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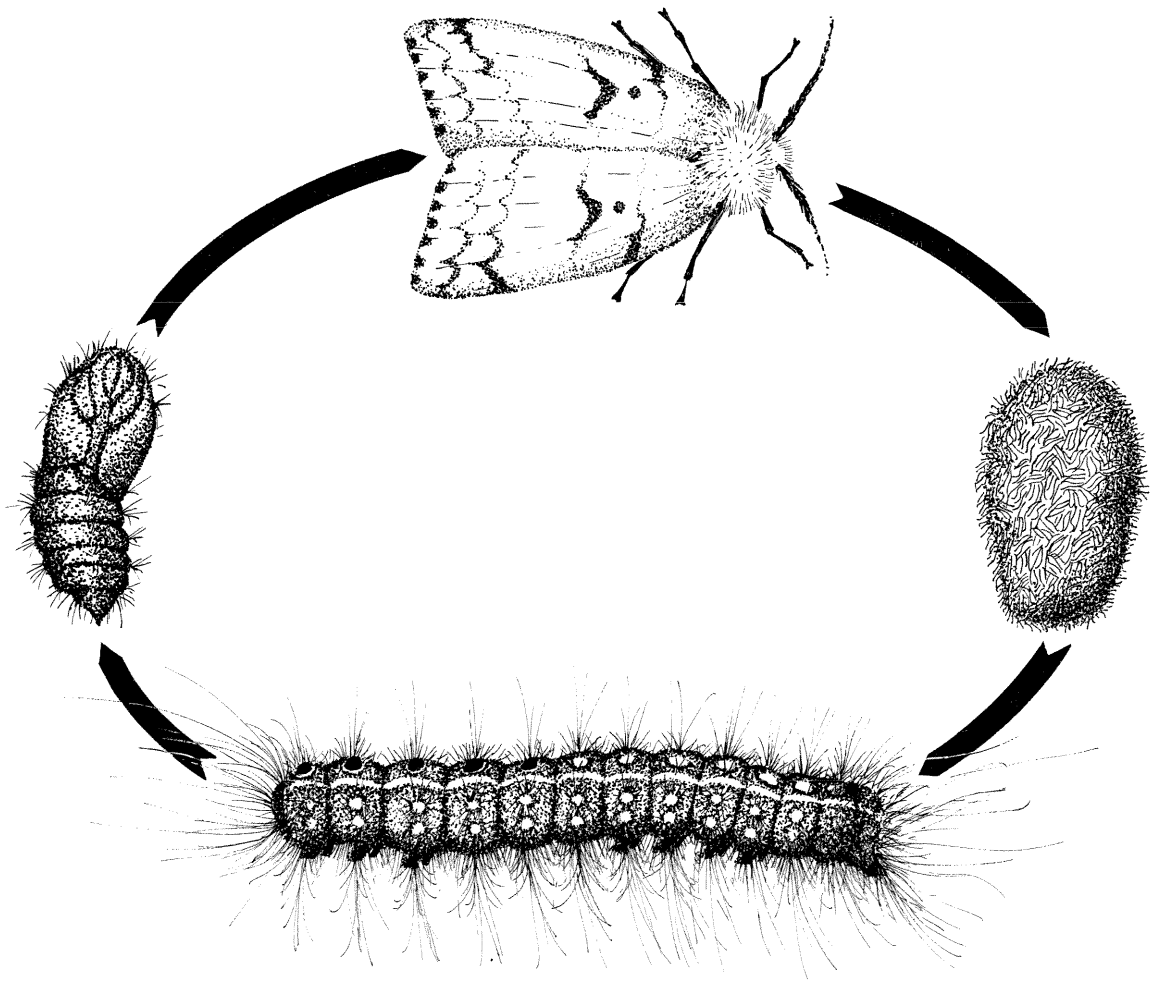
Guidelines for the Use of GYPCHEK to Control the Gypsy Moth



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Abstract

This paper presents positive and negative attributes of GYPCHEK for evaluation by land managers contemplating gypsy moth control. Special precautions and procedures are outlined. Environmental and ecological considerations are discussed and results to be expected from the use of GYPCHEK in gypsy moth control are presented.

