New Biopesticides

Caroline Hauxwell, Kristen Knight, Paul Grundy, David Holdom.
DPI Biopesticides Unit, 80, Meiers Rd, INDOOROOPILLY 4068.

The adoption of biopesticides by the cotton industry in Australia has been impressive. The use of **Nucleopolyhedroviruses** (NPVs) has grown from a research project, through a niche product aimed primarily at sorghum, to wide scale use as an important tool in control of ***Helicoverpa armigera*** in cotton, sorghum, chickpeas and sweetcorn. **Gemstar** has demonstrated that biopesticides are effective in cotton IPM, despite the fact that cotton is one of the most difficult crops in which to achieve maximum efficacy. Increasing grower confidence in biopesticides as IPM tools has led to increased demand for products, which in turn has created a new market niche for suppliers, and considerable interest in potential biopesticides against emerging pests.

Gemstar is now readily available, and is joined this year by a new registered product, **Vivus**, manufactured in Australia by Australian Produced Biologicals. Vivus, like Gemstar, is currently based on the *Helicoverpa zea* NPV but produced in native *H. armigera* larvae, with the same efficacy as Gemstar. APB are also beginning production of a product based on the native *H. armigera* NPV. Both Vivus and Gemstar are registered in cotton. This is good news for growers, with greater security of supply (from two different companies) and an increase in diversity of products.

The NPV products will all perform in the same way and be applied using the same methods, with a label rate in cotton of 500ml per hectare applied with a ground rig. We've extended research on additives to look at ways to improve applications in cotton. A number of the available additives significantly improve performance of NPVs in cotton (figure 1). Coax and Aminofeed gave the best results in these glasshouse trials, while Mobait and Coaton HP were less effective. We recommend that NPV is always applied with an effective additive. We've also been looking at ULV formulations in oil, and the results are looking very promising. We should see an extension of licenses to ULV soon.

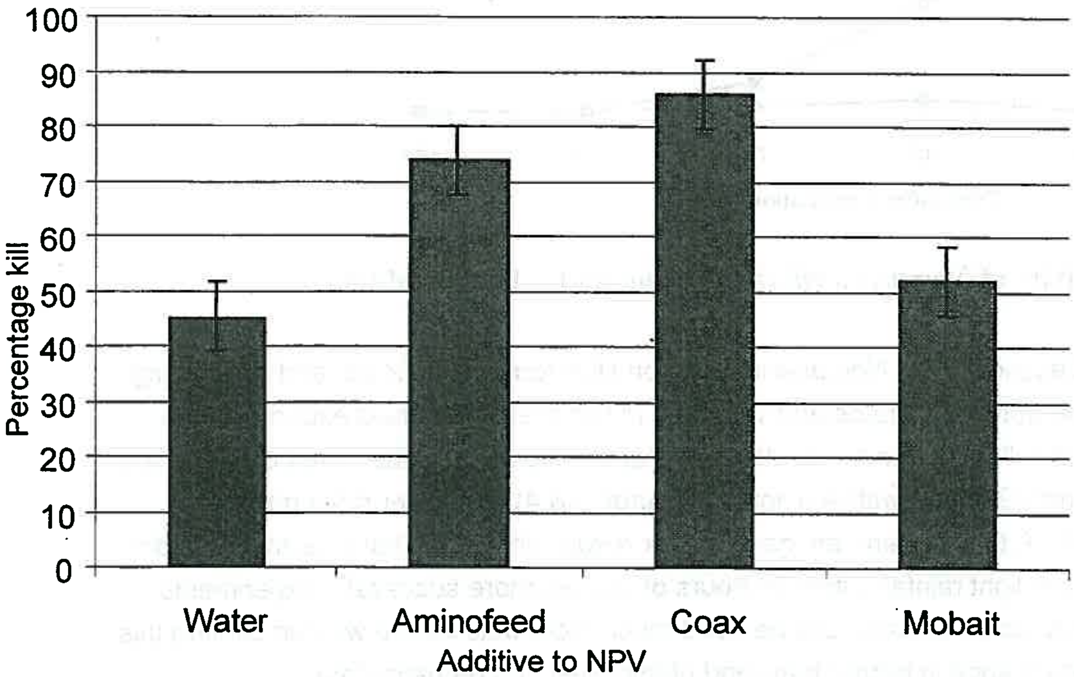

Figure 1. Percentage death of *Helicoverpa armigera* larvae with different additives to NPV.

