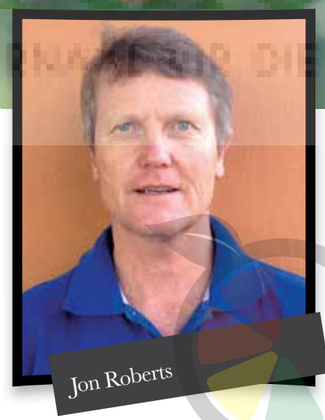
New plant-breeding techniques to keep growers in the game



Jon Roberts

The past year has seen a continuous stream of bad news challenging the citrus industry – including tough markets, logistics challenges, floods in Durban and serious inflationary increases. By **Jon Roberts**

Adding to current woes, the EU imposed drastic regulations at very short notice, in the middle of the picking season. This, while SA already complies with the current rigorous false codling moth risk management system (FMS), which had been highly effective in dealing with the risk of pest disease. This is in stark contrast to other southern hemisphere countries that have had as much as 200% higher incidences.

The new legislation requiring cold sterilisation treatment is contrary to scientific evidence and unjustified, and therefore an unnecessary trade restrictive measure. It's the equivalent of a trade block for Southern African states.

The FMS and the equally unsubstantiated citrus black spot (CBS) requirements come on the back of already onerous Good Agricultural Practices (GAP) requirements, which see the continuous red carding of chemical treatments, while at the same time being expected to produce a spotless orange for these discerning markets. We understand that the GAP practices are perfectly justifiable when it comes to issues like food safety, chemical use, social responsibilities to labour, and environmental impact. Therefore, it's confusing to have a scientifically unsubstantiated measure instituted by the EU to impose cold sterilisation that requires increased energy use. This flies in the face of GAP requirements for reduced carbon usage.

This is a debate that is unlikely to be won in the favour of SA, and it appears that this will be the continued modus operandi of the "developed world" to maintain whatever trade restrictive measures they can to protect their farmers. Though, those very famers are already heavily subsidised and their markets are counter-seasonal to those of SA.

So, how do we comply whilst navigating eroded revenues and shifting goalposts?

In addition, there are diseases like Huanglongbing (HLB) and ever-increasing new diseases and pests, due to climate change. And a global increase in average temperature is likely to increase the rates of reproduction of pests. Citrus valleys in the Eastern Cape experienced the first swarms of locust in recent generations. Another challenge is the almost uncontrollable entry points at the border posts whether by road, rail, air or on foot. This can be seen in the number of new pests and diseases that have been encountered just in the last decade. It is clear that agriculture and humanity are faced with serious challenges going forward.

Additional measures will need to be added to our mitigation systems to comply with the zero-tolerance approach of the northern hemisphere, and to manage the increasing challenges imposed by climate change.

An obvious element to be added – and for me, the ultimate solution to be included in current pest management systems – would be the breeding of cultivars that are tolerant or even resistant to these diseases. In a previous article, the breeding and discoveries in Florida of rootstocks that are potentially tolerant or resistant to diseases such as HLB, was discussed. These rootstocks are already being evaluated in SA. However, the conventional breeding systems, in some cases are not possible due to the sterility or incompatibility of some varieties of citrus. Furthermore, it is long term, (up to 15 years) and expensive due to the time it takes for growing out and evaluating to confirm the traits.

The proliferation of a number of New Plant Breeding Techniques (NPBTs), genome editing and cisgenics being but two, have been developed in recent years, now classified as NPBTs. However, the efficiency of NPBTs requires knowledge on which genes are responsible for the horticulturally important traits. In recent years many consortiums have been involved with genome sequencing and in time, it will be possible. Through NPBTs such as genome editing, using clustered regularly interspaced, short, palindromic repeats (CRISPR) it will allow scientists to target specific traits like the genes responsible for susceptibility or resistance.

The American Seed Foundation did an interview with Prof Fred Gmitter titled "Saving the orange", in reference to the Florida citrus industries' fight to save their industry from HLB. He said: "Using genome editing, we are doing what the tree could normally do. Given enough time, citrus trees would develop, evolve and build resistance to a disease like HLB. This might take a hundred thousand years, but if we can identify the gene that could make that change now, where it probably would have occurred naturally, we've accomplished something VERY important."

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The benefits of NPBTs include alternative methods for advancing biotic and abiotic resistance, nutritional quality, and crop performance.

Genome editing involves minor changes to a precise position in the DNA to specific genes with a known function. This causes an inheritable mutation that would have occurred in time in any case, in response to biotic or abiotic stresses. Cisgenesis is also a promising NPBT. It involves the transfer of genes, resulting from cross-compatible species, and therefore, a similar process to classical breeding.

Currently NPBTs are regulated differently. In the US NPBT crops are exempt from the strict GMO regulations of the USDA. However, there is still debate in the EU where they are currently considered to be GMOs.

There are significant challenges around food shortages worldwide. It will be interesting to see if there is consensus that these technologies are safe, and do not genetically modify with the same dangers argued to exist in GMOs.

An extract from *NPBTs in citrus for the Improvement of Important Agronomic Traits* by Fabrizio Salonia, Angelo Ciacciulli, Lara Poles, Helena Domenica Pappalardo, Stefano La Malfa and Concetta Licciardello: "The international community is working at developing short-, medium-, and long-term strategies in order to prevent and, eventually, to face the risk related to HLB, representing the most devastating citrus disease in the world. The identification of resistance and susceptible genes and the application of NPBTs to produce, in the near proximal future, resistant citrus plants."

While HLB is certainly the biggest threat facing citrus worldwide, there are multiple diseases that are seen as phytosanitary diseases and used as a pretext for protectionist restrictions in free trade as we have experienced over the past decade in SA.

Could equilibrium be restored between production costs and profitability for those cultivars that are resistant or tolerant and show no symptoms of the disease? Maybe, but it is evident that momentum is being gained, which should produce breakthroughs in these technologies in the near future.

Some anticipated hurdles in the process include which way the GMO status goes worldwide, and identifying the precise location of specific genes with known function that would advance traits such as biotic and abiotic resistance, nutritional quality and crop performance.

The International Citrus Congress on 6 - 11 November in Turkey should give insight into progress to date on some of the work where these technologies are being used.