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USE OF VIRUS AND ITS INTERACTIONS WITH THE ENTOMOPATHOGENIC FUNGUS *NOMURAEA RILEYI* (FARLOW) SAMSON IN SOYBEAN

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RINGKASAN

Keberkesanan virus nuklear polyhedrosis (NPV) yang spesifik pada *Anticarsia gemmatalis* atau dikenali juga sebagai velvetbean caterpillar (VBC) terhadap populasi VBC di ladang dan interaksinya dengan *Nomuraea rileyi* telah dikaji. Virus ini pada kadar 7.4 dan 37 LE dapat mengawal populasi VBC dengan berkesan di bawah paras kerosakan di sepanjang masa ujian. Kejayaan ini adalah disebabkan oleh kukuhnya virus ini di ladang. Berdasarkan kepada bilangan larva, 'white cadavers', dan hasil, tidak terdapat interaksi yang nyata antara VBC NPV x kulat. Dari berkurangnya kesan merebak oleh *Nomuraea rileyi* di dalam petak yang disembor virus jelas menunjukkan populasi *Nomuraea rileyi* adalah bergantung kepada kepadatan perumah.

INTRODUCTION

The entomogenous fungus *Nomuraea rileyi* (Farlow) Samson has been reported for many years as one of the most important natural factors controlling populations of velvetbean caterpillar (VBC), *Anticarsia gemmatalis* Hubner (WATSON, 1916; HINDS and OSTERBERGER, 1931; ALLEN *et al.*, 1971). *N. rileyi* frequently appears too late in the season to prevent a severe defoliation of soybean by the VBC. Because of this, there exists a two-week period when VBC population may increase to economically damaging levels (ALLEN, *et al.*, 1971; KISH and ALLEN, 1978). Therefore, selective control measures of VBC between the peak of the pest population and that of the fungus is thus required to prevent damage before the fungus begins suppressing the VBC populations.

One of the possible selective measures is the application of the nuclear polyhedrosis virus (NPV), which has been found effective in controlling or suppressing VBC populations. STEINHAUS (1957) reported a possible VBC NPV from rotting specimens of VBC and *Xylomyges* sp. In 1972 an NPV was isolated from the VBC larvae collected on soybean near Campinas, Brazil (ALLEN and KNELL, 1977). However, to incorporate the use of virus into an integrated pest management program with *N. rileyi* as the major component, its compatibility with *N. rileyi* must be investigated.

This paper presents the results of efficacy and persistence tests of VBC NPV in the control of VBC on soybean and its interaction with *N. rileyi.*

MATERIALS AND METHODS

Hutton variety soybean were planted on June 23, 1977, at a rate of 67.25 kg/ha with a row spacing of 0.9 m. The plots were hand-weeded.

Four treatment plots and two controls were arranged in a randomized complete block with four replications. Each plot consisted of eight rows 15.24 m long. The VBC NPV treatments at dosages of 7.4 and 37 larval equivalent (LE), used alone or in combinations with benomyl, were applied to the test plots on September 8, 1977. At this stage the soybean plants were at stage R−5 (FEHR *et al.*, 1971) and there were at least 13 VBC (1.27 cm. or less) per row m. To each

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virus preparation, 1.12 kg/ha of an adjuvant was added before application. Sprayings were done with a four-row sprayer mounted on a tractor moving at 4.8 kilometer per hour. The sprayer was set at 2.11 kgs/sq. cm. delivering 164 l./ha. Benomyl alone was applied to designated plots on September 9th and again on September 26th using a Hahn 312 'High-boy' sprayer at 4.8 km/hr. covering eight rows at a time. The pressure was set at 7.00 kg/cm^2. In all cases benomyl was used at a rate of 1.12 kg 50% wettable powder per ha.

Benomyl was used in combination with other treatments and as a treated control in order to analyse for interaction since it has been found to suppress *N. rileyi* epizootics in the field (JOHNSON *et al.*, 1976).

