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OBSERVATIONS on the USE of GYPCHEK

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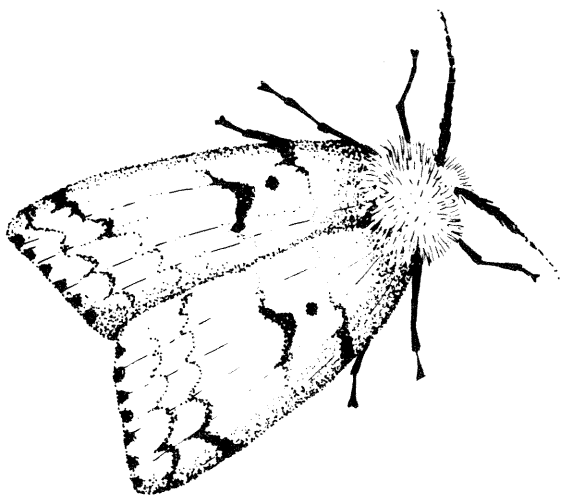

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Abstract

This paper reports the results of the 1978 aerial test with the gypsy moth NPV product, GYPCHEK. Although a general population collapse was observed, conclusions could be made on the efficacy of three formulations and two aircraft nozzling systems. The molasses formulation was more effective when applied with Beecomist® nozzles, but Pro-tec® formulations were more effective when applied with Flat Fan® 8006 nozzles.

INTRODUCTION

THE NUCLEOPOLYHEDROSIS VIRUS (NPV) of the gypsy moth, *Lymantria dispar* L., causes a naturally occurring disease which reaches epizootic proportions as gypsy moth population densities increase (Campbell 1963). In laboratory investigations the virus was found to be highly pathogenic to early-instar larvae (Doane 1967; Magnoler 1974). Tests of the relative virulence of purified and nonpurified NPV preparations of the same isolate have produced conflicting results (Magnoler 1974a; Rollinson and Lewis 1973). Also, tests with different geographic isolates of the virus have shown the Hamden (Connecticut, USA) strain to be one of the most virulent tested (Magnoler 1970; Rollinson and Lewis 1973; Vasiljević and Injac 1973).

Preliminary field studies indicated that the gypsy moth NPV applied on the ground (Magnoler 1974a; Rollinson 1965) and from the air (Yendol et al. 1977) is effective in causing larval mortality, protecting foliage, and reducing egg-mass densities. In 1976, a new NPV product called GYPCHEK replaced the product that had been cleaned and concentrated by isopycnic centrifugation in a K-rotor ultracentrifuge.

However, additional efficacy trials with GYPCHEK were necessary. The product was used in new formulations and applied by different systems for greater protection against ultraviolet light and a longer effective life. Recent field experiments with GYPCHEK have been reported (Wollam et al. 1978).

Reported here are the results of trials to determine the relative effectiveness of each of three NPV formulations used with both conventional (flat fan) and motorized spinning cage nozzle systems.