INTRODUCTION

A LAND MANAGER frequently must answer two important questions when confronted with a gypsy moth infestation: Should I institute control action? What control approach should I employ? And there are other important questions that must be asked, weighed, and answered: What is the cost? What are my short and long range objectives? What are the economic, political, environmental, and ecological constraints? Are there operational difficulties and problems? What is my time frame?

These guidelines were developed to aid the land manager in the selection and use of GYPCHEK,[1] a biological insecticide for gypsy moth control.

WHAT IS GYPCHEK?

GYPCHEK is an insecticide prepared from gypsy moth larvae that have been killed by the nucleopolyhedrosis virus (NPV). The active ingredient in GYPCHEK is the virus, which is embedded in a protein particle called the polyhedron. The powder, milled to pass through 50-mesh screens, contains the virus, insect material, and a small amount of harmless bacteria. The insecticidal activity of GYPCHEK, determined by a bioassay procedure, is printed on the label as so many activity or potency units per gram (See Appendix). These activity or potency units are used to prescribe the field dosage. The present field dosage is 25 million potency units per acre (0.4 ha), usually applied twice.

GYPCHEK is specific against the gypsy moth and has no effect on other insects. GYPCHEK has shown no adverse effects on fish or game birds, vertebrates, or man. If the powder gets into the eyes, it can cause moderate irritation because GYPCHEK contains some gypsy moth hairs.

GYPCHEK is a proteinaceous material and as such is subject to degradation by sunlight and heat.

HOW DOES IT KILL GYPSY MOTH LARVAE?

After the gypsy moth larvae ingest viral polyhedra along with the foliage, the virus rods are liberated from the polyhedra and attack internal tissues and organs of the larvae. The rods multiply rapidly, eventually causing disintegration of the internal tissues and death. The entire process takes 10 to 14 days, depending on the temperature. Larvae about to die have a characteristic oily, greasy appearance (Fig. 1). Before this time, virus-infected larvae are not visibly different from normal larvae (Fig. 2). Virus-killed larvae typically have an inverted-V appearance and are extremely fragile to the touch (Fig. 3).

HOW DO YOU USE GYPCHEK?

GYPCHEK is registered for aerial application only. The procedures for mixing GYPCHEK are found on the product labeling (Appendix). The following are special reminders on the use of GYPCHEK.

[1]The use of trade, firm, or corporation names in this paper is for the information and convenience of the reader. Such use does not constitute an official endorsement or approval by the U.S. Department of Agriculture or the Forest Service of any product or service to the exclusion of others that may be suitable.

Figure 1.—Virus-infected gypsy moth larvae about to die have a characteristic oily, greasy appearance.

