Climate Change Impacts and Adaptation for Deciduous Fruit Production

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Revived urgency – earth’s temperature rise could reach 1.3(+/-0.3)°C in 2016
South Africa: climate crisis 2015-2016

- 2015-2016: Worst drought in 30 years, high temperatures
- Drought declared nationally on 27 May (WC previously excluded)
- Induced by El Niño and compounded by climate change
- Western Cape drought, heat wave, fires: damages to wine/fruit R720 million; R2-4 billion damages to sector
- Serious concern about dam levels and the next season
- Climate change expected to bring more of this

R720m fire, drought bill
The impact on entire agriculture sector can run into billions, MEC believes
• Urgent action needed in the agricultural sector to adapt to the unavoidable impacts of climate change, and reduce its greenhouse gas (GHG) emissions

• SmartAgri – a joint initiative between DoA and DEA&DP
The SmartAgri Plan

- Western Cape Agricultural Sector Climate Change Framework and Implementation Plan
- The SmartAgri Plan builds on the Western Cape Climate Change Response Strategy (WCCCRS 2014) – first sectoral response framework and plan
- Launch: 17 May 2016
- Everyone in the sector has a role to play
The SmartAgri Plan 2016

www.greenagri.org.za
Brief for the Deciduous Fruit Sector

A Status Quo Review of Climate Change and the Agricultural Sector of the Western Cape Province

www.greenagri.org.za
Climate change and the deciduous fruit industry

- Impacts differ between production regions, fruit types, cultivars and farms, and within-farm
- Responses need to be tailored
- Presentation: focus on Western Cape but will touch on other production regions
Deciduous fruit production zones

Bokkeveld
Bo-Langkloof - Outeniqua
Breede
Cape Town - Winelands
Cederberg
Grabouw - Villiersdorp - Franschhoek
GrootBrak-Plett
Hardeveld/ Sandveld-north
Hex
Knersvlakte
Koup
Little-Karoo
Montagu-Barrydale
Mossel Bay-Herbertsdale
Nelspoort
Olifants irrigation
Piketberg
Rooikaroo-Aurora
Rûens-East
Rûens-West
Sandveld-South
Swartland
Tankwa-van Wyksdorp

Developed by M. Wallace, Western Cape Department of Agriculture.
WC Climate shifts: 1960-2010

- Rising temperatures (1°C warming), higher max/min temperatures, more hot days
- Mean annual rainfall: no overall trends
- Some stations show some trends in rainfall some months
- Reduction in rain days Jan-April and August; increased rain days in Nov-Dec in the west
- Shift toward later start of rainy season and a wetter late season
Ceres: Positive Chill Units are decreasing (esp. May)

Figure 4.11 Observed accumulated positive chill units for Ceres for the period 1981 – 2010.

Phumudzo Tharaga 2014: Impacts of Climate Change on Accumulated Chill Units at Selected Fruit Production Sites in South Africa. MScAgric (UFS)
Bethlehem: no trend

Figure 4.7 Observed accumulated positive chill units for Bethlehem for the period 1981 – 2010.

Phumudzo Tharaga 2014: Impacts of Climate Change on Accumulated Chill Units at Selected Fruit Production Sites in South Africa. MScAgric (UFS)
Western Cape climate projections: 2050

- Warming: 1.5°C - 3°C by 2050, lower range along coast
- More hot days, fewer cold days
- Reductions in winter rainfall across the province (greater certainty in the western regions)
- More rain on windward mountain slopes in autumn and spring
- Strong likelihood of more intense rainfall events
- Both increased and decreased mean rainfall should be considered by decision makers
Positive Chill Units will decrease further

Tharaga 2014 - Ceres: Climate change projections indicate decreases in accumulated PCUs of 2 – 5% by the 2020s, 7 – 17% by the 2050s, 20 – 34% towards the end of the century. This culminates in a loss of between 320 and 540 PCUs by the 2080s.

Midgley and Lötze 2011: Future warming of 0.5, 1.0, 1.5 and 2.0 °C in the Grabouw-Villiersdorp region will reduce chill units by 9-17 %, 19-34 %, 29-48 %, and 39-62 %, respectively. In the Koue Bokkeveld region, similar warming will result in losses of 10-14 %, 13-20 %, 18-26 %, and 24-32 %.

With rest-breaking agents apple production in the Koue Bokkeveld will remain viable from a chilling perspective.
Severe weather events: increasing out to 2050

- More heat stress
- More frequent and longer dry spells
- More heavy rainfall and floods
- Possible changes in hail and strong winds
- Increasingly favourable conditions for wildfires
Changes in maximum temperature: 2050
Additional number of hot days: 2050
Additional number of hot days: 2050

1. Koue Bokkeveld
2. Elgin-Grabouw
3. Langkloof
Rainfall changes: 2050

DE KEUR (altitude 935m)
Total monthly rainfall RCP 8.5

- Observed 1942 to 1989
- (increase) 10th to 90th percentile range 2040 - 2060

Graph showing total monthly rainfall changes from 1942 to 1989 and projected increases and decreases from 2040 to 2060.
Rainfall changes: 2050

