REPORT: Visit to Israel and Turkey

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Hortgro Science,

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Content

1. Objectives of the visit:

The objectives of the visit were the following:

- To learn more about the management of water, precision irrigation and irrigation innovation for which Israel is so well known.
- To visit Netafim, the major drip irrigation supplier in South Africa.
- To visit low chill pome and stone fruit breeding programmes.
- To meet up with applied Israeli researchers working on rest breaking, irrigation, fruit cracking, and fruit thinning.
- To meet representatives from Saturas with the intention to trial their stem water potential probe in deciduous orchards in South Africa.
- To listen to presentation on the latest horticultural research on a diverse range of subjects and to expand networks during the International Horticultural Congress.

2. Touring party members:

Hugh Campbell	Hortgro
Wiehann Steyn	Hortgro
Xolani Siboza	Hortgro
Karen Theron	SU Horticultural Science
Hannes Halgryn	Fruitways
Keith Bradley	Fruitways
Angelique Zeelie	Fruitways
Tobie van Rooyen	ProCrop
Abie Vorster	Netafim

3. Israel

Prof Eilon Adar	Host: Prof Eilon Adar, Director, Zuckerberg Research Institute for Water Research, Ben-Gurion University of the Negev (http://in.bgu.ac.il/en/bidr/ziwr/Pages/default.aspx).
	
	Date: 6 August
	
	Reasons for visit:
	• Prof Adar is a global expert on water resource management, water sources, use and technology. His main research activities deal with: quantitative assessments of groundwater flow systems; sources of recharge on complex basins with puzzling geology and scarce hydrological information; and modelling of temporal and spatial distribution of contaminants in aquatic systems (adapted from Bloomberg online).
	• Prof Adar visited the Western Cape during 2018 as host of the Israeli embassy but was unfortunately not available to present at the Hortgro Science Technical Symposium – this was a follow-up visit to strengthen ties with Prof Adar.
	
	Programme:
	• Met with Prof Adar at the Ramat Negev Desert Agroresearch and Business Center (http://www.negev.org/index.html) where various crops are grown with brackish water.
	
	Key learnings:
	• Water should be managed as a commodity that has value. When water has to be bought and can be sold, people are more likely to treat it as a resource from which the maximum value should be extracted. This ensures efficient water use at national, municipal, farm and household level.
	• Underground water is connected and boreholes should be coordinated at catchment level. We need a bottom-up approach for ground water management at local catchment level.
	• Prof Adar explained to the group that there is three pipelines running through the whole Israel which are mixed according to the quality of the water and the crops requirement:
	  ○ Blue pipe = fresh water from the north (Sea of Galilee)
	  ○ Green pipe = brackish well water
	  ○ Red pipe = treated water
	• While it is important to optimise water use and to save water, we need to secure more water for the future, for example by recycling of water. 80% of municipal water in Israel is recycled and sold to agriculture.
	• Recycled water is an untapped resource in South Africa. Their might be opportunities for agricultural communities surrounding rural towns to invest in recycling and to thereby secure another source of irrigation water whilst helping the municipality to manage sewage.
	• Israel accepted its water limitations but had the dream of “making the desert bloom”. The current drought in the Western and Eastern Cape is a wakeup call that we require the same urgency to deal with our new and future reality of water limitation. The belief that “everything will be ok in the end” or that

