How a nuclear technique helped save the Western Cape's orange industry

By Miklos Gaspar

Citrus fruit is the second most important agricultural export commodity in South Africa, with most of the production destined for exports. The industry employs 10% of the country's agricultural labour force.
(Photo: M. Gaspar/IAEA)

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> *— Piet Smit, orange farmer, South Africa*

Every morning at 7 a.m. a small plane takes off to swoop around a fertile valley amidst the scenic mountains of the Western Cape in South Africa, offloading its cargo of 1 000 000 ready-to-mate moths. The insects have been mass-reared and sterilized using a gamma irradiator and other specialized equipment made available by the IAEA in 2007. The result: citrus orchards free of the devastation of the false codling moth in the Olifants River Valley, and an industry, once on the brink of extinction, is now thriving again.

"In just five years the infestation has gone," said Martli Slabber, who grows oranges, clementines and lemons on her 100-hectare farm. "From two infested fruits per tree every week we are down to a single one in the entire orchard per season."

The suppression of the moth has saved the livelihoods of close to 10 000 people, added grower Gerrit van der Merwe. "Without citrus, there would be no jobs here."

Slabber and van der Merwe are two of 400 citrus farmers who use the services of XSIT, a company owned by the Citrus Growers Association of South Africa, to deal with the false codling moth, which naturally resides in some parts of the country, including the Olifants River Valley. The moths' larvae feed on citrus fruits, destroying the pulp.

XSIT — named after the nuclear-based sterile insect technique (SIT) — produces and releases 40 million sterile moths every week in an area of over 15 000 hectares. Fed on an optimized diet of maize, wheat germ and milk powder, the moths are irradiated and released when they are at the height of their sexual potential. The sterile moths mate with wild insects, but this mating does not produce any offspring, diminishing the population over time (see The Science box, page 12).

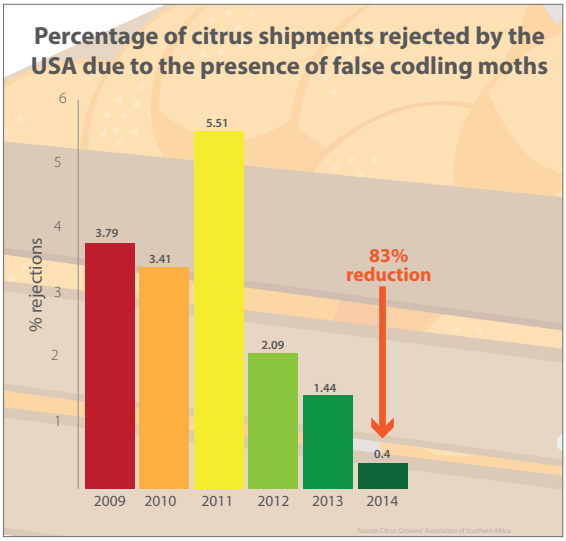
"SIT has allowed us to go green and not use chemicals against the moth anymore," said Piet Smit, who produces 11 000 tonnes of citrus a year on 250 hectares of land. "We also no longer have problems with insecticide residue levels on the fruit."

Thanks to the reduced use of chemicals, wildlife has returned to the orchard, van der Merwe added.

Citrus, the lifeblood of the region's economy

South Africa is the second largest exporter of citrus fruits in the world, with exports worth over $1.4 billion in 2014. Citrus is the country's second most important agricultural export commodity after wine. The industry employs 10% of South Africa's agricultural labour force.