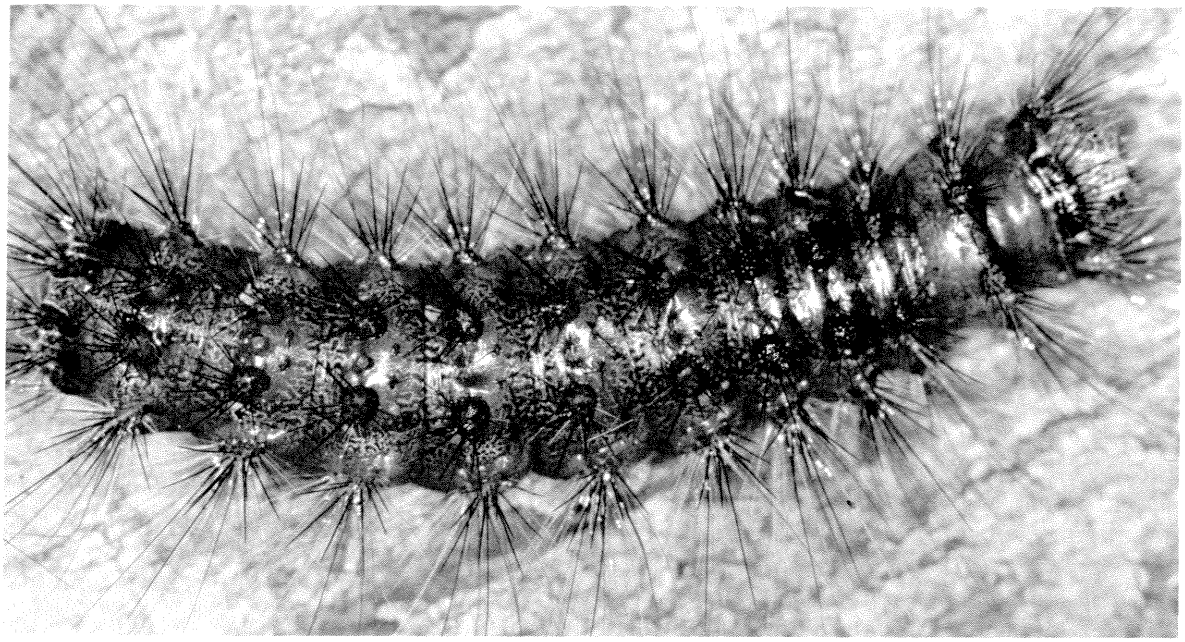


Figure 2.—Normal gypsy moth larva.

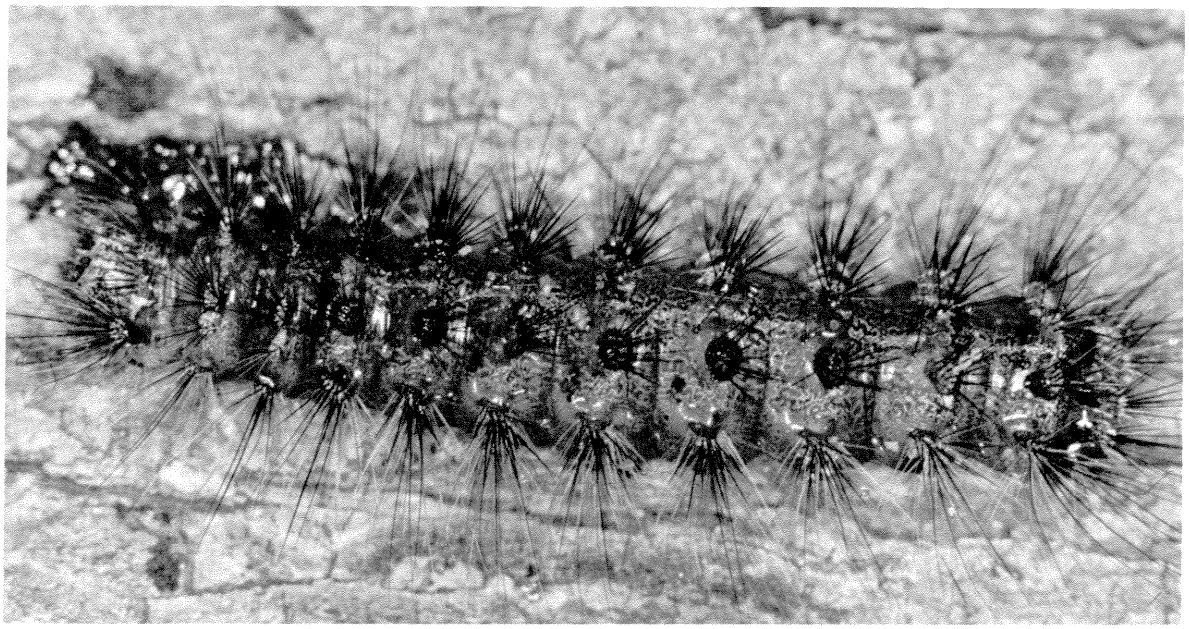
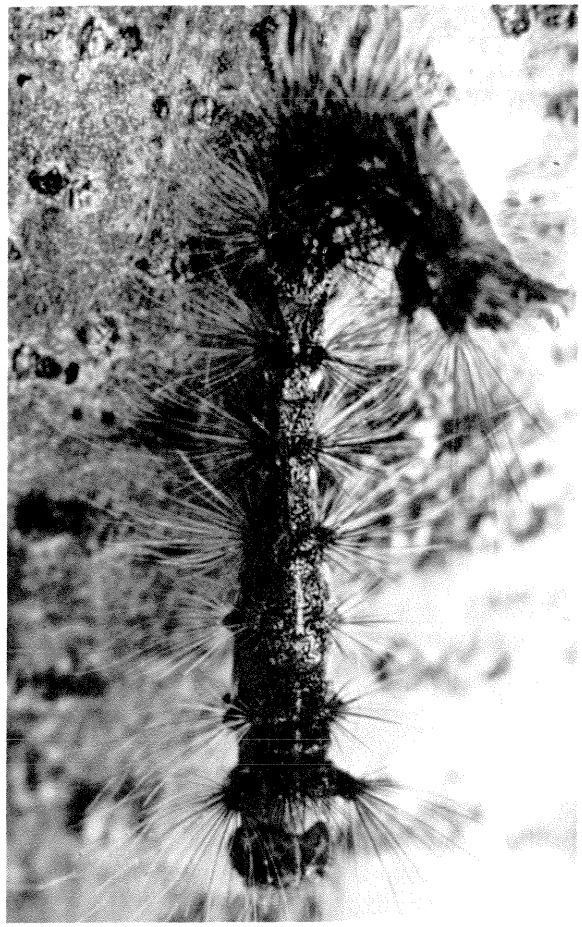