	"they" (whoever they might be) should sort out our water problems is misplaced and unrealistic. Action: • Publish findings of visit in the Fresh Quarterly. **Action Wiehann Steyn – Done (**FQ#2) • Suggest to the TTAC that Prof Adar is invited as keynote presenter to the 2019 Hortgro Science Technical Symposium. **Action Wiehann Steyn – Done** • Present report to Hortgro Pome and Stone. **Action Hugh Campbell & Wiehann Steyn**
Agricultural Research Organization: Volcani Center	Hosts: • Dr Moshe Flaishman, Snr Scientist • Dr Etti Orr, Snr Scientist Date: 7 August Reasons for visit: • The Volcani Center is the leading agricultural research organisation in Israel and is world-renowned for their horticultural research (https://www.agri.gov.il/departments/20.aspx) • Moshe Flaishman has recently established a pear breeding programme. • Etti Or is a researcher on dormancy in grapevine. Observations: • Moshe is breeding pears and (more recently) apples for adaptability to low CU accumulation and adaptability to high temperatures. • There is a strong focus on the genetic plasticity of genotypes, i.e. the ability to adapt (and be commercially grown) to diverse conditions including low chill and heat. • Moshe indicates that winters are increasingly interrupted by periods of high temperature. • Uses markers for dominant genes – no use for complex traits. Has a marker for low chill in apple. • Has also used Anna to obtain low chill adaptability in apple but then add a couple of generations of backcrosses (1/8 Anna in the final product). • Pear breeding programme has a focus on Fire Blight resistance. Have some very low chill pears (blush). • All phase 1 planted onto 3 different Quince rootstocks as Quince provides a form of stress that helps plant get out of juvenility. • Etti Or mentioned the risk of losing Dormex. However, EU's been quiet – possibly anticipating their own future low chill problems. • Uses NH_4NO_3 in rest break mixes or own its own. • Have various theories on dormancy release mechanisms – Dr Esmé Louw will catch up with Etti at the International Dormancy Workgroup meeting, Nov 2018, Kyoto, Japan. Relevant recent publications: • Gabay et al. (2018). High-resolution genetic linkage map of European pear

	(Pyrus communis) and QTL fine-mapping of vegetative budbreak time. BMC Plant Bio. 18. 10.1186/s12870-018-1386-2. • Flaishman et al. (2017). Deciduous fruit trees in a warming world: differentially expressed heat-regulated genes can be used in marker-assisted horticultural practice. Acta Hort. 327-332. 10.17660/ActaHortic.2017.1177.47. • Flaishman et al. (2015). Differential response of cell-cycle and cell-expansion regulators to heat stress in apple (Malus domestica) fruitlets. Plant Sci. 233. 10.1016/j.plantsci.2015.01.005. • Zheng et al. (2018). Abscisic acid catabolism enhances dormancy release of grapevine buds. Plant Cell Environ. DOI: 10.1111/pce.13371 Actions: • Pass on info on to Cultivar Acquisition Manager/ André Smit. **Action Wiehann Steyn**
Netafim Yiftah factory (based at a Kibbutz)	Host: Ziv Charitt, Chief Agronomist, Tree crops Date: 8 August Reasons for visit: • Netafim (https://www.netafim.com/) is the leading supplier of drip irrigation technology in South Africa and is well known for their irrigation innovation. • Irrigation efficiency is a key aim of Phase 2 of the OoF programme and Hortgro Science is seeking the involvement of Netafim in new OoF orchards. Programme and observations: • Plant measurement is the future of irrigation scheduling. • Most irrigation scheduling in Israel is done based on pressure chamber readings of stem water potential – commercial companies are providing this service. Actions: • Popular article in SAFJ or Fresh Quarterly on different soil and plant sensors for irrigation scheduling. **Action Wiehann Steyn**.
Ben Dor Fruits and Nurseries	Hosts: Joseph (Seffi) and Ido Ben-Dor. _____ Date: 8 September Reasons for visit: • Ben Dor (https://www.bendorfruits.com/index.html) is a breeder of low chill cultivars, some of which (mostly plums) are grown in RSA. Observations: • Seffi pitches Ben Dor as an international breeding company that supplies cultivars according to the needs of the client, whoever and wherever they might be. • Used to be a fruit grower, but at the cost of water and the challenges around

