PIP – SUMMARY OF TRIALS

November 2014

Findings from PIP field trials assessing the effectiveness of M3 Lure and Kill traps against fruit fly

Summary

This is an abridged summary of the findings from the trials. More detailed summaries are given below and the full trial reports can be accessed via the PIP website.

The field trials sponsored by PIP were to assess technologies for control of fruit flies in mango orchards. They were carried out in three countries in West Africa (Senegal, The Gambia and Burkina Faso) during 2012 and 2013. In all trials traps were compared at different densities (number per ha) with alternative control techniques to assess the effectiveness of different treatments in reducing the number and damage caused by fruit flies. Two main species of fruit flies were the chief focus of the work, but by far the most important was the invasive fruit fly *Bactrocera invadens* with *Ceratitis cosyra* being the second species.

In the trials a type of trap known as M3 was used at different numbers per hectare of 200, 300 or 400 traps (or 500 per ha in Gambia and Senegal). M3 traps have an attractant and an insecticide, see below. Treatment applied for comparison with traps was spraying selective portions of foliage with the insecticide spinosad (branded as Succes Appat) which contains a bait attractant to lure the fruit flies to the lethal pesticide. This treatment was applied each week, whereas the traps were left for the duration of the trial. There was also an untreated control in each trial.

Results in both Burkina Faso and Senegal (where some problems were experienced with the experiments) were that the spinosad based attractant was generally the most effective treatment, reducing adult fly numbers (mostly *Bactrocera*) by 84 % in Burkina Faso. The lowest trap density (200) gave only a slight reduction in the number of adult flies, while the highest (400) gave a 70% reduction in numbers of adult flies in Burkina, with 300 traps reducing numbers by 25%.

In Gambia the traps were more effective, giving a reduction in numbers of at least 65% at all densities. The best treatment was 500 M3 traps/ha, which gave a reduction of 85%. Treatments that involved spinosad insecticide (Success Appat) reduced fly numbers by around 75% but surprisingly, the result was no different whether M3 traps were present or not.

The damage caused to mango fruits was assessed separately from the effect on adult fly abundance, by counting the number of puncture wounds in mango fruits harvested from experimental plots. The results from the different treatments were not conclusive, although the damage levels in the untreated control were higher towards the end of the trial in Burkina, which probably demonstrates that the cumulative effect of all treatments was slightly beneficial. Puncture data from The Gambia and Senegal was either not available or inconclusive.

The traps did not affect the performance of parasitoids species which have a beneficial effect on controlling fruit flies, and the treatments did not damage the mango trees.

Introduction

The increasing importance of fruit flies

Since fruit flies of the species *Bactrocera invadens* arrived in West Africa around 2003, they have become an increasing threat to the important mango production industry. Presence of the flies reduces yield and quality of mango, causing them to rot while they are becoming mature. Losses can approach 100% as the rains arrive. Fruit flies alone are responsible for reduced availability of mangoes in local markets.

Possibly of even more significance in the context of trade, *B invadens* is a quarantine pest which means that there is zero tolerance of presence of the species as maggots in the fruit or as adults in containers containing fruit being exported. In the past 10 years an increasing proportion of mango exports from Mali, Côte-d'Ivoire, Burkina Faso and Senegal have been refused entry into the European Union and other importing countries due to the presence of fruit fly larvae in consignments.

The economic cost of fruit flies is estimated to be many billions of CFA francs. Because control measures are urgently needed for this aggressive and invasive pest, PIP sponsored a series of field trials to assess the effectiveness of different fruit fly control strategies. The trials took place in Senegal, The Gambia and Burkina Faso. They assessed the field performance of M3 lure and kill traps placed in mango orchards at different densities (number per ha). The trials also compared the performance of M3 traps with selective application of spinosad an insecticide of a type called 'naturalyte' whose active ingredient is derived from a soil actinomycete.

Table of trials carried out in the three countries

	Trial name	Execution	Organisation	Country
1	Report on the biological efficacy of M3 traps on mango fruit flies	2012 Badara region	Ministère des Enseignements secondaire, supérieur et de la Recherche scientifique Centre National de la Recherche scientifique et Technologique Institut de l'Environnement et des Recherches Agricoles Centre Régional Recherches Environnementales et Agricoles	Burkina Faso

2	Evaluating the efficacy of M3 in controlling Bactrocera invadens in Mangoes in Gambia	2013 Janbangjelly farm	National Agricultural Research Institute	Gambia
3	Réalisation d'un essai d'efficacite biologique du M3 contre les mouches des fruits de la mangue au Sénégal	2013 Notto Gouye Diama in the Thiès region	Université Cheikh Anta Diop Faculté des Sciences et Techniques Institut sénégalais de recherche agricole (ISRA)	Senegal

1. Trials in Burkina Faso

1.1 Background and protocol

M3 traps were tested in the field against mango fruit fly in Burkina Faso. The traps significantly reduced populations of the two main species of fruit flies *Bactrocera invadens* and *Ceratitis cosyra.* The traps did not affect the performance of parasitoids species which have a beneficial effect on controlling fruit flies, and the traps did not damage the mango trees.

Figure 1 : M3 fly trap

M3 fly traps, also called M3 bait station, have an attractant and a pyrethroid insecticide to 'lure and kill' the pest.

Experimental treatments compared trap density of 200, 300 and 400 traps per hectare (hung on trees) with treatment using several applications of Succes Appat, which is a spinosad based insecticide. There was also an untreated control. The spinosad treatment was applied once a week for the duration of the experiment on 1 m^2 of foliage at a height of 2–3 m. The dilution rate was 1 l in 5 l of water.

Abundance of fruit flies was measured using a different type of trap (Tephri traps containing Invader-lure blocks are effective for both male and female flies) and damage level in fruit was also assessed.