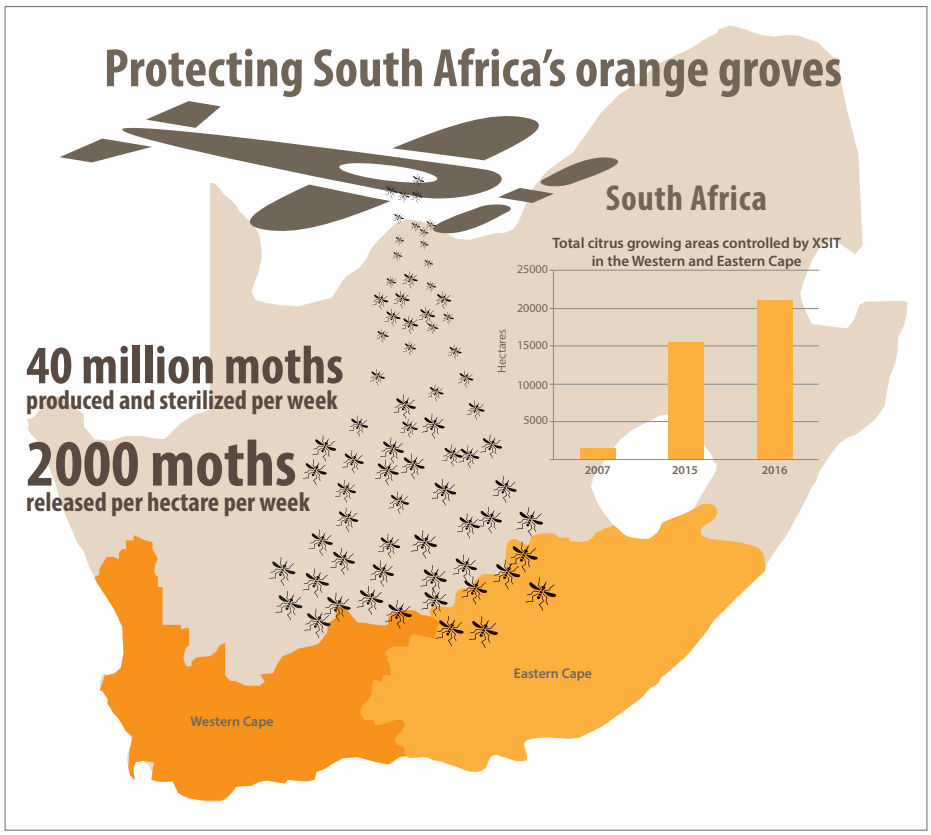
Back in 2005, the main export market for the region's citrus fruit, the United States of America, tightened import quality and infestation reduction measures, as US agricultural authorities grew concerned about the spread of the false codling moth to their country, potentially threatening their citrus and cotton industries.



Slabber, van der Merwe and other farmers in the area used to lose between 10% and 15% of their production to the pests before harvest, but the real losses came from the pest-infested fruits that made it into shipments and were returned by US inspectors. If they found just three larvae in a shipment of 160 000 oranges, they would return the entire consignment. "We were seriously considering alternative crops," Slabber recalled.

The search for a new method

It was time to find a new pest control method, explained Vaughan Hattingh, a biologist and researcher, and now Chief Executive Officer of Citrus Research International (CRI). CRI began research in radiation biology and rearing techniques to see if SIT could be adapted for the false codling moth. The IAEA, in cooperation with the Food and Agriculture Organization