Figure 3.—Virus-killed gypsy moth larva.



Timing

The active ingredient in GYPCHEK is much more effective against small larvae than against large. Two primary factors should be considered: (1) larval size—application should be made when the majority of larvae are 1st and 2nd instar, (2) leaf size—since GYPCHEK is a stomach insecticide, leaf expansion should be at the maximum consistent with larval size. Expansion of small leaves will produce untreated leaf surfaces and can dilute the effect of the treatment. Thus, the timing of the first application should balance larval size and leaf expansion—with greater emphasis on larval size.

A second application of the material is recommended because: (1) the expected life of GYPCHEK in the field is about 3 days with present formulations; there will be slight activity for 4 to 6 days; (2) further expansion of leaves requires coverage of the newly exposed surfaces; (3) further hatch and dispersal of gypsy moth larvae can add a significant number of insects not ingesting viable GYPCHEK from the first application, (4) additional coverage of leaves with active GYPCHEK extends the period of exposure of larvae that may have received a sublethal dose or none at all.

The second application should be timed about 5 to 10 days after the first, but should not be applied if the larvae are at the more resistant instars (4th or larger).

Size of treatment area

Although there is no limit to the size of the area that can be treated, there are two important considerations. Coverage should be thorough—both vertically and horizontally. In heavy populations (4,000 or more egg masses per acre) the likelihood of reinvasion of treated blocks increases dramatically. Small blocks less than 50 acres should not be treated as they are apt to be overrun by invading larvae searching for food. The invading larvae will not be controlled because the GYPCHEK will have been degraded.

Therefore, if reinvasion is a threat, small treatment areas should be avoided or the treatment blocks should be enlarged. Reinvasion does not pose a problem in isolated infestations that can be treated in their entirety.

Population density and quality

There has been much theorizing about the gypsy moth population levels at which GYPCHEK would have the greatest effect. European literature indicates that the gypsy moth NPV is considered most effective at low, building population levels than at the peak of the insect outbreak. Most testing has been in the range of 300 to 3,000 egg masses per acre. We do not know how effective GYPCHEK would be against very low populations (less than 100 egg masses per acre) or very high populations (more than 4,000 egg masses per acre). Table 1 summarizes the results of field tests with GYPCHEK since 1974.

Using numbers of egg masses per acre to estimate population density can be mislead-

Table 1.—Effects of aerially applied GYPCHEK on egg mass populations of the gypsy moth[a]

Year	Population density		Foliage protection[b]
	Pretreatment	Posttreatment	
	Egg masses/acre		
1974[c]			
Treatment	1,817	2,124	Not acceptable
Control	1,732	5,550	Not acceptable
1975[c]			
Treatment	960	600	Acceptable
Control	1,000	1,240	Not acceptable
1976[c]			
Treatment	2,009	475	Acceptable
Control	2,606	1,369	Not acceptable
1977[d]			
Treatment	1,260	356	Acceptable
Control	1,455	2,293	Not acceptable
1978[d]			
Treatment	528	4	Acceptable
Control	478	5	Acceptable

[a]Averages of all plots. Data presented for general comparisons. The number of egg masses per acre ranged from 250 to 3,200.
[b]Acceptable if total defoliation was less than 50 percent.
[c]Highly purified gypsy moth NPV.
[d]Present GYPCHEK product.

ing since a small number of large egg masses (600 or more eggs per mass) can produce more larvae than a much higher number of small egg masses (less than 200 eggs per mass). Also, larvae hatching from small numbers of large egg masses are thought to be more vigorous and healthy then larvae hatching from large numbers of very small egg masses.

In 1978, where treated populations averaged about 500 egg masses per acre, there was a total collapse of treated and untreated populations. This collapse was neither predicted nor expected.

