



A mature FCM larva

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IMPROVED COLD TREATMENTS For increased exports

False codling moth disinfestation treatments that are progressively more successful, efficient, cost-effective and scientifically defensible, remain a goal for South African researchers. By Prof Sean Moore (IPM Portfolio Manager, CRI)



Prof Sean Moore



Every new export market that has opened for South African citrus since 1999 that required official bilateral negotiations to establish a protocol, has required that fruit receive a stand-alone cold disinfestation treatment, usually specifically for false codling moth (FCM).

But in 2017 the European Union designated FCM a regulated pest, which upped the ante significantly. In terms of regulations that came into force on 1 January 2018, SA's biggest export market for fresh fruit, including citrus, imposed zero-tolerance regulations for exports of citrus, peaches, pomegranates and peppers from Africa to Europe. Any live FCM in any of these produce from SA, results in immediate rejection and loss of the affected consignment, at a cost of millions of rands.

The EU has however, accepted a multi-tiered systems approach as an effective alternative to a standalone cold treatment.

This includes a cold shipping component as one of several risk mitigating steps. It is very important that SA executes this system effectively, to the satisfaction of the EU, otherwise export opportunities to this market could be compromised for producers. This needs to be avoided at all costs, as the South African citrus industry exports more than 35% of its produce to Europe annually.

Additionally, as SA's other export markets grow in volumes, conventional cold disinfestation (sub-zero temperatures for 22 days or more) becomes increasingly less feasible. Difficulties are the cold sensitivity of several cultivars and the lack of infrastructure at South African ports to apply the required pre-cooling schedules.

With so much at stake, a project was designed to refine existing, as well as developing improved cold treatments that are less onerous, both as standalone disinfestation treatments and as components within a systems approach. As part of a systems approach, the precise level of mortality required by a specific cold treatment is determined by the measured efficacy of the preceding steps in the system.

The study

Previous studies have quantified the efficacy of cold treatments at 1, 2, 3 and 4°C for different durations against fourth and fifth instar FCM.

What remains to be done, are trials at these temperatures that test various other parameters such as extended time periods, effects of cold treatments on different FCM populations, field-collected larvae in fruit vs. larvae in artificial diet, and characterisation of symptoms of larvae surviving cold treatments, indicative of continued survival or mortality thereafter.

My team and I at Citrus Research International (CRI), used several objectives to structure our research. However, due to the dynamic nature of the project – influenced both by evolving market requirements and the consequences of new findings – specific objectives were regularly modified. Some of these were:

1. Determine what numbers of survivors complete development after various cold treatments. This study was conducted due to reported interceptions of live FCM larvae in South African citrus fruit in the EU. In the trials, fourth and fifth instars in artificial diet were exposed to regimes that had all previously been shown to result in mortality rates of between 82% and 99%. This provided the researchers with sufficient survivors to identify the characteristics that would irrefutably indicate death or imminent death, or likely survival, after exposure to cold treatment. These included the larva's colour, shape, length and weight, as well turgidity and bruising.

2. Determine the efficacy of a range of cold treatment regimes (0, 1, 2, 3, 4, 4.5 and 5°C) against FCM eggs.
3. Compare the cold susceptibility of different FCM populations. These included populations from different geographical regions, feral FCM in field-collected fruit and laboratory reared FCM on an artificial diet.
4. Determine the duration required to achieve 100% mortality of FCM larvae at a range of temperatures.
5. Examine lower lethal temperature (LLT) and time (LLt) as indicators of relative efficacy of phytosanitary cold treatments.

Notable findings

To achieve 100% mortality of FCM larvae with temperatures of 0, 1, 2, 3 and 4°C durations of 16, 19, 20, 24 and 28 days were required, respectively. Complete mortality has not yet been demonstrated with 4.5 and 5°C. For a temperature of 1.2°C to provide Probit-9 efficacy as a postharvest disinfestation treatment for FCM, 19 days is the absolute minimum time required.

Cold treatment of 28 days at 4.5°C will result in 100% mortality of FCM larvae. At 3°C there was some variance in mortality between FCM from different regions. However, after 20 days of exposure the differences in mortality between the populations disappeared.

It was established that the compactness and turgidity of larvae are far more reliable indicators of their continued survival than movement. If larvae are flaccid and show any signs of bruising, they will die despite appearing to still be alive after the cold treatment. We now need to develop an accurate measure of turgidity, which will hopefully provide a tool for determining certain death vs. potential survival.

Next steps

Although a tremendous amount of progress has been made in developing full and abbreviated cold treatments for FCM for phytosanitary disinfestation use, work in this field will need to continue for as long as FCM remains a regulated pest.

The development and implementation of an even wider range of improved cold treatments will preserve and grow fruit export industries worth an estimated R30 billion per year. The citrus industry alone contributed more than R22 billion to South Africa's GDP in 2020.

With the development of effective and practical treatments, we can be instrumental in not only keeping our high-value fruit industry afloat, but even facilitating increased exports, including to new markets. ▶



Dr Marcel van der Merwe and Luke Cousins inoculating oranges with FCM eggs for cold treatment trials