	labour they are now focusing on breeding. • They believe that good genetics within the breeding populations is key. Good genetics in their context refers to climatic adaptability and taste (high flavour, aroma and TSS). • Most noteworthy recent cultivars include red-fleshed plums, Eden pear (grown at 150-1000 CU, 1 year storage in RA), Nashi pear hybrids, low chill apples, coloured apricots, red flesh and donut peaches (up to 32º BRIX), and red-fleshed nectarines – see the website for more info. • We didn't visit the nursery, but Ben Dor produces trees in pots under nets, also bare-rooted trees, and tissue culture apple and plum rootstocks – see the website for more info. Actions: • Pass on info on to Cultivar Acquisition Manager/ André Smit. **Action – Wiehann Steyn**
Migal Galilee Research Institute and the Golan Heights	Hosts: • Prof Raffi Stern, Horticulture researcher • Dr Omer Crane, Horticulture researcher • Dr Amos Naor, Soil science researcher Date: 9 September Reasons for visit: • Prof Stern is a general horticulturist who has worked much in the same field as Prof Karen Theron, i.e. fruit set, fruit size, colour development and cracking in Pink Lady. • Dr Crane accompanied us to a visit to the Golan Heights apple and cherry production area. • Dr Naor is a leading irrigation scientist and has written many papers and reviews on the subject. Observations: • High temperatures (4 days >34ºC) within 40 dafb associated with cracking in Pink Lady, which often leads to *Alternaria*. ○ It was noted by Prof Stern that European researchers come to Israel to explore the impact of high temperatures on tree performance. • Bumble bees as pollinators work at lower temperatures than honey bees and also under nets – unfortunately, the best options are exotics and not an option for SA growers. • Golan Heights receives about 1000 CU. Rest breaking is still necessary. Crop loads are kept at 60 tonnes / ha due to the requirement for 70% of the crop to be >70 mm in size. • Prof Crane showed us some trial plantings of young apple trees trained as multi-leader, bi-baum or central leader trees. • According to Prof Naor, stem water potential measurements are commonly used in Israel to schedule irrigation. • Research has established the WP range needed in apple.

	• Higher WP threshold is needed at higher crop load to not have negative effect on fruit size. Relevant publications: • Naor. (2006). Irrigation scheduling and evaluation of tree water status in deciduous orchards. Hort. Reviews 32: 111-165. • Naschitz and Naor. (2005). The effect of crop load on tree water consumption of `Golden Delicious' apples in relation to fruit size: an operative model. JASHS. 130: 7-11. • Cohen et al. (2007). Hydraulic resistance components of mature apple trees on rootstocks of different vigours. J. Exp. Bot. 58: 4213–4224. • Naor et al. (1995). Stem water potential and apple size. JASHS 120: 577-582. • Stern et al. (2013). Reducing the incidence of calyx cracking in 'Pink Lady' apple using a combination of cytokinin (6-benzyladenine) and gibberellins (GA_{4+7}). J. Hort.l Sci. Biotech.88: 147-153. • Stern. (2015). The photosynthesis inhibitor metamitron is a highly effective thinner for 'Golden Delicious' apple in a warm climate. Fruits 70: 127-134. • Ginzberg and Stern. (2016). Strengthening fruit-skin resistance to growth strain by application of plant growth regulators. Sci. Hort. 198: 150-153. • Joshi et al. (2018). Identification of candidate genes mediating apple fruit-cracking resistance following the application of gibberellic acids 4 + 7 and the cytokinin 6-benzyladenine. Plant Physiol. Biochem. 127: 436-445. • Krikeb et al. (2017). Evaluation of apple flowering intensity using color image processing for tree specific chemical thinning. Adv. Animal Biosci. 8: 466-470. Current projects: • Effect of irrigation and crop level on yield, fruitsize distribution and water relations of apple trees (Naor) • Effect of irrigation and crop level on yield, frutsize distribution and water relation of nectarine trees (Naor) • Development of irrigation control criterion based on both midday stem water potential and daily trunk shrinkage (Naor) Actions: • Europeans come to Israel to explore the impact of high temperatures on tree performance: This should also pose an opportunity in South Africa to host research of European counterparts. **Action: Hortgro Science** explores opportunities of hosting research.
Saturas	Hosts: • Anat Halgoa Solomon, CEO • Dr Avishai Avni, chief agronomist • Avi Shtain, agronomist Date: 8 September Reasons for visit: • Saturas (http://saturas-ag.com/about-us/) approached W Steyn through