The efficacy of GYPCHEK can be markedly affected by the quality or behavior of the larval populations being treated. Points to consider regarding the quality of the larval population and its relationship with GYPCHEK are:

- The natural virus load and a way to predict it.
- Gypsy moth populations may experience a total collapse at about 500 egg masses per acre—far below densities where such occurrences are expected.
- Information is lacking about how best to assess the quality of the larval population and when and how to apply treatment.

Mixing

Since GYPCHEK is an insoluble powder and will be applied as a suspension, it should be thoroughly premixed by vigorous mechanical agitation in a small amount of water before it is added to the spray mixing tank. Good agitation must be maintained in the mixing tank and in the aircraft. At least 15 minutes should elapse between final mixing of GYPCHEK and loading into the aircraft.

It is relatively simple to mix GYPCHEK. The following is the recommended sequence for mixing:

1. Pump and meter water into the mixing tank to about one-half to two-thirds of the total volume of water for the particular mix.

2. Carefully dissolve the proper amount of the ultraviolet screen, Shade,® in this water. Eliminate all lumps—agitate thoroughly.
3. Add the necessary amounts of molasses and sticker while vigorously agitating the mix. Add the remaining water to complete the required mix.
4. Continue agitating for 5 to 10 minutes. At this point the formulation can be held for 1 or 2 days if necessary.
5. To complete the formulation when spraying is scheduled, add the premixed GYPCHEK suspension to the tank and thoroughly mix for 10 to 15 minutes before loading into the aircraft.

If this procedure is followed, only 10 to 15 minutes will be needed to prepare final formulation once the decision to spray has been made. An efficient mixing crew can easily have the next tank mix ready by the time the aircraft returns to the loading area.

Special precautions in mixing and applying GYPCHEK

There are a few points to keep in mind when mixing and applying GYPCHEK:

- Follow the label directions carefully. The pH of water used in the mixing must be between 5.5 and 7.5. Stagnant pool water should not be used if a suitable source of flowing water is available.
- The active ingredient in GYPCHEK is a living organism and will be injured or killed by heat. GYPCHEK should be premixed only in short sequences to prevent temperature buildup. This is best accomplished by using an electric blender. Be sure to thoroughly rinse the premixed GYPCHEK while adding it to the mixing tank. Aerial spraying systems that generate high temperatures should be avoided. The spray mix should never be allowed to reach 100°F or held at temperatures above 90°F for long periods.
- All efforts should be made to minimize the time from final mixing to application. Retention of the final formulation in the mixing tank should not exceed 48 hours.
- Apply the material in the evening since this will allow GYPCHEK to be fed on for several hours before the degrading effects of sunlight begin. This timing also will coincide with the normal feeding period of the insect.
- Keep premixed batches of GYPCHEK calibrated for spray blocks cool (on ice) until they are placed in the mixing tank. These batches can be made up well in advance (1 to 2 weeks) of planned spray dates. The size of the premixed batches will be decided by the planned operation and can be adjusted to the size of the available mixing equipment. Premixes can be prepared as easily for large operations as for small ones. They should be refrigerated until use. Plastic ice chests will keep the premixes sufficiently cool at the mixing and loading site.
- Since the premixed GYPCHEK is added to the mixing tank last, all other ingredients can be mixed and held for several days if necessary. GYPCHEK can be added to the mixing tank when spray conditions are acceptable. Do not use the spray tank agitation system in the aircraft as a substitute for the mixing tank on the ground.
- Rinse Beecomist® nozzles after 2 to 3 loads have been delivered. If flat fan nozzles are used, remove and clean the nozzle screens after each load or do not use nozzle screens.

HOW TO MEASURE EFFECTS OF GYPCHEK

Several methods can be used to measure the efficacy of GYPCHEK. These can be placed into two general categories: (1) population change, and (2) defoliation reduction.

Population changes are monitored in the following ways:

- Changes in egg-mass density based on the number of egg masses per acre before treatment compared to egg masses per acre after treatment as measured in fixed sampling points. It is important to determine the number of viable eggs in the egg masses. The number of residual egg masses is one primary indicator of efficacy.
- Burlap bands placed on trees in treated and untreated areas provide resting areas for larger larvae. This technique provides good information on the relative abundance of

larvae in treated and untreated areas, and an insight into any catastrophic mortality in the populations.

