THE UTILITY OF NUCLEAR POLYHEDROSIS VIRUS FOR HELIOTHIS MANAGEMENT IN COTTON IPM PROGRAMS

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Introduction

The disruptive nature of many of the broad spectrum insecticides on which heliothis control relies on cotton limits the adoption of integrated pest management (IPM) programs, particularly where they place emphasis on natural enemies found in the cotton crop. From this perspective, there is a need for selective products that will satisfactorily reduce heliothis numbers yet conserve beneficial insects (parasites and predators). Nuclear polyhedrosis virus (NPV) is one microbial agent that may adequately fill this role. This paper presents trial data on NPV from *Helicoverpa zea* (GemStar®) used against heliothis on cotton in southeast Queensland during the 1994/95 and 1995/96 seasons.

Materials and Methods

Applications of a commercial formulation of NPV, GemStar® (biosys Inc.), were evaluated in unreplicated plots of raingrown cotton on the Darling Downs, Queensland. GemStar was applied at 741 mL/ha in 50-100 L water/ha with 1% v/v molasses and 0.01% v/v wetting agent using ground rig sprayers. *Helicoverpa* spp. activity was assessed by routine scouting activities and collections of larvae (VS = very small, S = small, M = medium and L = large) were made at intervals, usually 3 and 7 days after treatment (DAT) on the NPV-treated and unsprayed plots. Yield from these treatments were compared with adjacent conventionally-treated plots. The 'unsprayed' and NPV-treated plots at Nandi in 1994/95 received two conventional insecticide treatments (on

16 and 21 December 1994) prior to the commencement of our involvement at this site on 5 January 1995.

Results

Warra 1994/95

A single application was made at this site on 23 December 1994. In (S + M) larval collections 3 DAT, 77.1% (n=35) died from NPV. The estimated LT50 (time to 50% mortality determined by simple linear regression) was 6.7 days. In the unsprayed, 4.4% (n=46) died from NPV.

Nandi 1994/95

At this site a total of five GemStar applications were made between 16 January 1995 and 3 March 1995. Mortality rates due to NPV for (VS + S + M) larvae collected at 3 or 4 DAT averaged 52.1% (range 38.6-72.4%) in the treated plot and 5.4% (range 0-20.0%) in the unsprayed (Figure 1). The lower infection level with NPV on 23 February 1995, was recorded after spray pump pressure problems were noted. In most cases larval mortality from NPV was highest in the 3 or 4 DAT collections, and declined thereafter with time after treatment. During the period after treatment on 8 February 1995, when showery, overcast weather prevailed for more than one week, NPV infection of (VS + S) larvae was maintained at moderate to high levels (83.3% on 16 February and 42.9% on 20 February), almost certainly as a result of secondary spread of infection.

The LT50 for (VS + S + M) larvae collected 3 or 4 DAT and held in the laboratory at 25°C was similar for each of the five NPV applications, averaging 6.97 days (range 5.96 - 8.17 days). Larval size was also important in determining the final NPV mortality. For larval collections 3 or 4 DAT, higher mortality was consistently recorded for (VS + S) larvae (average 63.8%) than for M larvae (average 44.7%).

Warra 1995/96

A total of 10 GemStar applications were applied between 28 November 1995 and 24 February 1996. NPV mortality for (VS + S + M) larvae collected 3 to 5 DAT averaged 43.9% (range 10.9-80.6) in the treated plot (Figure 2). In contrast, NPV mortality in the unsprayed averaged 3.3% (range 0-9.8).

Yield

Yield estimates from unsprayed, NPV-treated and conventionally-treated comparisons show that the NPV spray program resulted in yields similar to those of the conventional treatment at two of the three sites reported here (Table 1). At all sites yields from the NPV-treated plots were superior to the unsprayed. The higher than expected yield on the 'unsprayed' at Nandi in 1994/95 is probably a reflection of the low early to mid season *Helicoverpa* spp. activity and the use of two conventional insecticide sprays during December as previously mentioned.

Table 1. Yield assessments in bales/ha for the evaluation of NPV on the Darling Downs.

	Unsprayed	NPV	Conventional
Warra 1994/95	3.69	3.75	3.80
Nandi 1994/95	5.34	5.56	6.26
Warra 1995/96	2.42	4.39	4.42

Discussion

Helicoverpa spp. larvae showing typical NPV symptoms were found on the NPV-treated plots throughout the trials. The most obvious were M and L larvae found on the upper foliage. During visual searching, infected S larvae were frequently found in squares, especially when sampling 5 or more DAT.

Although counts indicated that total larval numbers remained above economically acceptable levels (>2 larvae/m) following NPV application, there are several aspects that warrant comment. Firstly, unless larvae were in advanced stages of NPV infection, NPV-infected larvae were counted as healthy larvae. As already shown, the average LT50 for these sprays was almost 7 days. This issue highlights an important problem for insect pest managers when using NPV.