	Netafim re possibility of testing their sensor in South Africa. It was convenient to meet with them while in Israel. Observations: • The Saturas sensor is embedded in the trunk of the tree where it continuously logs stem water potential. These readings might make it possible to irrigate according to the tree's water needs. • This technology might have application in RSA if it is cost effective. We may need to develop stem water potential thresholds and WP ranges for our conditions. • The model by which Saturas will make the sensors available is still uncertain but may involve them collecting the data and suggest irrigation decisions to the grower. Actions: • Arrange for sensors to be incorporated into a trial of Prof Stephanie Midgley in the Witzenberg Valley on apple water use under nets from Oct. 2018. **Action Wiehann Steyn – Done**.

Chatting to Prof Adar in the Negev desert.

Moshe Flaishman at the Volcani evaluation site.

Ziv Charitt of Netafim explaining the Saturas stem water potential sensor.

Tasting fruit at Ben-Dor.

Assessing the low chill Eden pear.

Apple planting system trial on the Golan Heights with Omer Crane.

A netted apple orchard on the Golan Heights.

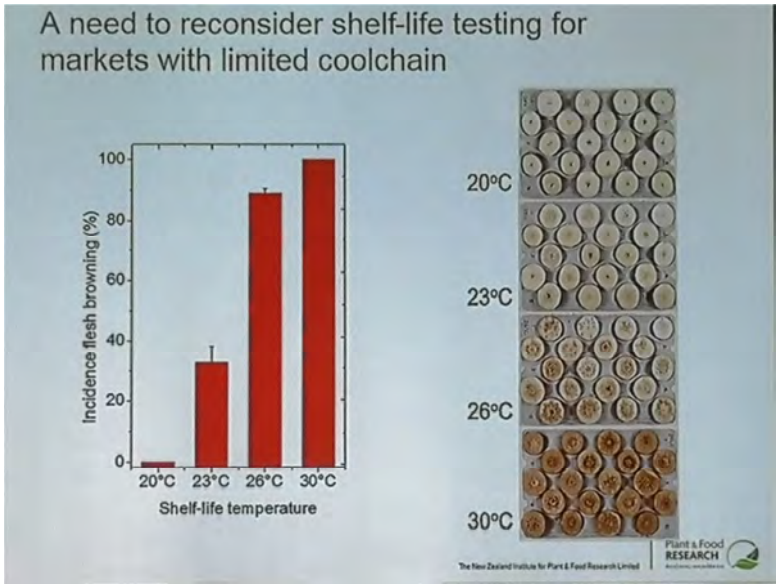
The SA touring party to Israel and Turkey.

