PIP – SUMMARY OF TRIALS

October 2014

Field trials using INVADER-b-LOK™ to reduce fruit fly damage on mango in Senegal.

Abstract

Trials were carried out in mango orchards in Senegal to assess the performance of INVADER-b-LOK™ traps containing methyl eugenol and an insecticide, in controlling fruit flies of *Bactrocera invadens* and several *Ceratitis* species. The traps were distributed at densities of 6 or 12 per hectare and included a treatment with half the recommended dose per trap. A reference product (Timaye) was used and there was an untreated control.

The seven treatments (including reference product and control) were applied to two plots, making a total of 14 plots. Several different ways to assess fly abundance and treatment efficacy were used in the treatment plots. Fly numbers captured in various (different) reference traps and damage to fruit that was harvested and incubated in the laboratory, formed the basis of the assessment and was used to compare treatments. Numbers of *Bactrocera* generally accounted for over 95% of the fruit flies.

INVADER-b-LOK™ traps reduced the population of male flies of the *B. invadens* species. The results for *Ceratitis* were less clear. It can be concluded that the INVADER-b-LOK™ trapping technique has a useful role in managing fruit flies. However, used alone, it would not be sufficiently effective to reduce levels of infestation, which remained at 30 to 50% throughout the trial.

Introduction

Since the introduction of the invasive fruit fly, *Bactrocera invadens*, into the Economic Community of West African States (ECOWAS) there have been problems with mango exports due to the presence of larvae in fruits. This has caused a significant reduction in market access, with consequential loss of revenue and livelihoods in the region. Countries particularly affected include Burkina Faso, Senegal, Cote d'Ivoire, Guinea Conakry and Mali, and several consignments of mango from these countries have been rejected at the entry point into Europe.

Recognising the regional pressure, PIP has funded several field trials. In 2012 two products were identified as potential control technologies in the fight against the invasive fruit fly. These were INVADER-b-LOK ™ and M3. The trial summarised below was funded by PIP and carried out in Senegal by Prof. Karamoko Diarra of the University of Cheikh Anta Diop, Faculty of Science and Technology, in collaboration with the Senegalese Institute of Agricultural Research (ISRA) during 2013.

This is an English summary of a report written in French entitled *REALISATION D'UN ESSAI D'EFFICACITE BIOLOGIQUE DU INVADER – b – LOK CONTRE LES MOUCHES DES FRUITS DE LA MANGUE AU SENEGAL*. The original report contains more detail on treatments, techniques and results.

1. Experimental procedures

The fruit fly control trial was carried out on a mango farm of 100 ha, on which the main variety was 'Kent'. The farm is organic with production aimed principally at exports to the EU, Morocco and Ghana.

The test treatments were INVADER-b-LOK™ which is a fibre block incorporating the parapheromone attractant methyl eugenol in tandem with the insecticide mercaptothion (malathion), which is a lure and kill technology developed and sold by River BioScience. The main target pest was the invasive fruit fly, *Bactrocera invadens*.

A reference product, Timaye (methyl-eugenol (10 %) + deltamethrin (0.06 %)), was included as one of the treatments. There was also an untreated control.

Efficacy was assessed using standard fly traps and number of larvae emerging from harvested fruits. The treatments were replicated twice, and the trial started in July 2013.

TREATMENT	PRODUCT	DOSE
T1	Control – no treatment	-
T2	12 INVADER-b-LOK™ per ha, replaced every 6 weeks.	Normal dose
T3	12 INVADER-b-LOK™ per ha, replaced every 8 weeks	Normal dose
T4	12 INVADER-b-LOK™ per ha, replaced every 10 weeks	New formulation
T5	12 INVADER-b-LOK™ per ha, replaced every 6 weeks	½ dose
T6	6 INVADER-b-LOK™ per ha, replaced every 6 weeks	Normal dose
T7	450 g of Timaye / hectare with 10g per trap and 45 traps per ha	10 g / bottle trap

Figure 1 : Treatments – Number of traps, dose and frequency of trap replacement

Two of the traps with the reference product and the test (INVADER-b-LOK™) traps attract mainly males as the methyl eugenol is a sex (para)pheromone. Because the traps target the pest and use very small quantities of chemical pesticides -deltamethrin and malathion-, the technologies are considered to be acceptable in organic production.