The success of viral NPVs for Heliothis control has increased interest in other insect pathogens as potential biopesticides, in particular fungal pathogens. DPI have been conducting research on fungal biopesticides for several years, and we've expanding this area of our research to address threats from sucking pests, in particular **whitefly**, **mirids**, **aphids** and **green veggie bug**.

We are testing a number of new and potential products with a view to registration. We have tested our own isolates and formulations of ***Nomuraea rileyi*** and ***Beauveria bassiana*** together with commercial products against Heliothis and mirids, and are now working on whitefly and aphids using *Beauveria* and another fungus, ***Paecilomyces fumosoroseus***. The products most likely to be registered first are based on *Beauveria*. This fungus is active against sucking pests, including whitefly, aphids and mirids, and will also infect Heliothis (at low levels).

In presenting this data I want to stress that we are conducting experiments to develop this technology, not testing something we already know well how to use, so our results are preliminary and variable in the field.

Initial work looked at developing an alternative to NPV for control of Heliothis, and compared the relative efficacy of different fungi against Heliothis. Results in glasshouse assays showed that *Nomuraea* is the most effective fungal pathogen against Heliothis, killing a higher proportion of larvae than *Beauveria* isolates. Subsequent assays looked at foliar persistence of *Nomuraea* on cotton. Cotton foliage sprayed in the field was sampled at 24 hour intervals and assayed for residual activity. The results showed that *Nomuraea* has reasonable residual activity at 48 hours (Figure 2). This compares favorably with NPVs, which typically have little residual activity after 24 hours.

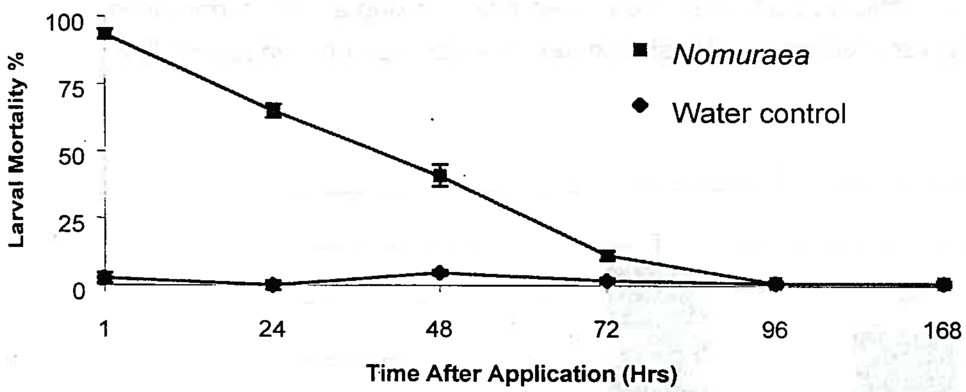

Figure 2. Residual activity of *Nomuraea rileyi* on cotton under field conditions.

We are developing field application of *Nomuraea* based on ULV formulation in oil, and conducting experiments to determine application rates and volumes. In two preliminary field experiments in cotton, mortality of larvae collected one or two days after application with higher rates of *Nomuraea* was only slightly lower than Gemstar with Aminofeed (figures 3 & 4), but lower rates gave less effective control (figure 4). A third experiment gave a poor result, which may have been due to dry conditions, since there was light rainfall within 24 hours of the two more successful experiments. Humidity may have an impact on efficacy, but we need much more data before we can confirm this. We hope to improve performance in further trials and obtain yield and damage data.

