Exterminate Grain Chinch Bugs

Trials using ethyl formate yield promising results

By Anna Mouton

"Phytosanitary issues are among the many challenges we face in the international trade of fresh fruit," said Dr Shelley Johnson, research associate at Stellenbosch University. Johnson has been working on a solution to the problem of grain chinch bug.

South African fruit exporters increasingly face rejections due to the presence of grain chinch bug — *Macchiademus diplopterus* — in their produce. Fumigation with methyl bromide is effective but no longer an option. Finding an alternative that meets consumer demands for sustainably produced and residue-free food has been the driving force behind Johnson's research.

A REDISCOVERED FUMIGANT

Ethyl formate is the most likely replacement for methyl bromide. "They're calling it a rediscovered fumigant because it was used way back in the 1920s for dried fruit pests," recounted Johnson, "before methyl bromide fumigation came into use."

Ethyl formate occurs naturally in the environment as well as in both raw and processed foods. "It has a characteristic smell of rum and tastes of raspberries so it's used as a food additive and a flavouring agent," said Johnson.

Previous work on grain borers and rice weevils found that the formic acid in ethyl formate inhibits a crucial respiratory enzyme complex leading to death by suffocation. "The researchers claim that development of resistance in insects is unlikely," said Johnson. "This is good news because another potential alternative to methyl bromide is phosphine — but there are a lot of resistance issues with that."

Ethyl formate is a flammable volatile liquid. Flammability can be reduced by mixing it with an inert gas. One such product is Vapormate which was developed by the Linde group. Vapormate delivers ethyl formate and carbon dioxide through a vaporiser. It is registered in several countries and Afrox is seeking approval for Vapormate in South Africa.

PHOTOS: SHELLEY JOHNSON | STELLENBOSCH UNIVERSITY

CINCHING THE CHINCH BUG

"We'd heard about the high efficacy of ethyl formate against insects so we thought, let's have a look at what it does to grain chinch bug," said Johnson. Her team started with small-scale trials in fourteen-litre glass desiccators. Chinch bugs were confined in perforated tubes and placed among fruit in the desiccators.

"To develop a mortality curve we tested at different concentrations of ethyl formate," explained Johnson. "There's a 100% mortality at 50 grams per metre cubed and this occurred within an hour of fumigation. This was very exciting for us — it was something that worked quickly and killed all the chinch bugs!"

Johnson also investigated phytotoxicity by exposing various fruits to ethyl formate concentrations of up to 149 grams per cubic metre for durations of up to six hours at different temperatures. Fruit were then assessed for damage after cold storage and simulated shelf life. No off-tastes were observed.

Russet Gold Bosc pears were the only fruit that developed abnormalities — stem, calyx and wound blackening — and only after treatment at 23 degrees Celsius. "We could then determine safe zones of what treatments one can apply without damaging the fruit," said Johnson. The results indicated that ethyl formate could be safely used to control chinch bug in these pears.

SCALING-UP ETHYL FORMATE FUMIGATION

The next step was developing a system to apply ethyl formate as a fumigant in a container. With the assistance of engineers from Gas At Site, a container was adapted to allow delivery of specific concentrations of ethyl formate and nitrogen. Due to the flammable nature of ethyl formate it was necessary to maintain levels of less than 1.8% ethyl formate and less than 5% oxygen. Gas levels were analysed throughout the trials.

Johnson was able to treat grain chinch bug in the container with no phytotoxic damage to the fumigated fruit. "We're able to create a uniform distribution of fumigant inside the container and inside the fruit packaging that we've tested so far. We were also able to measure the decay of the fumigant inside the container and easily top it up if necessary," reported Johnson.

The container will be used to test fumigation of other insects and more fruit types in a variety of packaging. For industry, the main concern is how to scale up the treatment so that it can be applied to cold rooms. Johnson announced that funding has already been approved to do this research.

"Essentially we're on the right track," she concluded. "The main thing is that we have something that works for chinch bug." **FQ**

FAR LEFT The flammable ethyl formate is mixed with nitrogen as a safety measure

LEFT A container was used to test whether ethyl formate fumigation was feasible.

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