Photo 1 : INVADER b-LOK™ trap

In each of the 14 experimental blocks, four different traps were placed to assess the abundance of *Bactrocera* and *Ceratitis* species. The attractant lure used in these traps was Invader in Lyndfield trap for the *Bactrocera* flies and CapiLure , QuestLure in Sensus trap and BioLure in Chempac trap for the *Ceratitis* spp. These traps used dichlorvos as the insecticide. CapiLure (red capsule) attracts male fruit flies, whereas QuestLure (green capsule) attracts female flies. BioLure attracts both sexes.

Photo 2 : Trap being put into a tree

Photo 3 : Labelled fruit

2. Assessment methods

Weekly counts of captured flies in standard traps were noted and observations made on numbers caught in the different treatment traps. In addition, 10 fruits from each plot were harvested and taken to the laboratory. Fruits with puncture marks were incubated and emergence of flies was recorded.

Results were tabulated in Excel and analysed using statistical software to reveal which treatments were statistically significant from others, including the control.

In spite of problems with rain, birds, weed vegetation and some labelled fruit being inadvertently harvested by the farm workers, results were obtained.

3. Results

The population of male flies caught in the standard traps was the basis for comparing the treatment results over the period of the experiment. The figure below shows the number of male *Bactrocera* resulting from the six treatments and control (upper line)

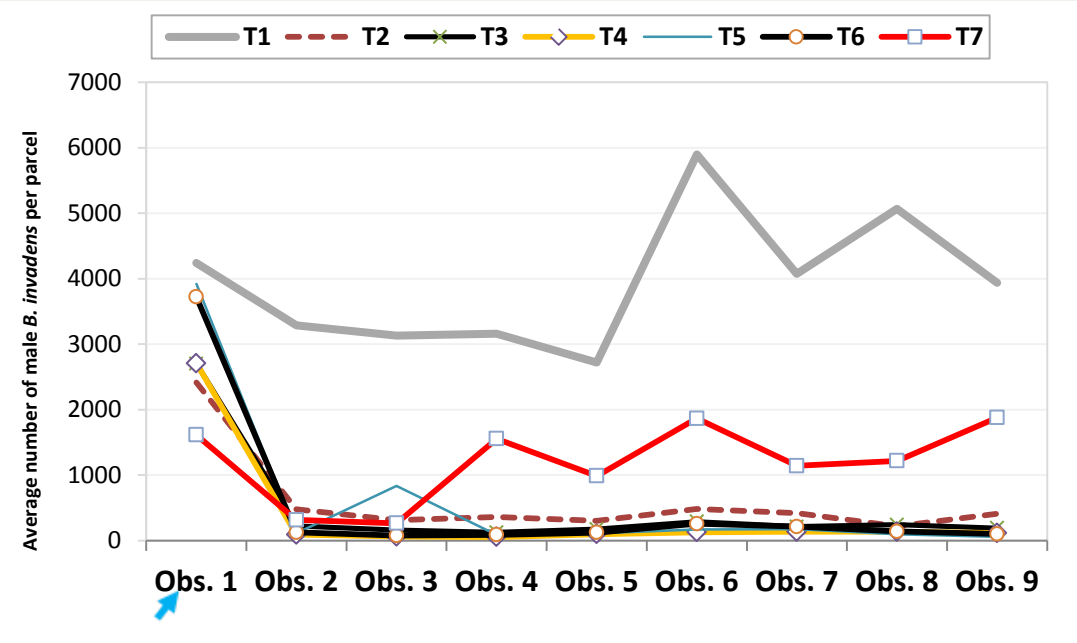

Figure 2 : Impact of the treatments using INVADER-b-LOK™ on the number of male flies caught in the Lyndfield trap during the 9 observations (counts) over the experimental period.

