4.

2.11 **Determine the effect of mixed maturities, fruit position in the canopy, crop load and plant water status on shrivel incidence**. Assess whether ABA application may affect cuticle deposition and thereby moisture loss and shrivel.

2.12 **Utilize the plum adaptability project to assess the effect of climate on shrivel susceptibility**.

3. Packaging and logistics research

3.1. **Determine the effect of packaging with or without plastic liners on fruit quality in pome and stone fruit**. Evaluate plastic replacements. Quantify effect on value, weight loss, yellowing and shrivelling.