

Cold treatment

unlocks new fruit fly control options

When two pests can be controlled with the same treatment, the benefits to the citrus export industry are significant and numerous. New research results suggest such an opportunity exists in the battle against false codling moth and fruit fly infestations. By Dr Aruna Manrakhan (Citrus Research International)



Dr Aruna Manrakhan

The risk that pests can be exported along with fruit has to be constantly mitigated in the world of international trade. False codling moth (FCM) and fruit fly are two species that require constant care on the part of the South African citrus industry, as both are of phytosanitary concern to some markets that import locally produced fruit.

Both of these pest species can be controlled using either stand-alone postharvest disinfestation methods (cold or irradiation) or with a systems approach that includes both pre- and postharvest treatments. An important benefit of the latter is a less severe cold treatment requirement, which reduces the risk of fruit chilling injuries.

In 2017, a systems approach for mitigation of the risk of FCM in citrus exported from SA to Europe was developed and implemented under the name of the FCM risk management system (FMS).

Two years later, the EU amended its regulation regarding non-European fruit fly pests on specific fruit types, including citrus, imported from specified countries. Fruit originating from these countries would either have to come from fruit fly free areas or be subjected to effective fruit fly treatment.

In response, the South African citrus industry applied a systems approach for fruit fly, similar to the FMS.

One of the postharvest measures required by the FMS for citrus (except lemons and limes), is shipping at temperatures in the range of -1°C to 4°C. While there are internationally approved cold treatments for fruit flies in citrus at temperatures of 3°C or below, the efficacy of treatments at temperatures higher than 3.2°C for fruit fly pests on citrus in Southern Africa required evaluation.

One treatment regime that satisfies the phytosanitary requirements for both FCM and fruit flies exported from Southern Africa, presents obvious efficiency and cost-effectiveness advantages to the local citrus industry. Hence a project was designed by Citrus Research International (CRI) and co-funded by the Postharvest Innovation Programme to determine if fruit fly pests can be controlled by temperatures above 3.2°C, as provided for in the FMS.

The two-year study was led by Dr Aruna Manrakhan from CRI.

Study design

Three fruit fly pest species have been recorded on some citrus types in Southern Africa, namely *Ceratitis capitata*, *Ceratitis*

rosa and *Bactrocera dorsalis*. Studies to test the efficacy of cold treatment on all three species would be time consuming and costly. Hence, it was decided to determine which of the three was the least sensitive to cold and proceed with further investigations on that species alone.

With this principle established, the following study objectives were formulated:

1. Determine the larval development time of the three fruit fly species in an artificial rearing medium
2. Compare the in-vitro (in the artificial rearing medium) and in-vivo (in fruit) cold tolerance of third instar larvae of the three fruit fly pests at 3.5°C
3. Determine the efficacy of a 3.5°C treatment for the most cold-tolerant fruit fly species at 4, 8, 12, 16, 20, 24 and 27 days (exploratory testing)
4. Confirm the efficacy of a 3.5°C treatment for the most cold-tolerant fruit fly species for 24 consecutive days.

Findings

In terms of the first objective, the researchers found no significant differences in larval development time between the three fruit fly species. However, the results of the second objective clearly showed the *Ceratitis capitata* was significantly more cold tolerant than *B. dorsalis* and *C. rosa* at 3.5°C, in both the in-vitro and the in-vivo tests.

Working with the third instar larvae of *C. capitata*, the third objective was carried out in a three-replicate study at three different temperatures, ranging from 3.53°C to 3.57°C. In the first replicate, exposure to cold was evaluated for up to 27 days. In the two other replicates, exposure to cold was evaluated only for a period of up to 24 days. No survivors of third instar larvae of *C. capitata* were recorded beyond 16 days of cold treatment.

Objective 4 was fulfilled with a large-scale



Clockwise from the back: Dr Aruna Manrakhan (project leader and researcher), Phindile Rikhotso, Glorious Shongwe, Nonhlanhla Mthunywa, Patience Mlangeni (laboratory assistants) and John-Henry Daneel (technician)

test carried out on Valencia oranges in three replicates. At mean temperatures between 3.5°C and 3.8°C for 24 days, there were no survivors among a total estimate of 26 753 third instar larvae that were treated.

Results and recommendations

The study proved that a cold treatment at or below 3.5°C for 24 days is effective for disinfestation of *C. capitata* in citrus. This treatment, either on its own or within a systems approach, will effectively mitigate the risk of fruit fly pests on export citrus produced in SA. 🍊



Mediterranean fruit fly
Ceratitidis capitata



Cold room used for the study

Project information

Project title: Efficacy of false codling moth partial cold treatments for fruit fly pests of citrus
Principal investigator: Dr Aruna Manrakhan
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PHI Programme and Industry contributions: R310 967 and R310 967
Lead institution: Citrus Research International
Beneficiary: The South African citrus industry
Human resource development: 1 MSc student, 2 technical research assistants
Focus area: Postharvest disinfestation, fruit flies, quarantine pests, cold exposure.