- Timed walk counts. Slow walks of 5 or 10 minutes through treatment and check areas will provide a good estimate of the relative densities of larval populations. Living and dead larvae are recorded as seen during this slow walk. This technique and the burlap technique should be used only when the larvae are large and exhibit their diurnal behavior pattern.

Damage estimates, the second primary efficacy measurement, are based on visual defoliation measurement at the same prism points where the egg mass counts were made. Estimates should be made on oaks and other tree species. Defoliation estimates can be either total or net. Total defoliation refers to the gross amount of defoliation at the measurement point uncorrected for initial defoliation before spraying. Net defoliation is the gross amount minus the prespray defoliation; this method better accounts for the protection afforded by the treatment. Net defoliation should always be used if there is a significant amount of defoliation before spraying. This requires a defoliation estimate just before treatment as well as the final defoliation estimate.

WHAT CAN BE EXPECTED FROM THE USE OF GYPCHEK

At the outset it should be noted that the complete elimination of the population cannot be expected from the use of GYPCHEK. The positive and negative aspects of GYPCHEK are shown in Table 2.

Reduction of population

Proper application of GYPCHEK can reduce the number of residual egg masses in treated areas by 75 percent, though greater reduction can often be achieved. Under certain circumstances (1976 spray test), egg viability in the succeeding generation also may be markedly reduced.

Protection of foliage

When defoliation of most trees exceed 50 percent, refoliation will occur; in the process of refoliation, stored foods in the tree are used and the vigor of the tree is subsequently reduced, rendering it susceptible to opportunistic mortality-causing organisms. Preventing refoliation can be an important management objective.

Foliage protection sufficient to prevent refoliation is possible when GYPCHEK is ap-

Table 2.—Positive and Negative Attributes of GYPCHEK

Positive	Negative
No effect on beneficial forms of life	Relatively slow acting
Natural component of gypsy moth ecosystem	Considerable care must be used in timing and application
Selective against gypsy moth	Affects only gypsy moth, this is negative only when another pest in the same area is at damaging levels
Affords population reduction (75 percent minimum)	
Affords foliage protection (prevents refoliation)	Short residual activity
Insect does not develop resistance	At present more expensive then conventional insecticides
Suited to a pest management system	Quantities are limited
Ecologically and environmentally acceptable	At present must be applied twice

plied properly and at the right time, even though 10 to 15 days are needed for the material to exert its effect.

Less than 55 to 60 percent total defoliation can be expected, and, in many cases, less than 30 percent.

ENVIRONMENTAL CONSIDERATION

GYPCHEK has no effect on the natural enemies of the gypsy moth, and no degrading effect on the environment in which it is applied. This can be advantageous where ecological and environmental considerations are of paramount importance in the selection of an insecticide. Extensive tests have shown that GYPCHEK does not affect birds, fish, or other wildlife, and that it has a shorter residual effect on bark and in soil than the natural-occurring virus.

ROLE OF GYPCHEK IN GYPSY MOTH PEST MANAGEMENT

Conclusive data on the long-range effect of GYPCHEK on gypsy moth populations is not yet available. GYPCHEK has yet to be tested in combination with other control tools to determine the combined effects, either short or long term.

Table 3 shows the objectives and constraints of land managers when planning treatments. GYPCHEK fits into pest management plans where:

1. Environmental considerations are critically important.
2. The cost of treatment is not a major consideration.
3. Protection of foliage and reduction of larvae and egg masses is desired, but total larval elimination is not required.
4. The area will be used immediately after treatment.
5. The effect of treatment is not expected to exceed 3 years.
6. The natural mortality-causing complex of the gypsy moth must be protected.

Table 3.—Variables usually considered by land managers when contemplating gypsy moth control

User	Objective	Type of injury from gypsy moth	User constraint				
			Willingness to fund treatment cost	Environmental considerations	Expected duration of effects of treatment	Area usually considered
Timber grower	Wood production	Growth loss, tree stress, mortality	Nil to low	Minimum	Long	Large
Watershed manager	Water quality and quantity	Growth loss, tree stress	Moderate	High	Short to moderate	Medium
Recreation manager	Good public relations, prevent immediate loss of revenue	Defoliation, frass, larvae, tree mortality	Moderate to high	Moderate to high	Short to moderate	Small to medium
Public (individuals and municipalities)	Reduce maintainence and hazards, prevent nuisance and tree mortality, and removal and replacement costs	Defoliation, frass, larvae, tree loss	High	Moderate to high	Short	Small to medium