Assessment of Treatment Effect and Interaction

The efficacy of each treatment and its interaction with *N. rileyi* were determined by counting the number of living VBC larvae and *N. rileyi* – infected cadavers (white), as well as soybean yield.

The number of living VBC larvae (1.27 cm or longer) and of white cadavers were determined together using the shake-cloth method (BARNES and JONES, 1970). These were sampled at 5, 11, 16 and 24 days after treatment from 1.82 row m. per plot. The number of VBC larvae and white cadavers were then computed on a row meter basis.

Yield sample was also taken from each plot. A 7.62 m. section of soybean plants was cut from the two center rows with a chain saw. The plants were then run through a stationary small-plot thresher, and the seeds were cleaned and weighed. After adjusting to 13% moisture content, yields of each plot were converted to bushels per hectare.

Persistence of VBC NPV

To determine the persistence of the NPV in the field, leaves from each of the virus-treated and control plots were collected and fed to laboratory-reared larvae at 0, 5, 10, 17 and 25 days after treatment. The leaves were placed separately in 12.06 x 12.05 x 3.18 cm. plastic boxes. Ten second instar larvae (2 replicates) were placed in each box and allowed to feed on the virus-treated leaves for one to two days. The larvae were then fed with untreated leaves. Mortality was recorded five to seven days after feeding.

RESULTS

Treatment Effect and Interaction

The population of VBC larvae on plots treated with NPV was below economically damaging level i.e. 13 larval (row m for all days sampled with less than three larva/row m. at days 16 and 24 after treatment *(Figure 1)*. An analysis of variance showed no significant effect of the NPV or *N. rileyi* on the VBC population at days 5 and 24 but a significant NPV x *N. rileyi* interaction at these days. At days 11 and 16 the number of VBC in NPV-treated plots was significantly lower than that in plots receiving no NPV treatment. However, there was no significant difference in the number of VBC larvae among the two levels of the NPV (7.4 and 37 LE).

The incidence of *N. rileyi* infection in NPV-treated plots was not observed until the 11th day after treatment *(Figure 2)*. The number of white cadavers remained at a very low level, three or less per row m. throughout the test period. There was no significant effect of NPV or *N. rileyi* at day 11 following treatment. However, at days 16 and 24 post treatment, there was a significantly lower number of white cadavers in NPV-treated plots than in non-NPV plots, but no significant virus x fungus interaction for any day sampled.

The soybean yields produced by plots receiving applications of virus, virus plus benomyl, benomyl and the untreated plots are presented in *Table 1*. An analysis of