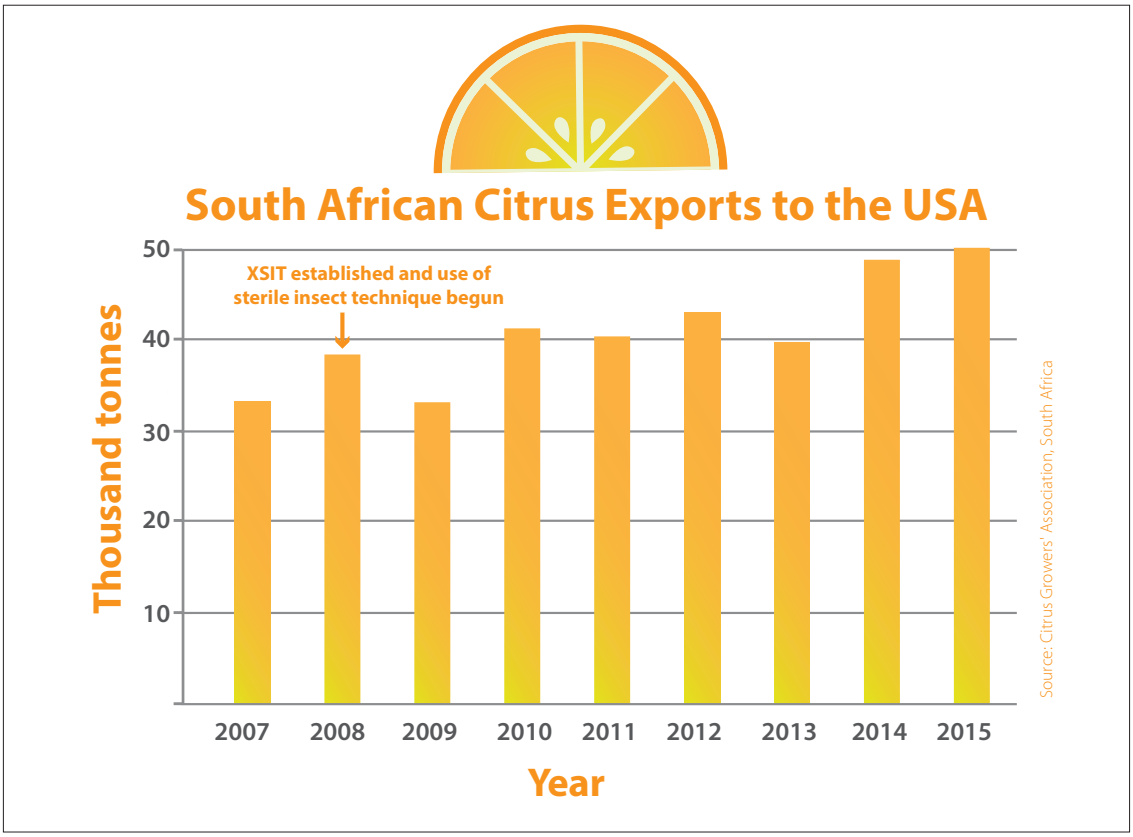
of the United Nations (FAO) and the United States Department of Agriculture, provided expertise and access to a network of specialists working on using SIT against other pests.

Thanks to funding from the IAEA's technical cooperation programme, Hattingh and his colleagues were able to get a first-hand look at a rearing facility for a related codling moth in Canada. This helped them lay the groundwork to eventually rear and sterilize enough insects to test the technique on a 35-hectare plot in an isolated and particularly infestation-prone part of Slabber's orchard.

"The results of the test surpassed our expectations," Hattingh said. "We realized that the false codling moth was a sedentary insect, so we could treat areas in isolation." It is this characteristic that makes the moth a prime candidate for SIT: controlling the insect population in a defined geographical area, even down to a single orchard, keeps the area insect-free long term because moth populations do not tend to fly far.

Public–private partnership for moth control

Following the success of the trial, the Citrus Growers Association and the South African Government co-founded XSIT in



order to develop the technique for use on an industrial scale. The area served by XSIT has increased more than tenfold since 2007, and the company has contracts in place to further expand to a total of 21 000 hectares.

Research is now ongoing not only to further perfect the technique, but also to make it available in far-flung areas of the country. The current method of producing sterile insects in Citrusdal, a town in the Western Cape, and transporting them to other areas for release works well for the neighbouring Eastern Cape, but it is not feasible for faraway places. XSIT's researchers, with support from the IAEA and the FAO, are working on a technique that involves transporting the pupae, which would then be irradiated at another location in the north-eastern part of the country.

THE SCIENCE

Birth control for insect pests

The sterile insect technique (SIT) is a form of insect pest control that uses ionizing radiation to sterilize insects that are mass-produced in special rearing facilities. These insects are released systematically over pest-infested areas, where they mate with wild populations, which subsequently do not produce offspring.

As a result, this technique can suppress and, in some cases, eventually eradicate populations of insect pests. SIT is among the most environmentally friendly control techniques available, and is usually applied as part of an integrated campaign to control insect populations.

The IAEA, in cooperation with the FAO, supports about 40 SIT field projects around the world, which are conducted within the framework of the IAEA technical cooperation programme. While most of these target pests that affect crops and livestock, research is also under way to use the technique against various species of disease-transmitting mosquitoes, including carriers of the Zika virus and malaria.