

Wiehann Steyn, Hortgro Science Crop Production Programme Manager, recently visited the USA. We asked him a few questions regarding the reasons for his visit, his impressions on the Washington State apple industry and his thoughts on technology that might be applicable to South African conditions.

By Erin Morkel, Hortgro Science Technology Transfer Manager.

You recently visited the United States. Tell us a little more about your visit?

I attended and presented a paper at the XII International Symposium on Plant Bioregulators in Fruit Production held in Orlando, Florida from 28 July to 1 Aug. Thereafter I visited the head office of Valent BioSciences in Chicago on invitation together with Prof Karen Theron of Stellenbosch University, Anton Muller of KROMCO and Schalk Reynolds of Philagro. Finally, I visited the apple producing regions in the Columbia basin of Washington State together with Karen and Anton

Why did you visit Washington State?

There were various reasons for visiting Washington State. The foremost was to observe and learn from American efforts and experiences in increasing farming efficiencies. I visited South Tyrol on invitation of the International Pink Lady Association in September last year and this gave me the opportunity to study orchard mechanisation efforts in which is probably the most progressive apple production region in the world in this regard. However, South Tyrolian farming operations differ considerably from our setup in South Africa. Farms are generally much smaller and together with subsidies, this facilitates the use of harvesting systems. From the presentations and discussions with Paul Stiekema of Zirkle Fruit in Washington, who visited South Africa as keynote speaker at the Hortgro Science Symposium, it became evident that much may be learned from the similarities in the scale of operations in Washington State.

A secondary reason for visiting Washington was to build relationships with researchers and extension officers at the Washington Tree Fruit Research and Extension Centre (TFREC) (<http://www.treefruitresearch.com>).

Who did you visit?

Dr Jim McFerson, Manager of the TFREC, organised a jam-packed programme that included visits to the Centre for Precision and Automated Agricultural Systems (CPAAS), some of the most progressive farming operations such as Zirkle Fruit Company, Auvil Fruit Company, Oasis Farms, Allan Brothers Ranch, sunburn and rootstock evaluation trials, Washington State University (WSU) apple scion breeding evaluation sites, and even attendance of a field day at the WSU Sunrise Research Orchard.

What's the uptake on mechanisation in Washington State?

Due to the cost of the machines and the scale of operations, the uptake of harvesting systems seems to be slower than in South Tyrol, for example. This is despite many orchards being suitable for mechanical harvesting. Utilisation of platforms for replacing ladders when thinning, pruning, tree training and also harvesting seems to be more widespread.

The Washington State fruit industry is putting a lot of money into mechanisation. Tell us little more of what you saw at CPAAS

CPAAS runs some very innovative blue-sky projects – visit them at www.cpas.wsu.edu to have a look at some of the more interesting projects such as the Bin-Dog, DBR harvest assist system and machine vision system for automatic pruning of apples. Some of these projects may eventually result in technology that will find on-farm application. CPAAS has 11 research and extension staff, 6 postdoctoral and 12 postgraduate students working on projects to the value of ca. \$7.5 million. The big spend on automation and precision farming is testimony to the need to decrease labour and farming operational costs through increased efficiencies.

So how did your visit to Washington State influence your thoughts on mechanisation?

What is clear to me is that mechanization cannot be seen – and should not be studied – in isolation. It makes up the orchard system together with a diverse range of factors such as the management philosophy, farming and production objectives, operational systems, labour organisation, climate, orchard design and topography. The newer generation of Washington State apple orchards are planted at high density and trained to rather sparse fruiting walls. Some of the larger operations buy rooted liners, usually of M9, which they then plant at very high density and bud in the orchard. A V-system is often employed and allows growers to intercept more sunlight. Yields of up to 100 tons per ha are achieved. Smaller growers tend to plant nursery trees instead of budding rootstocks in the orchard. Fruiting walls facilitate mechanisation. Harvesting productivity of 8 to 10 410 kg bins per man day is achieved with these orchards with conventional ladder harvesting. Regalis™ is used to keep trees to their allotted space – this reduces pruning. We have also seen a lot of Extenday™ on the ground to increase red colour development, but with potential positive effects on bud quality. Paul Stiekema took us to a young orchard where they were applying Regalis™ to the lower halves of trees to decrease basal dominance and to encourage more leader growth. When asked about this practise, Paul winking at Anton replied that he picked up some interesting new technology during his recent visit to South Africa.