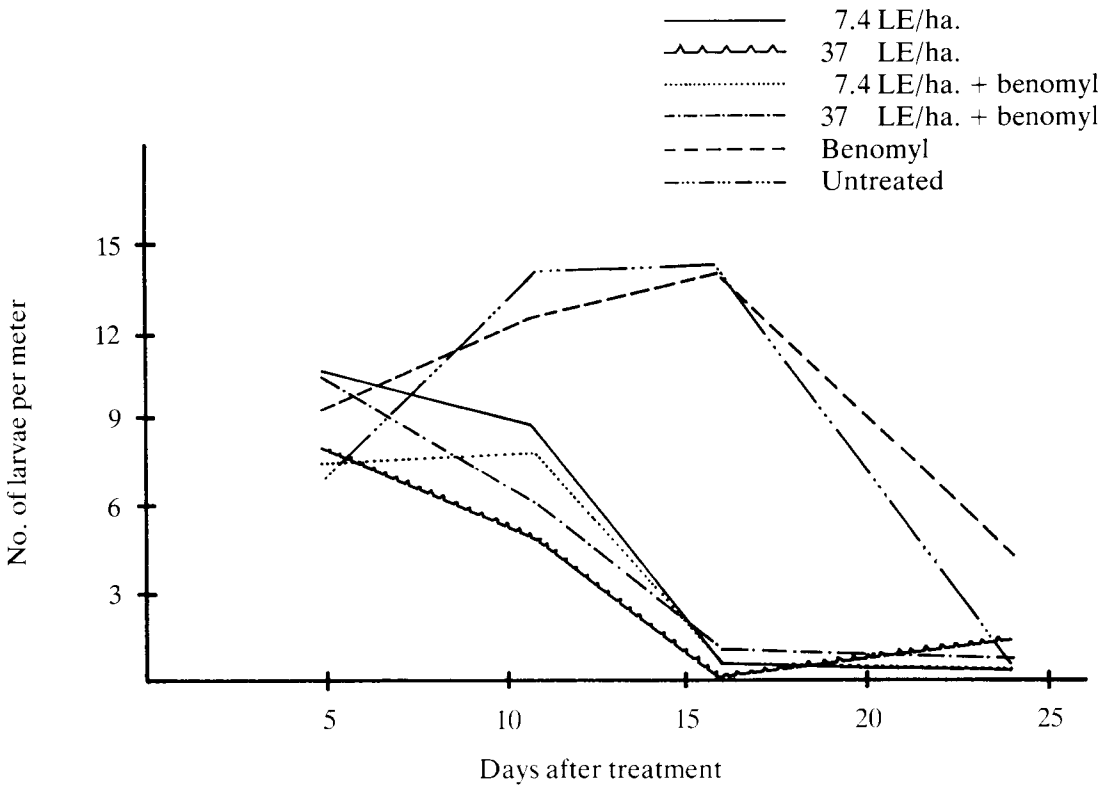

Figure 1. Velvetbean caterpillar larvae on soybean treated with VBC NPV alone or combined with benomyl, and benomyl alone.

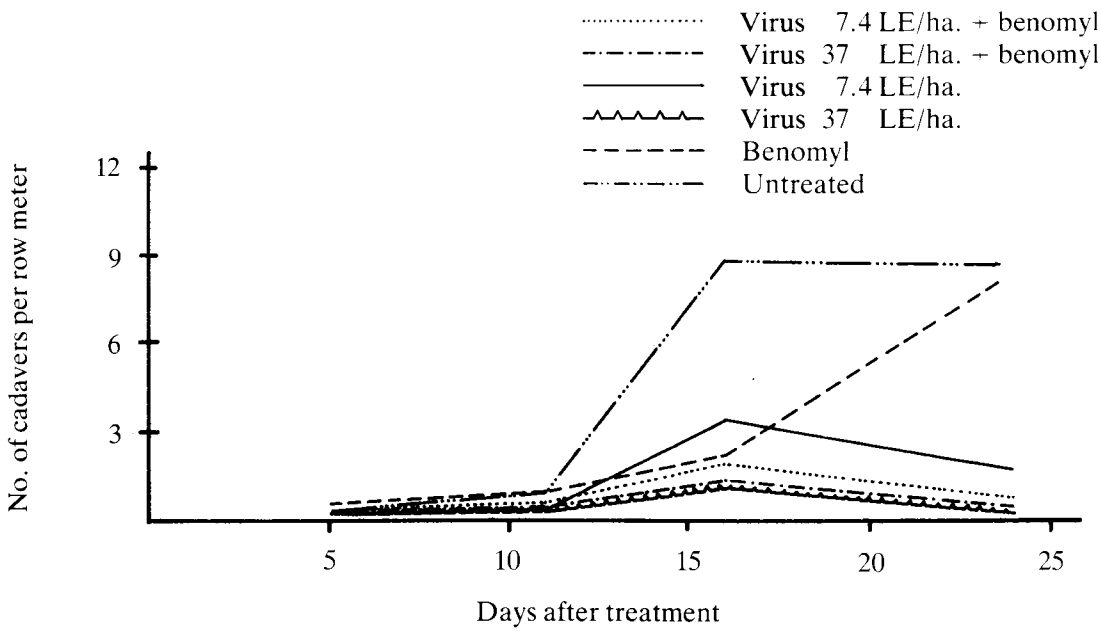

Figure 2: Fluctuation of N. rileyi-infected cadavers on soybean following application of virus, virus plus benomyl and benomyl.