1.2 Results

Effect on the number of adult flies – Number of *Bactrocera invadens* adults averaged around 1300 per control plot over the seven week period.

The lowest density of traps (200/ha) reduced this number but only slightly. The medium density of traps (300/ha) gave a reduction of around 25% in adult fly numbers, averaging around 1000, while the highest trap density (400/ha) produced a much more dramatic reduction in adult fly numbers of around 70% with average fly numbers falling to around 400 per plot.

The best reduction was obtained in plots sprayed with spinosad. This treatment gave around 84% reduction, leading to fly numbers of around 230 per plot.

Numbers of adults of the other important fruit fly species *Ceratitis cosyra,* were much lower as they prefer dryer conditions than those experienced in the trial. It was not possible to assess the difference between the treatments over the 7 week trial. All trap densities and plots treated with spinosad showed a reduction in adult flies, particularly early in the trial, but after the first two weeks, when there were only 2 or 3 flies per treatment, it was not possible to draw conclusions on differences between treatments.

Effect on the number of punctured fruit - The number of puncture holes caused by the two species was used as the measure of infestation of fruits. Damage by different fly species was not separated in the trial, although because numbers of *B. invadens* were far higher, most of the damage was from this species. The experimental results from the different treatments was not conclusive, although the damage levels in the untreated control were higher towards the end of the trial, which probably demonstrates that the cumulative effect of all treatments was slightly beneficial. However, fruits suffered from 50% to 100% infestation, which would be a level that causes a large loss of saleable fruit and mangoes with such a level of attack would likely be rejected by most markets.

2. Trials in Gambia

2.1 Background and protocol

For this trial, several treatments were applied :

1) Control – No application;

2) 400 M3 traps per ha;

3) 400 M3 traps per hectare plus Success Appat at 1.2 l of water (commercial dose);

4) Success Appatt (GF 120) in 1.2l of water;

5) 500 M3 traps per ha.

Before the trial began, the population of the two species of fruit flies was monitored using different types of attractant (lures) – Capilure, Queslure, Biolure and Invaderlure used in different types of trap (Sensus, Chempack and Lynfield).

Interestingly the number of *Bactrocera invadens* and *Ceratitis cosyra* caught in most trap/lure combinations was low at about 30 *B invadens* and around 7 *C cosyra* per trap. However the combination of the Invaderlure used in the Lynfield trap caught almost 1800 *B invadens*. Numbers of *C cosyra* were similar to the catch of the species in the other traps, and less than 10.

This demonstrated that the best combination for *B invadens* is the Invaderlure/Lynfield combination, but being a sex pheromone only the male flies were caught.

2.2 Results

The trial results were quite clear. All treatments reduced adult fly numbers by at least 65% compared with the untreated control plots. The best treatment was number 5 (500 M3 traps/ha) which gave a reduction of 85%. This was followed by both treatments that involved spinosad insecticide which reduced fly numbers by 78% when combined with M3 traps and 74% when used without any traps (these last two figures were not statistically different).

The authors recommended use of the highest trap density in endemic fly zones.

3. Trial in Senegal

3.1 Background and protocol

These field trials were carried out in an organic farm over a period of 10 weeks in July to September. As with the work in the other countries that is described above, the main objective was to determine how effective M3 traps could be.

1) Control – No application;

2) 400 M3 traps per ha;

3) 400 M3 traps per hectare plus Success Appat at 1.2 l of water (commercial dose);

4) Success Appatt (GF 120) in 1.2l of water;

5) 500 M3 traps per ha.

Abundance of male *Bactrocera invadens* was measured using Lyndfield traps baited with 'Invaderlure' and an insecticide (dichlorvos) killed captured flies. For the *Ceratitis* species two other attractants were used (Capilure and Questlure).

Despite problems of fruit theft, bird damage, the onset of rains and very weedy terrain that made work difficult, it was possible to make observations. However the results were very dependent on the method used to gauge abundance (i.e., what type of trap measured the effectiveness of the treatment).

3.2 Results

B. invadens - The biggest reductions in invasive fruit fly number of males was in treatments 4 and 5, which were the selective spraying of spinosad (Success Appatt) and the highest density of M3 traps. Puzzlingly, the spinosad spray used in combination with M3 traps (treatment 3) performed less well and was no better than the control treatment for male flies.

However, the roles were reversed for female flies of *B invadens*, as this same treatment 3 was the better of the two in terms of reducing the number caught.

Ceratitis spp - Numbers of this species were much lower (only one to twenty flies caught, compared with tens of thousands of *B invadens*) and it was not possible to draw conclusions on the most effective treatment.

When the rate of mango fruit infestation was used as the measure of effectiveness of the treatments, disappointingly it was not possible to make any definitive conclusions as the number of fruits infected was of a similar level for all treatments.

4. Conclusion

Although the treatments reduced the number of adult flies in the plots, in the experimental conditions of the trials neither the M3 traps nor the spinosad bait treatments reduced the number of fruit flies sufficiently to be considered sufficient control technologies on their own.

Even in the treated plots, fruits suffered from 50% to 100% infestation, which would be a level that causes a large loss of saleable fruit. Mangoes with such a level of attack would likely be rejected by most markets.

The conclusion is that several control technologies need to be used simultaneously, and these integrated methods include both traps, use of kaolin sprays, insecticide applications and active management of natural enemies, particularly at critical times in the season when fruit flies, and *Bactrocera* in particular, are abundant.

In addition to the use of a range of integrated control technologies used in the fruit orchards, export markets may insist on post-harvest treatments as well, before they accept mango and other fruit due to the nature of the pest and the fact that the fruit flies are considered to be quarantine pests with a zero degree of tolerance in regard to presence.

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