APPENDIX

TECHNICAL BULLETIN
GYPCHEK BIOLOGICAL INSECTICIDE

Gypchek Biological Insecticide consists of polyhedra of the gypsy moth nucleopolyhedrosis virus. Care must be taken in the mixing and application of this product. Stickers and u.v. protectants may enhance performance of this product. Apply in sufficient spray mixture for thorough and uniform coverage. This spray mixture is for aerial application only. Application is at the rate of 2 gal. (U.S.) finished spray per acre. Use boom and nozzle systems designed to result in droplets 150-400 mmd. (For example:Beecomist 275 or flat-fan 8006).

Tank Mixture (per gallon)

Gypchek	Amount to result in 25.0 to 125.0 million gypsy moth potency units per acre.
Molasses	0.25 gallon
Chevron Sticker	3 fl. oz.
Shade^{R}	1.0 lb. (same amount for 2 gallon)
Water	0.72 gallon

IMPORANT:Check pH of water from field source. If pH exceeds 7.5 or is below 5.5, add sufficient acid or base to adjust pH to approximately 7. NEVER USE CHLORINATED WATER IN THE SPRAY FORMULATION.

Mixing sequence for conventional mixing equipment.

1. Fill tank with water and start agitation.
2. Add acid or base if necessary to adjust pH.
3. Add sunscreen (Shade^{R}) by slowly pouring onto the surface of mixture under agitation. Avoid large lumps of powder.
4. Add molasses by slowly pouring into water and mix thoroughly.
5. Add sticker.
6. Add GYPCHEK. Mixing time can be reduced by premixing Gypchek with a small amount of water in a blender before adding to tank mix. Final formulation should be mixed for 10-30 minutes.

Note: Read label thoroughly before using. Follow all label cautions and directions.

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS

WARNING
Causes eye irritation. Do not get in eyes.

FIRST AID

In case of eye contact, immediately flush eyes with plenty of water for at least 15 minutes. For eyes, call a physician.

ENVIRONMENTAL HAZARDS

Avoid application to lakes, streams, or ponds. Do not contaminate water by cleaning of equipment or disposal of wastes.

DIRECTIONS FOR USE
GENERAL CLASSIFICATION

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

For foliar protection from gypsy moth larvae make 2 applications 7 to 10 days apart at the rate of 25.0 to 125.0 million gypsy moth potency units per acre in sufficient water for thorough and uniform coverage. Stickers and u.v. protectants may enhance performance of this product. Refer to technical bulletin for mixing and application instructions.

NEVER USE CHLORINATED WATER IN THE SPRAY FORMULATION.

STORAGE AND DISPOSAL

Activity may be impaired by storage above 90°F.

Do not contaminate water, food or feed by storage or disposal. Open dumping is prohibited. Do not reuse empty container.

Pesticide, spray mixture, or rinsate that cannot be used should be disposed of in a landfill approved for pesticides or buried in a safe place away from water.

Container disposal: Triple rinse and dispose of in an approved landfill or bury in a safe place.

Consult Federal, State, or local disposal authorities for approved alternative procedures.

GYPCHEK

BIOLOGICAL INSECTICIDE
FOR THE
GYPSY MOTH

Active Ingredient*:
(Polyhedral inclusion bodies of gypsy moth nucleopolyhedrosis virus). 20%

Inert Ingredients. 80%

Total 100%

*This lot contains at least ___ million gypsy moth potency units per gram.

KEEP OUT OF REACH OF CHILDREN

WARNING

See back of tag for additional precautionary statements.

For use by or under the supervision of U.S. Forest Service.

Notice: The U.S. Forest Service makes no warranty, expressed or implied including the warranties or merchantability and/or fitness for any particular purpose, concerning this material except those which are contained on the U.S. Forest Service's label.

MFG. BY: U.S. Forest Service, USDA
P.O. Box 2417
Washington, D.C. 20013

EPA ESTABLISHMENT NO. _____

EPA REGISTRATION NO. 27586-2

Net Weight _____ Lot No. _____

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Headquarters of the Northeastern Forest Experiment Station are in Broomall, Pa. Field laboratories and research units are maintained at:

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