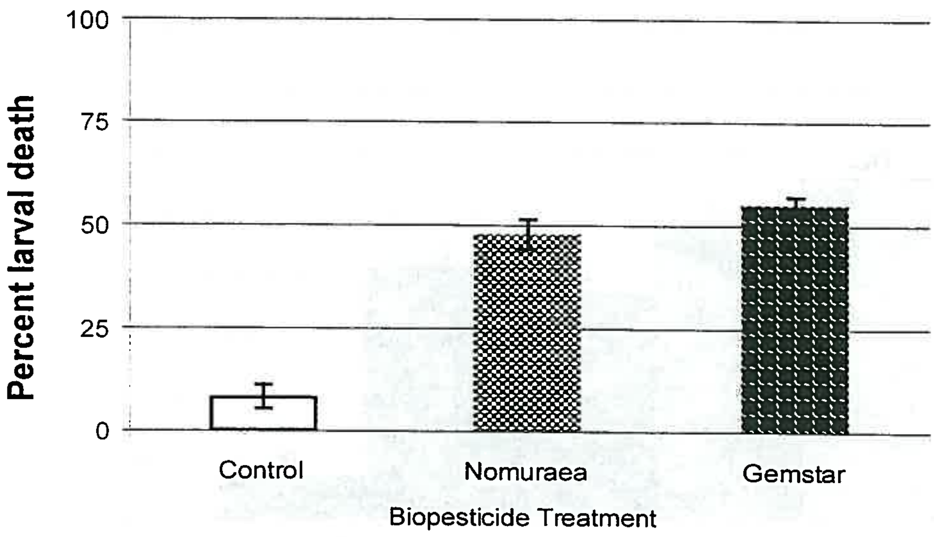

Figure 3. Mortality of Heliothis larvae collected from cotton after application with Gemstar and *Nomuraea rileyi*, Trial 1.

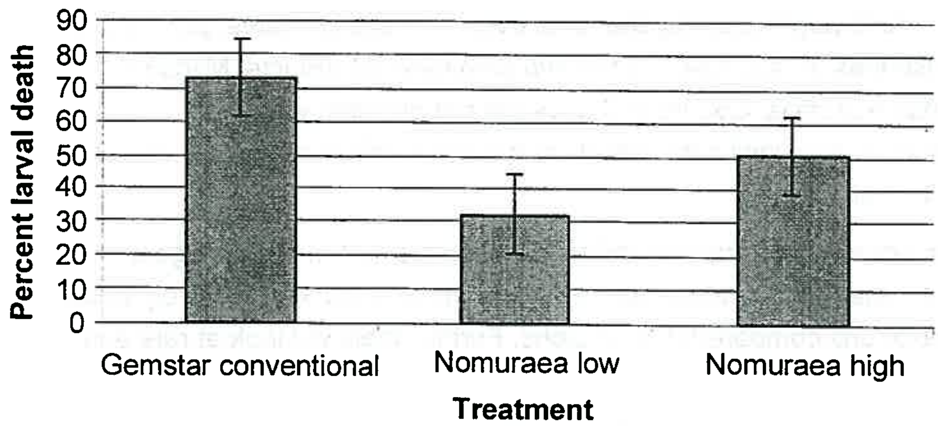

Figure 4. Control-corrected mortality of Heliothis larvae collected from cotton after application with Gemstar and two rates of *Nomuraea rileyi*, Trial 2.

Nomuraea has a slightly more broad host range than NPVs, and is effective against armyworms and loopers a well as Heliothis. It is still limited to the Noctuids, and is very soft on beneficial insects. *Beauveria*, on the other hand, has a much wider host range, including many of the significant sucking pests. We are investigating commercial *Beauveria* products from the USA and our own isolates and formulations as biopesticides against mirids, whitefly and aphids, and at impacts on beneficial insects.

In preliminary experiments this season against mirids in mungbeans, two commercial *Beauveria* emulsifiable concentrate products, Naturalis and Mycotrol, were compared with two of our isolates (37 and 124) in ULV oil formulations and Dimethoate. The first trial was conducted with low rates of spores. Beat sheet counts of mirids at 5 days after application gave the most satisfactory results (figure 5).