Koue Bokkeveld

Elgin-Grabouw

Langkloof
Future potential

With adaptation, generally remains viable for deciduous fruit (esp. stone) as long as dams fill up and water infrastructure is well maintained & managed & licensed to farming.
Future potential: Stellenbosch – Groot Drakenstein - Piketberg

Warming: low to medium range; Rainfall: decrease but more complex on mountains; Water allocations NB
Future potential: Warm & Koue Bokkeveld – Witzenberg – Upper Breede

Warming: medium range; Rainfall: decrease but more complex on mountains; Water is a problem.
Future potential: EGVV – Middle Breede - Koo

Warming: low to medium range; Rainfall: decrease but more complex on mountains; Apples come under pressure.
Future potential: Little Karoo

Warming: medium to high range; Rainfall: uncertain, models show increase or decrease
Future potential: Langkloof

Warming: low to medium range;
Rainfall: uncertain, models show increase or decrease;
Needs additional water infrastructure;
Apples may come under pressure.
Incremental versus transformative adaptation

Benefits of incremental adaptation:
- Responsive to change as it happens
- Aligned with existing market conditions
- Knowledge and technology exists

Risks of incremental adaptation:
- There are limits
- We can do the wrong things (maladaptation)
- We can start too late or miss the boat

Management decisions made in next 1-30 years have the potential to undermine the ability to cope with potentially larger impacts later
**How does adaptation happen?**

*Incremental* versus *transformative* adaptation

Benefits of transformative adaptation:
- Plug into longer term opportunities early in the game
- Resilient to fast changes and tipping points

Risks of transformative adaptation:
- We can do the wrong things due to uncertainties in the climate projections
- We can lose markets
- We don’t have the knowledge

Business decisions and the timing of such decisions: *Find the balance between “climate resilience” and “market resilience”*
SmartAgri Scenarios

- High Road Response
- Climate Shock
- New Era
- Grace under Pressure
- Muddle Through
- Hard Times
- Low Road Response
SmartAgri Scenarios

- High Road Response
- Climate Shock
- Low Road Response
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2016 position
SmartAgri Scenarios

- High Road Response
- Preferred position
- New Era
- Grace Under Pressure
- Muddle Through
- Hard Times
- Climate Shock
- Low Road Response
- 2016 position
- Worst position
What can fruit farmers do to adapt?

- Site preparation and soil management
- Cultivar and rootstock choices; plant material
- Training systems and canopy management
- Water management
- Precision farming and fine-scale mapping: Cape Farm Mapper, FruitLook, drones etc.
- Shade netting
- Rest-breaking agents
- Pests and diseases; Bees
- Risk reduction & management
- Monitoring and data management
- Market intelligence: global climate change impacts
Cultivar and rootstock choices

• Based on site microclimate – measure as intensively as possible

• Forward planning: medium- to long-term farm plan for cultivar replacement that accounts for gradual warming

• Fine-scale farm mapping: soils, climate, hydrology, flood risk, frost risk – then add 1°C and more variable rainfall

• Don’t use what is already marginal / risky

• Leave room for shifts in mean harvest date
Cultivar choices

- Cultivars with lower chill requirements
- Red/blushed cultivars/strains which are less sensitive to high temperatures
- Cultivars/strains which are more resilient against sunburn
- Cultivars/strains with good fruit size distribution
- Make use of very early or very late cultivars to avoid mid-season climate stress
- Cultivars with markets for Class 2 and 3 fruit
Genetic stability can be compromised under conditions of stress. Great care should be taken when selecting and propagating red/blushed strains. Resilience to colour loss and sunburn, together with chilling requirement, will become ever more important as cultivar criteria.
Quality of plant material

• Use improved robust strains, not old sensitive ones
• Plant strong and healthy trees – certified and disease-free with healthy root system
• Poor quality trees and struggling orchards: more susceptible to climate stress
Water management

- Maintain water infrastructure and reduce losses
- Attention to drainage and runoff management
- Correct management of on-farm wetlands and river banks including alien plant clearing
- Have a farm “drought plan”
Climate change will have different impacts in different regions. Building infrastructure is not always the solution. Adaptation must also include more efficient use and improved catchment management.
• Know precisely how much water is needed and how much is given – measure!
• Use FruitLook
• Use precision irrigation technology
• Eliminate wastage (over-irrigation)
Through precision measurements we are beginning to understand the water use of orchards of different ages and in different regions. Adaptation will require the optimisation of water productivity (volume of water used per unit of yield) and fruit quality.
There is a huge amount we still don’t understand about shade netting. This is a HORTGRO Science priority research area. The benefits could be enormous, but there are also risks.
Concluding remarks

• Fruit businesses need:
  – Knowledge and strategic research
  – Adaptive technologies
  – The business case for adaptation
  – Forward planning
  – Monitoring, analysis and adjustments

• Every production manager or technical advisor needs to engage on all five needs

Make the best possible decisions now and reap the rewards in 20-30 years without compromising on short term goals
Thank you