TABLE 1. YIELD OF SOYBEAN FOLLOWING APPLICATION VBC NPV, VBC NPV PLUS BENOMYL AND BENOMYL ALONE

Treatment	Average yield (bushels/ha.)
Virus 7.4 LE	56.64
Virus 7.4 LE + benomyl	56.83
Virus 37 LE	58.00
Virus 37 + benomyl	67.61
Benomyl	56.07
Untreated	44.77

variance showed no significant virus or fungus effect on yield and no significant virus x fungus interaction.

Persistence of Virus Activity

The stability of the virus activity as measured by larval mortality on NPV-treated leaves collected at successive intervals after spraying is shown in *Figure 3*. In general, there was no difference in larvae mortality at different dosages of the VBC NPV. When larvae were fed with virus-treated leaves collected immediately after spraying (day 0) the larval mortality ranged from 78.5% to 89%. At seven days after treatment, the virus still caused 58.5 to 67% larval mortality, but the mortality dropped to 19 and 30% ten days after treatment. Similar trend in the persistency of the virus was also reported by MOSCARDI (1977).

There was a general increase of 50 to 78% in larval mortality at all virus dosages 17 days after treatment. The mortality increased further at 25 days after treatment. During the same period larval mortality due to virus was also recorded in the untreated check. There was no difference in mortality in the untreated check and that of the virus-treated plots after 16 days.

DISCUSSION

Results from the study showed that the VBC NPV was effective in reducing the VBC population below the economically damaging level. The VBC NPV at 7.4 and 37 LE per ha showed significant larval reduction throughout. Larval populations following virus application never increased beyond the threshold level. The fact that the virus applied at these rate persisted well in the field probably explained the success of this NPV in suppressing the VBC. Even though larval mortality decreased to between 19 and 30% ten days after treatment, the mortality increased after that period with 69.5% to 80% larval mortality even at 25 days after treatment.

The extended and increased activity of the virus on VBC populations after ten days, could probably be explained by an epizootic caused by the initial application of the NPV. MCEWEN and HARVEY (1958) and GETZIN (1962) suggested that larvae infected by the initial application of virus could contaminate the foliage and initiate an epizootic. These authors reported such epizootic was effective in promoting subsequent reduction in *Trichoplusia ni* larval population on cabbage.

While NPV significantly reduced the VBC population, it also reduced the impact of an *N. rileyi* epizootic but not to the extent of wiping out the fungus. MOSCARDI (1977) indicated that the NPV either reduced the natural substrate of VBC or had an antagonistic effect on the fungus. As shown in *Figure 1*, the VBC population at day 11 after treatment was significantly lower in virus treated plots than in the untreated check. This could probably account for the lower incidence of white cadavers.

The fact that yields in VBC NPV treated plots were not significantly different from that of the controls could mean that VBC population was not high enough during the test period to cause significant damage to