Gerrit van Merwe and Karen Theron, respectively evaluating platforms and mechanical thinning, showed that tree structure is one of the major impediments to mechanisation in South African deciduous fruit orchards. To increase efficiencies in the orchard, we need to move towards more dwarfing rootstocks and fruiting walls, as is being advocated by various technical consultants – see the article on the Future Orchards in the **xxx** issue of the SAFJ for an indication of current thoughts

on the matter. The Washington State summer climate is similar to South African conditions in the Western Cape in that maximum temperatures regularly reach 35°C. Sunburn can therefore be a problem even though irradiance levels and the heat load on fruit at 47 °N are considerably lower than at 33 °S. Almost every apple orchard in Washington State has an overhead evaporative cooling system consisting of rotating sprinklers that typically comes on when air temperature exceeds 30°C and then operates on a 30 minute on 30 minute off schedule. I don't believe the effects of having permanently moist upper topsoil over the entire orchard floor and lowered canopy temperatures have been quantified. However, one may assume that rootstocks like that M9 that apparently do not enjoy high soil temperatures and drought stress may benefit from this climate control. Large scale evaporative cooling requires a lot of water. But water is not a scarce resource in Washington State – only 5% of the Columbia River is currently being tapped. The deciduous fruit growing regions in South Africa generally do not have the water resources for large scale evaporative cooling. In fact, water scarcity, a long-term drying trend and increasing competition for water are going to be major limitations to future deciduous fruit production in the winter rainfall regions.

Netting may allow us to achieve similar benefits as the Americans with their evaporative cooling in that it will significantly decrease sunburn and rub marks, allow the utilisation of more dwarfing rootstocks, decrease irrigation needs, decrease heat stress and thereby potentially increase tree productivity, preclude the need for hail insurance and improve spray application efficiencies. On the downside, netting is very expensive (especially if the North-westerly and South-easterly winds rip it apart), may increase some diseases and pests, may decrease fruit set (particularly on vigorous rootstocks) and decrease fruit colour. We need research to determine the growth and fruiting responses of trees on dwarfing rootstocks under nets and we also need to quantify the benefits and negative effects of nets in order to determine the feasibility of netting different cultivars. The effect of nets on pests and diseases also requires elucidation.

What are your impressions on the WSU apple breeding programme?

We have seen and got to taste some impressive fruit coming out of the WSU and Minnesota University breeding programmes. The WSU apple breeding programme aims to make a large number of crosses with very particular goals in mind. Markers that link to storability and fire blight resistance are used to screen the progeny of crosses. Only selections that potentially surpass existing cultivars are allowed through to the semi-commercial evaluation phase. This decreases the cost of evaluation – it doesn't make any sense to allow selections that are just good, but not superior, through to the semi-commercial phase. You can read more about the WSU apple breeding programme at <http://www.tfrec.wsu.edu/pages/breed/>.

Do you have any further comments relating to your visit?

Washington State has become aware of gradual erosion in extension officer and applied researcher numbers through retirement and resignations. At the same time, academics at university are under increasing pressure to conduct publishable (read basic and molecular) research. The risk of such a

situation is a gradual and even unnoticeable decline in the human capacity that supports innovation and technological prowess in the industry. To address this state of affairs, a once-off levy on apple production has resulted in the creation of an endowment fund that will ultimately fund five research chairs together with WSU. Our visit to Washington State coincided with the appointment of Prof Stefano Musacchi, previously of the University of Bologna in Italy, as Endowed Chair in Tree Fruit Physiology/Management (<http://www.growingproduce.com/article/32746/pomologist-stefano-musacchi-joins-faculty-at-washington-state>). His appointment was preceded by the appointment of Desmond Layne, previously from Clemson University in South Carolina, as Professor of Pomology and Endowed Chair - Tree Fruit Extension Program Leader (<http://www.goodfruit.com/Good-Fruit-Grower/Web-2012/Des-Layne-to-join-WSU/>). A further position for a plant physiologist specialising on sunburn physiology and protection is in the process of being filled. I believe our industry should be aware of the eminent risk of losing key researcher specialists through retirement. It isn't so easy to fill specialist positions as evident from Washington State sourcing staff globally and local failure to fill a vacancy for a preharvest citrus researcher.



A.



B.



C

Fig 1. Various Washington State apple orchard designs. A. Slender spindle trees at Allan Brothers Farms. B. An ultra-high density netted V-system at Auvil Fruit Company (Photo KI Theron). C. Paul

Stiekema and Anton Muller in discussion in a mature V-system orchard at a Zirkle Fruit Farm. Note the uniform fruit distribution and the use of Extenday™.



A



B

Fig 2. A 100 ton Granny Smith orchard at Auvil Fruit Company. Trees were planted to a V. Fruit on the under sides of the V sits in the open while a short “umbrella” of one-year-old shoots is allowed in

the inner upper sides of the V provide protection against direct sunlight. Extenday™ is used to reflect light out of the work row into the under sides of the V to increase bud quality.



Fig 3. TFREC researchers have commenced with netting research and will be expanding this research into a programme. Opportunities for mutually beneficial research collaboration with these researchers are being explored.



Fig 4. Overhead evaporative cooling system typical of Washington State (Photo KI Theron).



Fig 5. Regalis™ application to the bottom halves of a young ultra-high density V planting at a Zirkle Fruit Farm (Photo KI Theron).