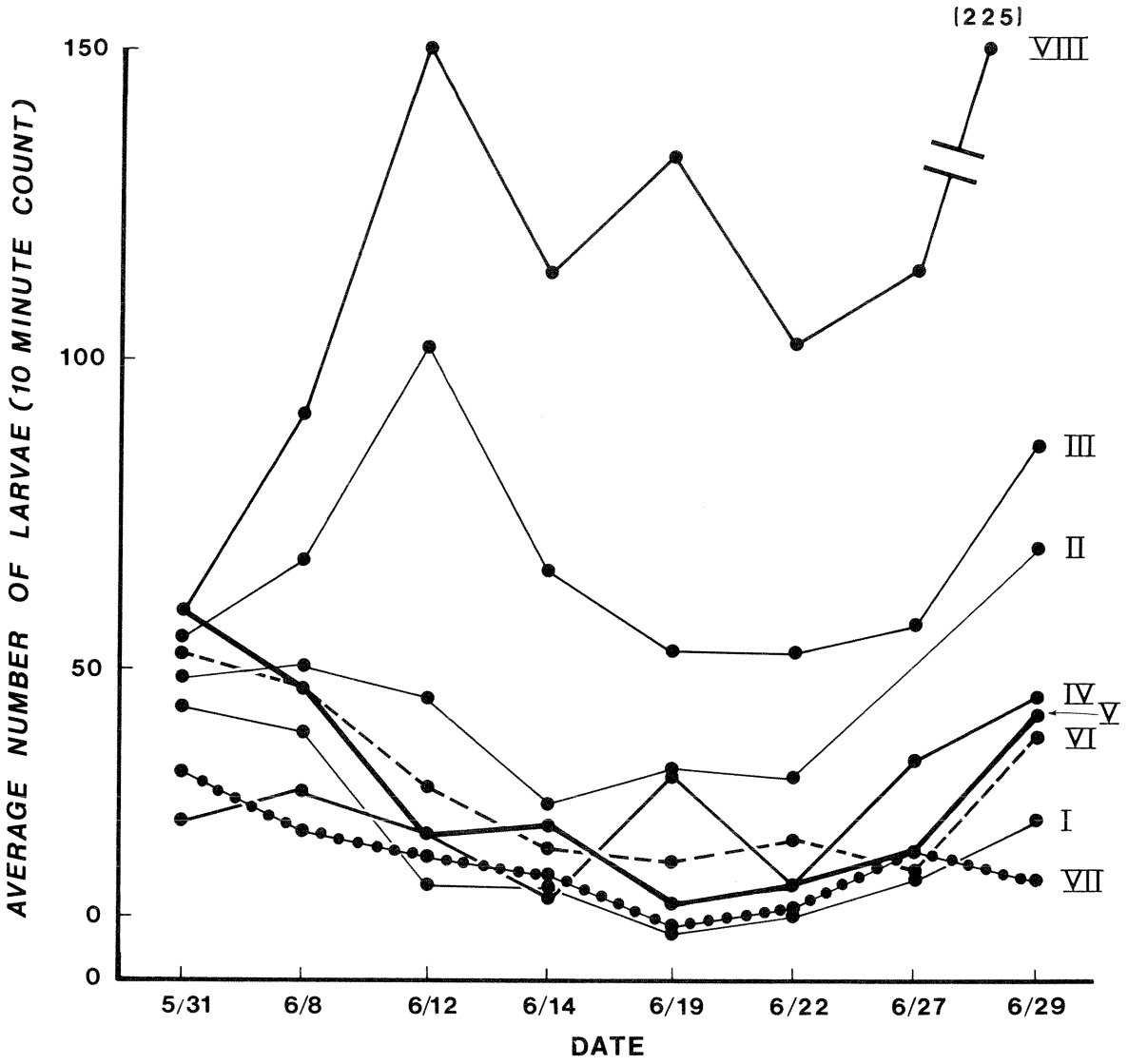
MATERIALS AND METHODS

The gypsy moth-infested experimental area was located in Clinton and Lycoming Counties, Pennsylvania. Twenty treatment plots, 50 acres (20.2 ha) in size, were established. Four additional plots were established as checks. The dominant tree species in the area were oak, *Quercus* spp., 30 to 60 ft (9 to 18.3 m) tall.

Prism points were used as a sampling method to determine spring and fall egg-mass numbers (Wilson and Fontaine 1978). This method was also used for defoliation estimates. In addition, 10-minute larval counts were made twice weekly to estimate large larval densities (Fig. 1). This information was useful in determining the relative effectiveness of the treatments.

A randomized block design and analysis

Figure 1.—Results of 10-minute larval counts taken during the 1978 gypsy moth NPV test.



was used to evaluate three replications each of six treatments, and two replications of a seventh treatment. An initial egg-mass density of between 200 and 1,500 per acre (0.4 ha) was used as the criterion for the block selection.

Virus preparations were applied aerially at the rate of 25 or 50 million Gypsy Moth Potency Units (GMPU) per acre (62 or 120 million GMPU/ha).

Two commercially available adjuvant systems were used with the NPV to evaluate its efficacy in the field. The first two formulations were the "standard"—Shade®[1,2], molasses[3], Chevron Spray Sticker®[4], and GYPCHEK. The third was a polymer-based sunscreen Pro-tec®[5], water and GYPCHEK.

The three tank mixes were:

[1]Mention of a proprietary product is for reference only and does not constitute endorsement by the U.S. Department of Agriculture or the Forest Service.
[2]Sandoz-Wander, Inc., Homestead, Fla.
[3]Pacific Molasses Corp., Baltimore, Md.
[4]Chevron Chemical Co., Perth Amboy, N.J.
[5]United States Trading International, Inc., Washington, D.C.

1.	NPV: 25 or 50 million GMPU	62 or 124 million GMPU
	Shade: 1 lb	1.1 kg
	Molasses: 0.5 gal	4.7 liters
	Chevron: 6 fluid oz	440 ml
	water: to 2 gal	to 18.7 liters
2.	NPV: 25 million GMPU	62 million GMPU
	Shade: 0.5 lb	.56 kg
	Molasses: 0.5 gal	4.7 liters
	Chevron: 6 fluid oz	440 ml
	water: to 2 gal	to 18.7 liters
3.	NPV: 25 million GMPU	62 million GMPU
	Pro-tec: 0.25 gal	2.3 liters
	water: 1.75 gal	16.4 liters

The seven treatments used in this experiment are shown in Table 1.