4. XXX. International Horticultural Congress

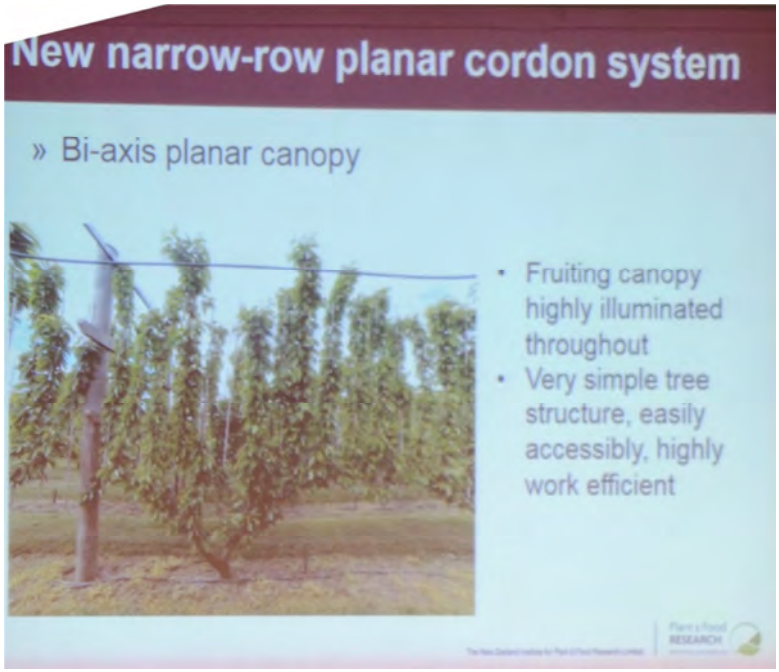
Event	XXX International Horticultural Congress
Date	12 - 17 August 2018 in Istanbul, Turkey
Organiser	Prof Yüksel Tüzel, Ege University, İzmir, Turkey
Delegates & RSA participants	• ~1800 delegates from >90 countries • Hugh Campbell, Karen Theron, Keith Bradley, Hannes Halgryn, Tobie van Rooyen, Angelique Zeelie, Xolani Siboza, Abie Vorster, Graeme Krige, Anton Muller, Willie Kotze, Elmi Lötze, Stephanie Midgley, Nicky Taylor (UP), John Annandale (UP), Ola Fawole, Esmé Louw, Wiehann Steyn, Sophia Malan (SAPO), Shelley Johnson, Asanda Mditshwa(KZN)
Programme	• 2 colloquia, 39 (24 within the ISHS series) symposia and 11 workshops • 9 plenary lectures, 67 keynote speakers, more than 950 oral and 750 poster presentations • Colloquia o Future Technologies in Horticulture o Innovations: Best Practices in the World
Noteworthy symposia and interesting presentations	• **S9- Evaluation of Cultivars, Rootstocks and Management Systems for Sustainable Production of Deciduous Fruit Crops** o Effects of dwarfing and semi-dwarfing apple rootstocks on the growth Evaluation of apple rootstocks planted in different locations in South Africa - Dr Xolani Siboza o Quantifying white root growth dynamics of bearing apple trees in a Mediterranean climate, South Africa - Dr Elmi Lötze • **S10- Understanding Fruit Tree Behaviour in Dynamic Environments** o Carbon gain in relation to water loss in the face of global change – Prof Graham Farquhar (Keynote) o Water use productivity of high performing apple orchards in the winter rainfall area of South Africa - Prof Stephanie Midgley o Seasonal adaptation of `Honeycrisp´ apple grown under colored protected netting in a semi-arid environment - Dr Giverson Mupambi o Illuminating the relationship between canopy light relations and fruit yield and quality in apple planar cordon orchard systems - Dr Ken Breen o Fruit set and quality responses to artificial spur extinction in planar cordon sweet cherry trees - Dr Jill Stanley o Does lack of winter chill cause variability in fruit maturity and quality? - Dr Esme D. Louw • **S31- Mechanization, Precision Horticulture, and Robotics (2nd International symposium)** • **S32- Strategies and Technologies to Maintain Quality and Reduce Postharvest Losses** o Innovations in storage technologies – Prof Chris Watkins (Keynote) o New genetics, new physiology, new challenges for apple and pear postharvest performance - Jason Johnston o Exploring X-ray treatments for disinfesting apples - Allan Woolf o Revisiting the regulation of fruit development and ripening: anything besides ethylene - Mondher Bouzayen (Keynote) o Dynamic controlled atmosphere storage and physiological disorders of

	apple fruit - Chris Watkins ○ Factors affecting internal browning of new apple cultivars over long term storage - Peter Toivonen ○ Effects of ozone applications on postharvest diseases of fruit and vegetables - Pervin Teksur ○ Fruit and vegetable consumption: the role of consumer attitudes, habits and routines – Roger Harker (Keynote) • **S33- Water and Nutrient Relations and Management of Horticultural Crops** ○ Does precision irrigation help to reduce water consumption in agriculture? - José Enrique Fernandez (Keynote) • **S38- 10th International Symposium on Temperate Fruits in the Tropics and Subtropics**
Noteworthy workshops and interesting presentations	• **Impact and mitigation strategy for the temperate fruits in the tropics and subtropics.** ○ Strategies for producing temperate tree fruit under milder winter temperatures - Dr Greg Reighard ○ The challenge of warming winters' do we understand tree dormancy enough to prepare deciduous orchards in warm places - Dr Eike Luedeling ○ Studies on adaptability of fruit trees to climate change - Dr Marisa Badenes • **Workshop on UAVs in horticulture**
Some learnings	• Newer apple cultivars (with often denser fruit) seem more susceptible to internal browning. • Internal browning increased markedly with increasing shelf-life temperature. • Increased internal browning at advanced maturity. • X-ray treatment may control codling moth but increases internal browning at high dosage. • Evidence that scion cultivars differ in water stress susceptibility. • Expression of DAM and SAP-like genes (expressed during dormancy release and stress conditions, respectively) provides an avenue for assessing the depth of dormancy. • Enormous progress in UAV's, remote sensing, machine learning, photogrammetry and associated fields. • Prof Terence Robinson indicated that G.213 is a low chill semi-dwarfing rootstock that should do well in South Africa. He indicated that about half of all Geneva rootstocks sold in the USA are produced via tissue culture. Indicated that Brazil is also going the tissue culture route.