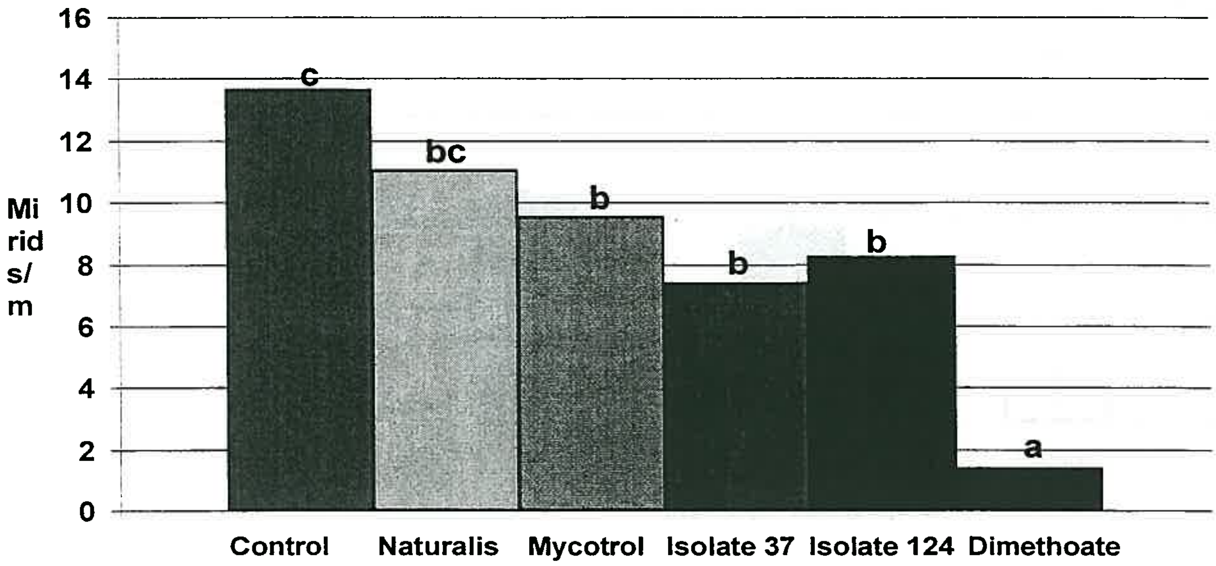

Figure 5. Efficacy of Naturalis EC, Mycotrol EC, isolate 37 and isolate 124 against mirids in mungbeans at 5 days after treatment. Ttreatments with the same letter are not significantly different.

There was a significant impact on mirid populations by the fungi even at these low rates, particularly with the two oil ULV treatments (isolates 37 and 124). Of the two commercial products, Mycotrol gave significantly better results than Naturalis. Counts at 7 days after application were less conclusive, though there was a statistically significant reduction in mirid numbers in at least one of the fungal treatments (isolate 124 in oil).

A third trial looked at establishing rates of Mycotrol and isolate 124. Isolate 124 in oil was again more effective than Mycotrol, which may be due to the fungal isolate in each, but is more likely to be due to greater efficacy of oil formulations compared to emulsions. Further trials will look at rate and formulation effects.

Dimethoate was clearly the most effective treatment against mirids, but it was also the most effective in cleaning up the beneficial insects too. Beat sheet counts showed that damsel bug numbers were significantly reduced in Dimethoate treatments, and this may lead to subsequent pest outbreaks, including outbreaks of Heliothis. There is concern that *Beauveria* products, which have a broad host range, may not be as soft as other biopesticides. In fact, one of our best isolates (124) was actually isolated from a damsel bug, but in the field trials this season damsel bug numbers were not affected by any *Beauveria* applications.