Two applications of each tank mix were made. The initial application date was determined by two factors: when at least 50 percent of the gypsy moth larvae were in the 2nd instar and when leaf expansion was at least 50 percent for white oak, Q. alba L. The first application was made May 28-29. The second application was made June 4-6 on all blocks. All applications were made in the evening between 4 p.m. and sunset. Three 450-hp Gruman AgCats® were used. All three aircraft had standard spray booms, two were equipped with Beecomist® nozzles with perforated sleeves and the third had 52-8006 Flat Fan® tee-jet nozzles. The swath width was 50 ft (15.2 m), the air speed was 95 mph (153 km/h), and the spray height was 50 to 75 ft (15 to 22 m) from treetops. Wind did not exceed 10 mph (16.1 km/h). It did not rain within 48 hours of application.

Table 1.—Treatment combination used in 1978 gypsy moth test

Treatment Number	Treatment	Number of replicates
I	Tank mix 1: Beecomist nozzles 25 x 10^6 GMPU/0.4 ha	3
II	Tank mix 1: Flat Fan nozzles 25 x 10^6 GMPU/0.4 ha	3
III	Tank mix 3: Beecomist nozzles 25 x 10^6 GMPU/0.4 ha	3
IV	Tank mix 3: Flat Fan nozzles 25 x 10^6 GMPU/0.4 ha	3
V	Tank mix 2: Beecomist nozzles 25 x 10^6 GMPU/0.4 ha 0.5 lb Shade/0.4 ha	3
VI	Tank mix 1: Beecomist nozzles 50 x 10^6 GMPU/0.4 ha (1978 Gypchek product)	3
VII	Tank mix 1: Beecomist nozzles 50 x 10^6 GMPU/0.4 ha (1977 Gypchek product)	2[a]
VIII	No treatment	4

[a]1977 material available for two plots only.

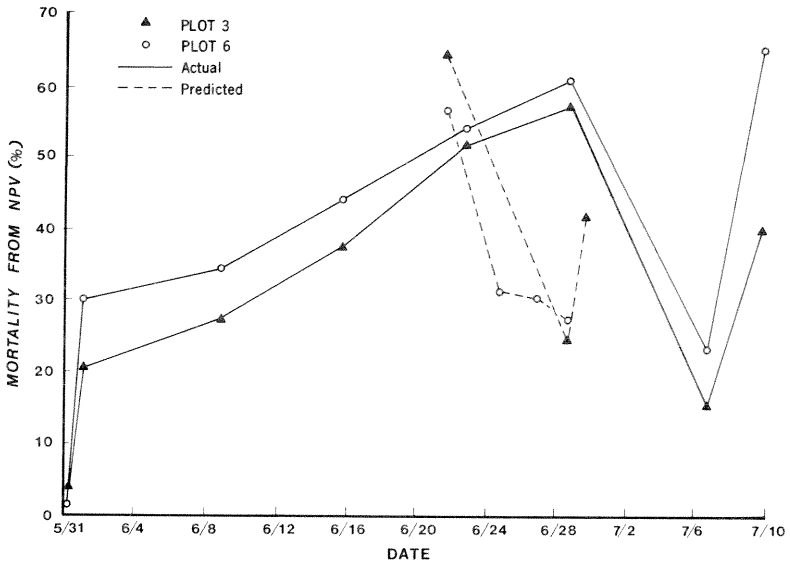


Figure 2.—Actual and predicted mortality from NPV in two control plots.

Figure 3.—Actual and predicted mortality from NPV in treated and untreated plots.