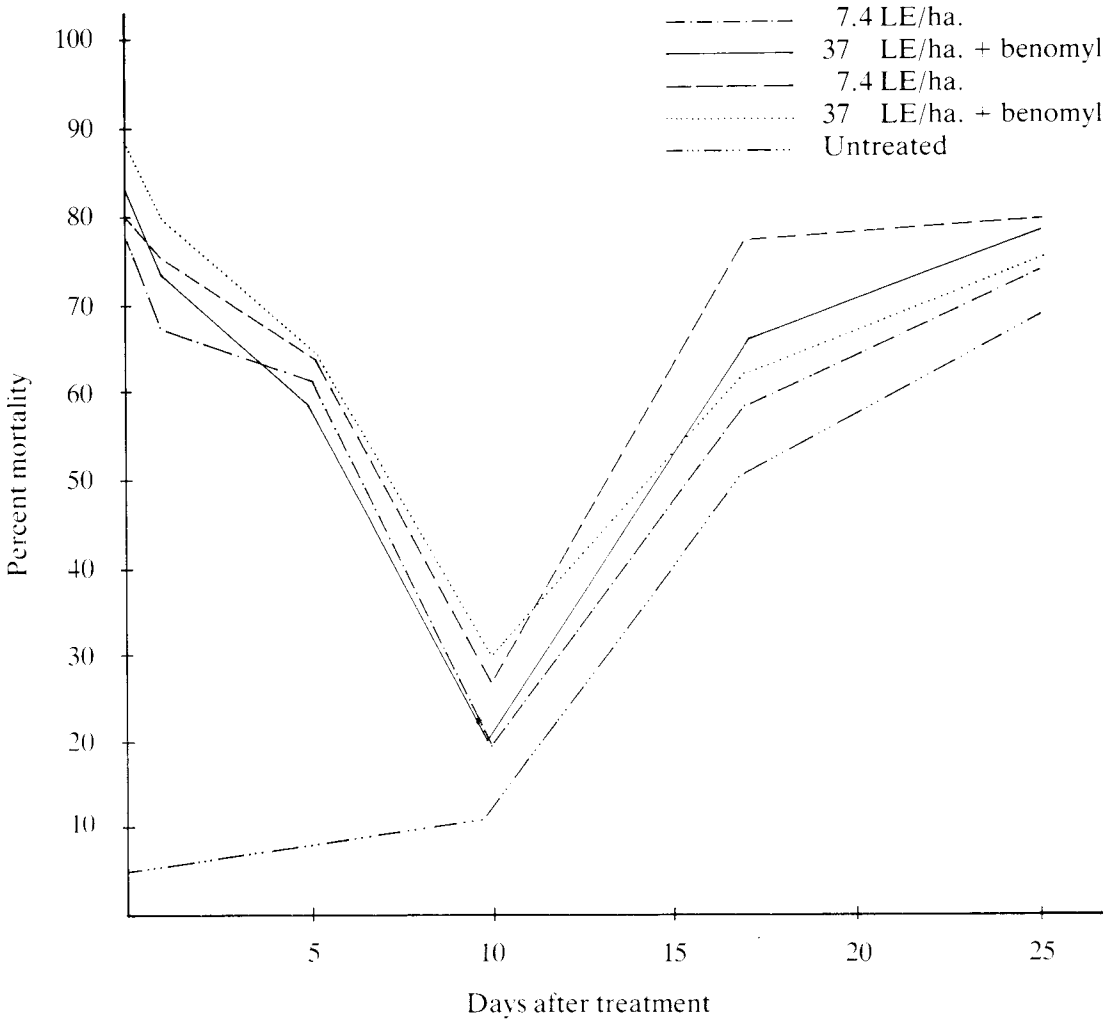

Figure 3. Persistence of VBC NPV on soybean leaves.

the soybean. However, the fact that the NPV was able to suppress larval populations over a long period undoubtedly attests to its potential use in future pest management programs for control of VBC on soybean with *N. rileyi* as the major component.

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SUMMARY

The efficacy of velvetbean caterpillar nuclear polyhedrosis virus (VBC NPV) against field population of VBC and its interaction with the naturally occurring fungus *N. rileyi* were investigated. The VBC NPV at 7.4 and 37 LE significantly reduced the VBC population below the damaging levels throughout the test period. The success of the VBC NPV was attributed to its high persistence in the field. There was no significant VBC NPV x fungus interations based on larval counts, white cadavers and yield. The reduced impact of an *N. rileyi* epizootic in all treated plots clearly demonstrated a host-density dependency of *N. rileyi*.

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