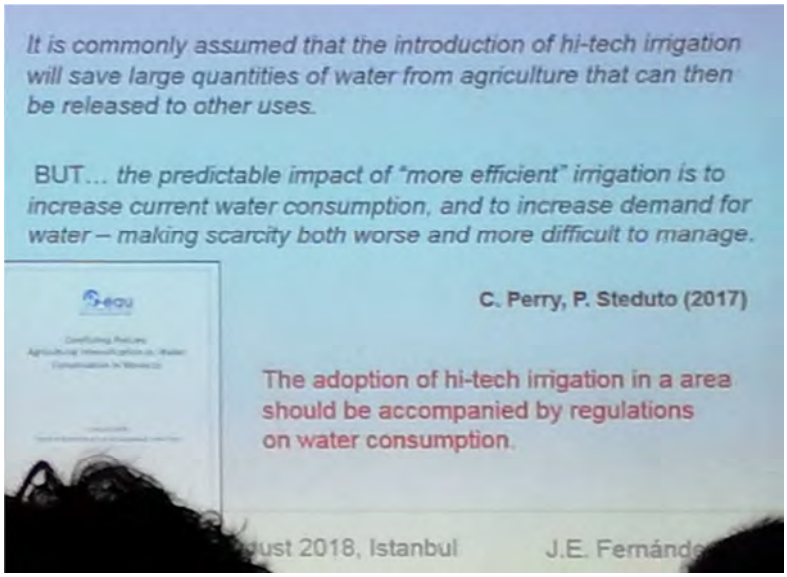
Some of the South Africans and international colleagues (Ken Breen front right and Eike Luedeling back right) attending the XXX International Horticultural Congress.



Slide from presentation by Jason Johnston that indicates that internal browning increases with increasing shelf-life temperature. The info has been passes on to Dr Elke Crouch.



Slide from presentation by Ken Breen of the new bi-axis planar cordon system that is being evaluated in NZ.



Keynote presenter José Fernández does not believe that more efficient irrigation will decrease water consumption.

Tissue culture and micro propagated plants at the Agromillora stall.

5. Take home lessons and recommendations

Lessons learnt	Recommendations and actions
1. Water	
• Water should be managed as a commodity that has value. When water has to be bought and can be sold, people are more likely to treat it as a resource from which the maximum value should be extracted. This ensures efficient water use at national, municipal, farm and household level.	• Invite Prof Adar to speak on these issues at the next Technical Symposium.
• Underground water is connected and boreholes should be coordinated at catchment level. We need a bottom-up approach for ground water management at local catchment level.	
• The recent drought is a wakeup call for the (Israeli) urgency that we require to deal with our new and future reality of water limitation. We need to secure more water for the future, for example by recycling of water. There might be opportunities for agricultural communities surrounding rural towns to	• Hortgro needs a focus (team or strategy) on water as potentially the most limiting factor to fruit production in future.