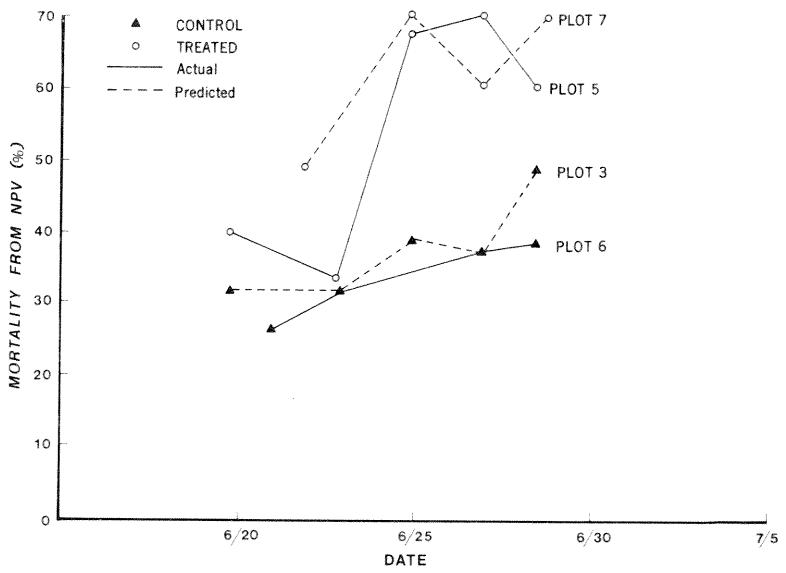
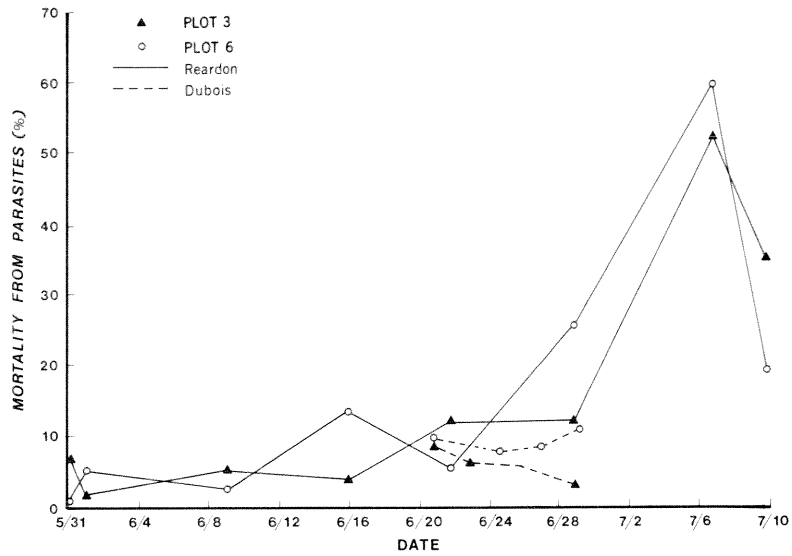


Figure 4.—Actual and predicted mortality from parasites in two control plots.



The number of gypsy moth egg masses was determined by the Wilson and Fontaine method (1978). Preapplication egg-mass densities ranged from 200 to 1,500 per acre (500 to 3,750 EM/ha). Postapplication egg-mass counts were made in September and October 1978. Because the counts were low (less than 100 EM/acre; 250 EM/ha), three 0.1-acre (.04 ha) sampling areas were examined in each plot in addition to the prism points.

Defoliation of oaks at each prism point was estimated and all tree species were determined when larval feeding stopped.

White Kromekote®[6] spray cards were used in selected plots to determine the size of spray droplets and the number of droplets per cm^2. The cards were collected after spraying and stored for evaluation.

Bioassay data were collected to establish the efficiency of the mixing system. Samples were taken to record dispersion of the NPV throughout the mixing and loading operations before and after application. Thoroughness of mixing was determined by sampling the mixing tank before loading the aircraft. Samples also were taken from the loading hose and the aircraft tanks after spraying and temperatures were recorded to determine if potentially inactivating temperatures had been generated by the mechanical mixing action.

Parasite and other natural mortality factors were assessed by collecting 100 larvae weekly from treated and untreated areas and rearing them in a field laboratory. The actual incidence of parasitism and virus mortality was then recorded (Figs. 2-4).

A second collection of larvae was made to test a system being developed (and being reported elsewhere) to predict virus incidence before its natural expression in gypsy moth populations (Figs. 2-3). Also accumulated were data to predict parasite activity (Fig. 4).

[6]Champion Paper and Fiber Co., Hamilton, Ohio.

RESULTS AND DISCUSSION

Mixing efficiency

Eighteen of the 20 spray mixes used in this test were sampled before loading. All 18 were within the calculated potency range (±10 percent). The water used in preparing the spray formulations was tested and had no effect on the potency of the GYPCHEK used. It was concluded from these quality control tests and bioassays that the mixing of the GYPCHEK in the various formulations was adequate and yielded the desired potency before spraying.

Larval counts

Despite a spontaneous reduction in the gypsy moth population during the study, it was possible to assess the effectiveness of each treatment by evaluating 10-minute larval count data for each treatment group (Fig. 1, Table 2). Treatments generally reduced the larval populations by two to ten fold compared with the controls (Group VIII).