In a third trial, mirids were collected and returned to the laboratory at 3 days after application, and time to death was calculated (figure 6). These mirid figures have been corrected to include only those insects that showed signs of fungal infection (ie sporulation). Isolate 124 killed the greatest proportion of these insects, isolate 34 killed fewer, while Mycotrol killed the least. Naturalis killed no mirids returned to the laboratory. It took approximately 150 hours from collection (9 days after treatment) for 50% of the green mirids that were killed by isolate 124 to die, and 200 hours for isolate 37. Insects returned to the laboratory are more susceptible to the pathogen than those in the field because of stress, but the results suggest that isolates 124 and 37 in oil may be more effective that the EC products, and that control from fungal control will be more slow-acting than Dimethoate. Trials this year will look at season-long control.

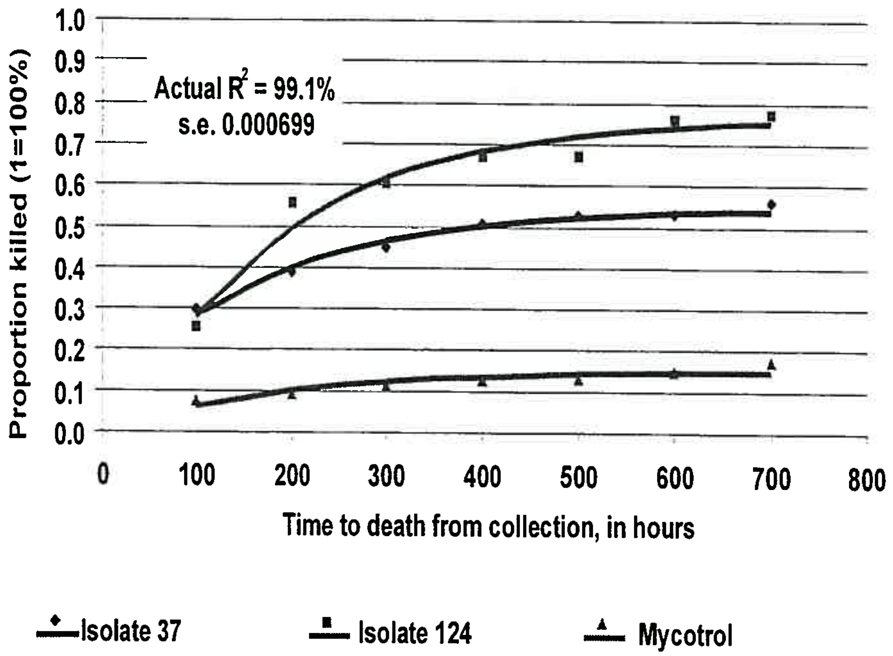

Figure 6. Time to death from fungal infection of green mirids returned to the laboratory after treatment with Mycotrol EC and two *Beauveria* isolates in oil.

Beauveria products has the potential to provide soft, slightly broad spectrum control of mirids and a number of other pests, though none of the products or isolates tested in this years' trials had any effect on green vegetable bug. GVB is a tough target, and more work is needed on identifying suitable isolates. The prevalence of the parasitoid *Trichopoda*, which was found in 50% or more of the GVB in our trials, mans that finding a soft biopesticides for this pests will be worth the effort. At least 3 commercial products from the US based on *Beauveria* and *Paecilomyces* and our own isolates will be tested against whitefly this coming season with the aim of generating data for an emergency permit as soon as possible.

Looking forward, there are a number of new viral and fungal products that should be registered in coming years. There's also potential to improve the performance of NPVs through formulation and application. Genetic engineering of the Gemstar virus in the USA has demonstrated significant benefits, particularly in controlling pyrethroid-resistant Heliothis, and we plan to build on the CSIRO and Cotton CRC work on GM viruses to look again at it's potential use in Australia.

The increased confidence of the industry in IPM and biopesticides mean that there is demand to expand the program from Heliothis to include sucking pests. Though it's early days for the fungal products, as with viruses, they do have a valuable role in IPM, working with beneficial insects to keep pests below thresholds and avoiding the problems of resistance to chemical insecticides.