invest in recycling and to thereby secure another source of irrigation water. Recycled water might be quite costly. However, water is unlikely to remain cheap and readily available. • We should be able to make drip irrigation work anywhere in our industry. Drip irrigation undoubtedly requires more intensive management. • The new continuous logging stem water potential probes developed by Saturas is an exciting development that may have us determine plant water needs and irrigate according to plant water status rather than indirectly through assessing soil water status.	• Drip irrigation is a key theme of Phase 2 of the OOF project. • Already arranged for Prof Midgley to evaluate the probes in one of her research projects – **In Progress**.
2. <u>Collaborations.</u> • There is significant overlap between South African and Israeli research needs on for example cracking and dormancy. • Collaboration with Prof Eike Luedeling of Bonn University. • Like Israel, South Africa could serve as a (counter-season) research base for EU researchers to explore the effects of adverse (increasing) temperatures on deciduous fruit production.	• Dr Esmé Louw will attend a dormancy workgroup meeting in Kyoto during Oct 2018. She will meet up with Prof Eti Or – **Done**. • We set up an informal meeting between Prof Luedeling and Dr Louw in Istanbul. It seems that a collaboration on the dynamic chill model might be forthcoming. Dr Louw will meet up with Prof Luedeling at the dormancy workgroup meeting in Kyoto - **Done**. • Hortgro Science to explore opportunities in this regard.
3. <u>Breeding</u> • Private breeding programmes are run like a business and are aimed at meeting the needs of the client. • There are other low chill production areas and breeding programmes aimed at meeting the needs of these areas. • Both Israeli programmes that we visited focus on the genetic plasticity of new cultivar, which means that cultivars should do well at high (1000 CU) and low (150 CU) chill. • Selection of promising genotypes has to take place in the regions (or regions very similar to) where they are to be grown.	• Reconsider our industry breeding programme in the light of the possibility of buying into private programmes.

Appendix 1

Contacts:

Congress Prof Eike Lüdeling, dormancy researcher, Bonn University

Research organisations

- **Zuckerberg Water Research Institute for Water Research,**
  http://in.bgu.ac.il/en/bidr/ziwr/Pages/default.aspx
  Prof Eilon Adar, Director
- **Volani Center**, https://www.agri.gov.il/departments/20.aspx)http://
  www.acfr.usyd.edu.au/ Dr Moshe Flaishman, Snr Scientist
  Dr Etti Orr, Snr Scientist
- **Migal Galilee Research Institute,** http://www.migal.org.il/
  Prof Raffi Stern, Horticulture researcher
  Dr Omer Crane, Horticulture researcher
  Dr Amos Naor, Soil science researcher

Companies

- **Netafim**, https://www.netafim.com/
  Ziv Charitt, Senior Agronomist
- **Ben-Dor Fruits and Nurseries,** https://www.bendorfruits.com/index.html
  Ido Ben-Dor, breeder
- **Saturas,** http://saturas-ag.com/about-us/
  Anat Halgoa Solomon, CEO
  Dr Avishai Avni, chief agronomist
  Avi Shtain, agronomist

Appendix 2

The final tour itinerary was as follows:

ISRAEL

Saturday 4 to Sunday 5 August:
Travel from Cape Town to Jerusalem via Istanbul

Monday 6 August:
Visit Prof Eilon Adar, Zuckerberg Institute for Water Research at the Ramat Negev Desert Agroresearch and Business Center.

Tuesday 7 August:
Visit Agricultural Research Organisation Volcani Center (Moshe Flaishman & Etti Or).
Travel to Tiberias, Galilee.

Wednesday 8 August:
Visit Netafim Yiftah factory and Training Center.
Visit Ben-Dor Fruits and Nurseries

Thursday 9 August:
Visit the Northern R&D Center of the Migal Galilee Research Institute. Meet with Profs Raffi Stern, Amos Naor and Omer Crane
Visit the Golan Heights with Omer Crane.
Travel to Haifa

Friday 10 August:
Travel to the Dead Sea

Saturday 11 August:
Visit Masada and travel to Tel-Aviv.

Sunday 12 August:
Travel to Istanbul, Turkey

TURKEY

Sunday 12 to Thursday 16 August:
Attend International Horticulture Congress, Istanbul

Saturday 18 August:
Depart Istanbul