Groups I and II were treated with the same tank mix (1), the only difference being that spinning sleeve nozzles were used in Group I plots while flat fan (8006) nozzles were used in Group II. A comparison of the 10-minute counts showed that the larval reduction from the use of spinning nozzles was about twice that from the use of flat fan nozzles.

However the reverse was true for Groups III and IV. Both groups were treated with the same tank mix (3), nozzle type being the only difference. The larval reduction from applications with the flat fan nozzles (Group IV) was more than twice that from applications with spinning nozzles.

These comparisons point up the fact that the formulation and the application system must be compatible to provide the maximum effect of the treatment. Mix 1 was thick and heavy (11 lb/gal) (1.25 kg/.95 liter) whereas Mix 3 was watery and light (8 lb/gal) (0.9 kg/.95 liter). Thus, better results were achieved when Mix 1 was applied with spinning sleeve nozzles. Mix 3 apparently was better when applied with flat fan nozzles.

On the basis of the 10-minute count, there was little differences between Groups I and V. The only difference between the two groups was that the formulation for Group V contained half the concentration of Shade (0.5 lb; .22 kg). This indicates that the concentration of Shade can be reduced without seriously affecting the formulation.

Mixes applied to Groups VI and VII contained twice the amount of GYPCHEK than the other formulations, the only difference being the source of GYPCHEK. On the basis of the 10-minute counts, the use of twice the amount of GYPCHEK, compared with Group I, does not materially affect the efficacy of the formulation.

Defoliation estimates

Because of the population collapse in the general area, no conclusions can be drawn on the basis of defoliation estimates. Total defoliation on all plots treated and untreated, was 10 percent or less. Oak defoliation did not exceed 15 percent in any plot.

Table 2.—Summary data from 1978 gypsy moth NPV test

Plot group	Average no. larvae (10-min count)	Percent defoliation (all spp.)	No. larvae hatched/0.4 ha	Egg-mass counts			
				Prespray	Postspray		
					Prism	.04 ha	Average
I	21.3	7.1	83001	758	6.0	3.3	4.6
II	41.7	10.5	47573	528	8.0	4.3	6.2
III	66.9	7.2	79145	614	3.7	0.0	1.9
IV	27.9	6.0	44296	490	1.7	0.0	0.9
V	29.6	7.2	50809	602	9.0	10.0	9.5
VI	30.8	7.0	21943	335	7.3	3.3	5.3
VII	17.8	7.2	40701	368	3.0	6.5	4.8
VIII	123.4	9.1	50333	478	0.7	5.0	2.9

Even though larval populations were sufficient to cause noticeable defoliation in some plots (Fig. 1), the very small amount of defoliation in these plots indicated that the factors causing population collapse exerted their influence before the larvae reached the size to cause significant defoliation. Figure 2 indicates that no major viral epizootics took place and Figure 4 indicates that parasite activity did not occur soon enough to have a significant effect on reducing the populations and on defoliation at the time when this would have to occur to result in so little final defoliation. Although natural NPV larval mortality was observed in the control plots (Fig. 3) its incidence was considerally less than that observed in the treated plots (Fig. 3). However, the levels of virus activity in the check plots did not seem high enough to be the only cause of the general population collapse. However NPV obviously was the principal cause of the collapse.

Egg-mass change

On the basis of the egg-mass data obtained in this test, it is impossible to conclude that any treatment had an impact on the populations. The final egg-mass counts, whether obtained by the fixed and variable plot technique or the 0.1-acre (.04-ha) sampling technique, represent the total accumulated mortality due to treatment and other effects. It is apparent that treatments had no deleterious effects on other mortality factors, either intrinsic or extrinsic. A comparison of the final egg-mass counts made by each counting system indicates that either system seems suitable. The major discrepancy between the two systems was in estimating the final egg-mass counts in the four check points.

CONCLUSION

The data accumulated in this test do not provide a solid basis for determining the effects of the NPV treatments on gypsy moth populations in central Pennsylvania.

The 10-minute counts and the viral prediction data do indicate that treatment effects in the sprayed plots were quite different from those observed in the control areas at a time when the virus effect should occur.

The data also indicate there was no heavy virus epizootic in the natural populations and that parasite activity, although contributing to the general population collapse, did not occur early enough in the populations to account for the very little defoliation observed in the test area. Although initial feeding populations in the area were relatively low, there were sufficient numbers to result in noticeable defoliation if mortality had not occurred. The exact cause or causes of the population collapse remain unknown.

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