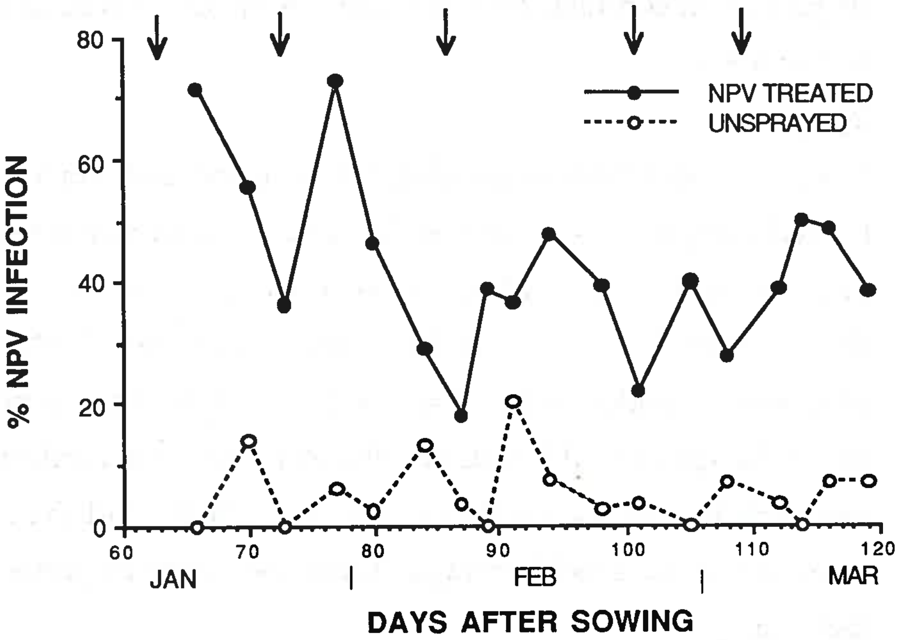

Figure 1. Percentage NPV infection of (VS + S + M) *Helicoverpa* spp. larvae on GemStar-treated and unsprayed plots at Nandi, 1995. Arrows indicate spray dates.

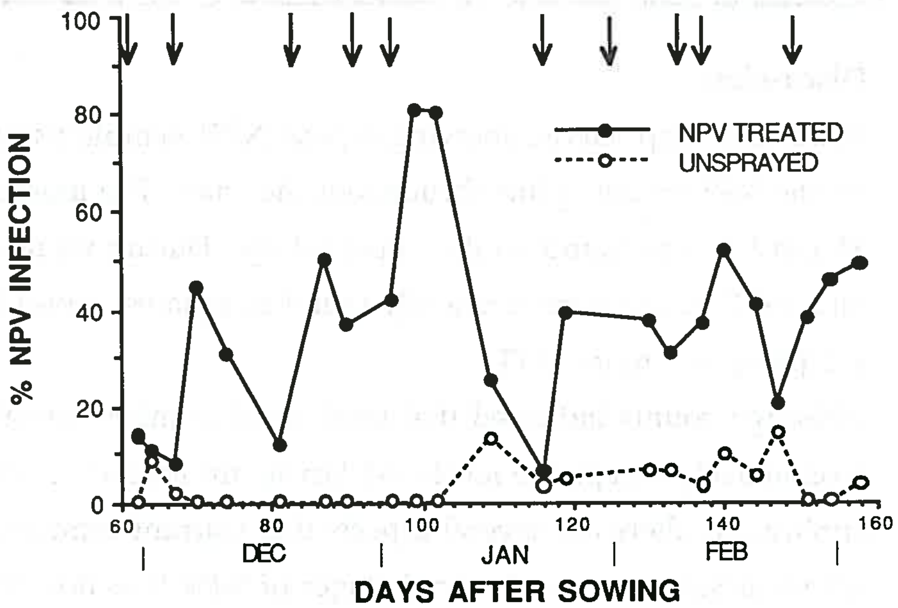

Figure 2. Percentage NPV infection of (VS + S + M) *Helicoverpa* spp. larvae on GemStar-treated and unsprayed plots at Warra, 1995/96. Arrows indicate spray dates.

Secondly, larvae infected with *Ascovirus*, a parasite-transmitted disease, remained on the plants for much longer than healthy larvae. Even though the rate of feeding of *Ascovirus*-infected larvae may have been much reduced when compared with healthy larvae, they were essentially recorded as healthy larvae during insect checks. During the 1994/95 Nandi trial, the level of *Ascovirus* infection averaged 27.7% on the NPV-treated plot. The end result of these first two points was an inflated pest density.

Thirdly, there were periods when spraying was required, but wet weather prevented ground rig application. Aerial application was not an option because of the small plot size and risk of spray drift onto the unsprayed plots. A decision was made to delay spraying until ground rigging was possible. During these delays the larval age spectrum increased and their control consequently was made more difficult when treatments were applied. While most NPV sprays were applied in the evening to avoid early exposure to UV radiation, some sprays were necessarily applied in the morning. This aspect of spray timing also requires consideration.

Although aphid populations developed on the unsprayed and NPV-treated plots, it was apparent that natural enemies successfully reduced aphid numbers and no specific aphid control was required. In contrast, the conventional comparisons were treated repeatedly with organophosphates for aphid control. At Nandi during 1994/95, 'hot spots' of spider mites observed in the NPV plot at the start of the trial did not develop to damaging levels under the NPV spray regime. These observations gave evidence of the non-disruptive nature of NPV applications.

Conclusion

These preliminary trials indicate that GemStar provides a moderate level of control of heliothis. While mortality above 80% was not achieved from any of the NPV sprays reported in these studies, it is likely that mortality levels exceeding this value could be achieved with improved timeliness of application. GemStar alone may not be satisfactorily efficacious against high pest densities, and the use of additives e.g. food sprays, or alternative chemistry e.g. spinosyns, may be needed in these situations.

NPV has a potentially important role in future management of *Helicoverpa* spp. in cotton. This role assumes greater importance as insecticide resistance in *H. armigera* escalates and the prospect for control by conventional means deteriorates. IPM programs must have a product that provides satisfactory levels of heliothis control yet still retains the beneficial fauna. NPV appears to offer a platform about which IPM programs can be constructed. Further evaluations of NPV in cotton in Australia are warranted. NPV may also have a place in refuge management options as part of the insect management plan for Ingard™ cotton.

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