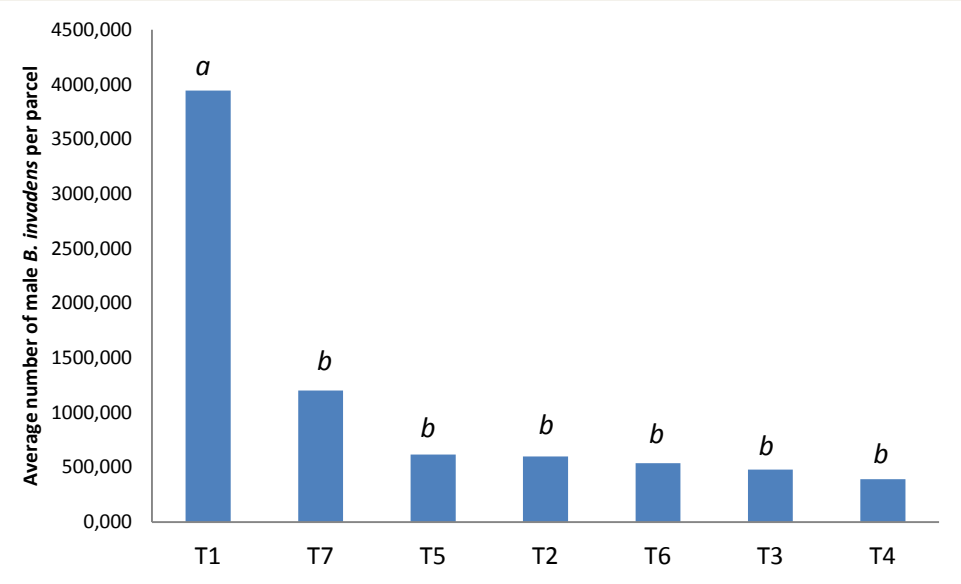

Figure 3 : Effect of treatments on overall number of male *Bactrocera invadens* flies captured in the Lyndfield traps (used as the standard against which treatments were assessed).

a, b: Treatments with the same letter are not statistically different.

There was a similar set of results for captured female flies, although overall numbers of females in the Lyndfield traps was much lower than the number of male flies (4000 male flies, versus 140 female flies in the control plot).

Ceratitis species

The *Ceratitis* species of fruit flies are also capable of reducing quality, yield and thus limiting market acceptance. In the trial, three species of *Ceratitis* were assessed, *C. sylvestrii, C. bremii* and *C. cosyra.* In the treatment plots, males *of Ceratitis* were captured in Lyndfield traps and some (but less) females. Similar results were obtained with CHEMPAC traps. Catch numbers were generally low for *Ceratitis* species, being typically around 5 or less, which is much lower than *Bactrocera*.

4. Discussion

All treatments that made use of methyl eugenol parapheromone (INVADER-b-LOK™) were effective in reducing the number of flies of both sexes to an extent that was statistically significant, compared with the untreated control. The Timaye treatment also reduced fly numbers, but not as effectively as the INVADER-b-LOK™ lure and kill traps.

There were no significant differences between treatments and even the half dose rate INVADER-b-LOK™ appeared to be effective, with numbers of male flies going down to around 8% of the number in the untreated control plots, and females to around 4% of the numbers caught in the untreated control plots.

Results in terms of infestation of fruits by fruit fly larvae

95% of the infestations were due to *Bactrocera invadens*. The infestation rate could not be assessed for some plots, but it ranged from zero to 100% in those that could be studied. Differences in larvae numbers between treatments and the untreated control were not significant, being generally around 30 to 50% infestation rate.

5. Conclusions

INVADER-b-LOK™ proved to give significant control of the invasive species *Bactrocera invadens.* In reducing the number of male flies dramatically it has demonstrated that, as a lure and kill technique, it can have a role in reducing the damage caused by the species that has a profound effect on mango trade.

Unfortunately the number of surviving flies (as measured by Lynfield traps) proved to be an under-estimate of the female fly abundance. The results from CHEMPAC traps confirm this. In many of the treatments the number of female flies captured in CHEMPAC traps was similar to the number caught in the control plot, typically around 100 flies and as many as 350 in some cases.

The number of flies of *B. invadens* captured in all treated plots could produce a level of damage and infestation of larvae in fruit that would make it acceptable for export markets. This conclusion was strongly reinforced by the results on the level of larval infestation in fruits harvested from the plots. An infestation rate of 30% would be unacceptable, and the rate of 50% would be totally intolerable to buyers in importing countries.

In conclusion, while INVADER-b-LOK™ has a useful potential role in managing *Bactrocera invadens*, an integrated approach combining several physical, chemical and biological control methodologies is needed to reduce the population of flies in mango orchards and bring infestation levels down. It is also likely that post-harvest treatments using hot water baths would be required as a further line of defence to prevent mango reaching the market with live larvae inside the fruit.

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