April, 1976 - September, 1976
Laboratory Report
Gypsy Moth Methods Development Laboratory
Animal and Plant Health Inspection Service
United States Department of Agriculture
Otis Air Force Base
Massachusetts
02542

The contents of this report are for the information of Animal and Plant Health Inspection Service, Plant Protection and Quarantine Personnel. Interim results and tentative conclusions should be treated as confidential and should not be cited as scientific literature without written prior approval

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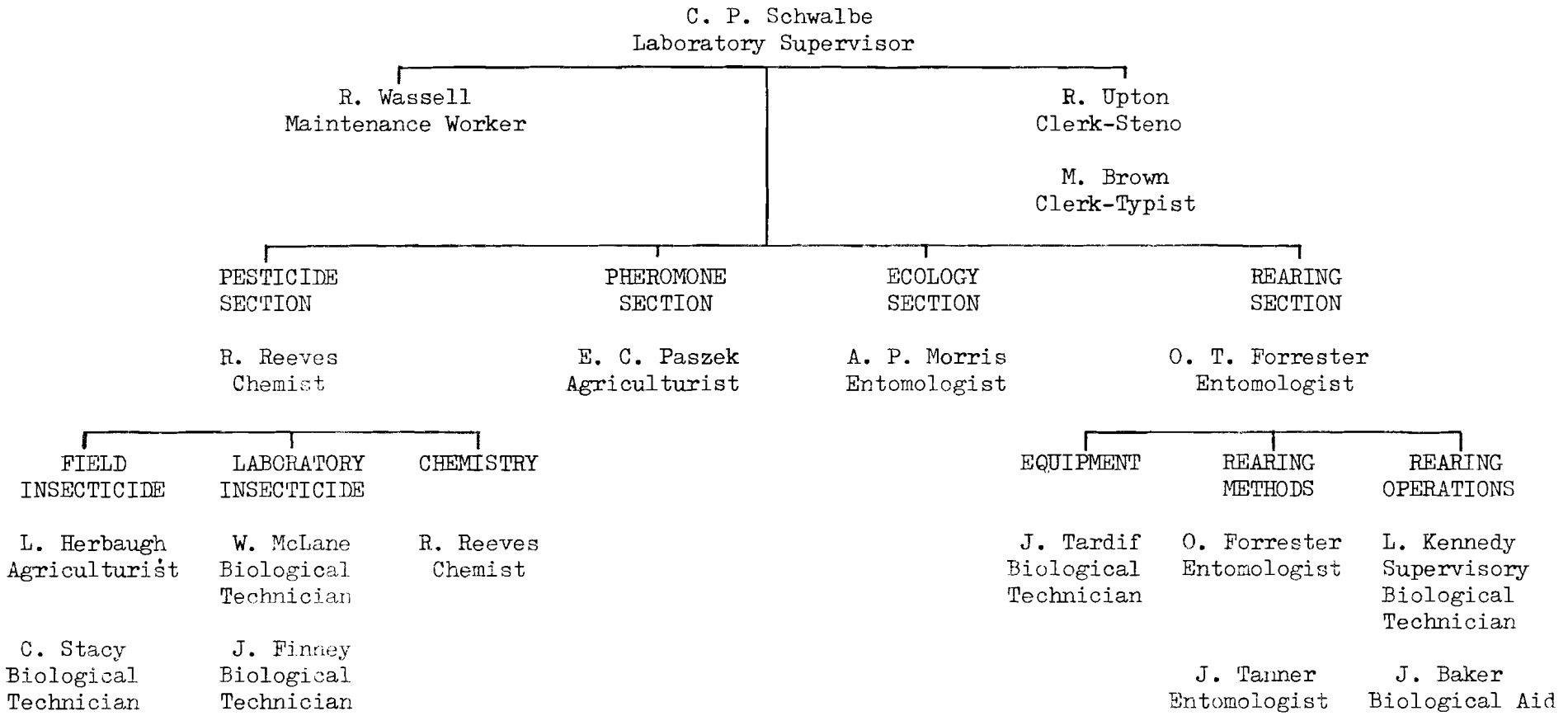
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## APPENDIX


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Project Number: GM 6.1.1
Project Title: Laboratory Screening of Candidate Pesticides Against the Gypsy Moth
Report Period: April 1, 1976 - September 30, 1976
Project Leaders: Winfred H. McLane, Joyce A. Finney

The main objective of this laboratory screening project is to collect mortality data on registered and experimental compounds potentially useful against the gypsy moth, evaluating the data and selecting suitable materials for field testing.

The following materials were tested against gypsy moth larvae using the oak seedling test technique.

| Material | Company | Dosage | Instar | Weather | Aging | % Mortality | Days After Treatment |
|---|---|---|---|---|---|---|---|
| ABG-6070 | Abbott | 0.25 lb/8oz/A | II | | | 100 | 6 |
| " | | 0.12 lb/4oz/A | II | | | 99 | 6 |
| " | | 0.06 lb/2oz/A | II | | | 97 | 6 |
| " | | 0.03 lb/1oz/A | II | | | 81 | 6 |
| " | | 0.01 lb/ g/A | II | | | 66 | 6 |
| | | Check | II | | | 1 | 6 |
| " (0.5 parts piperonyl butoxide to 1 part ABG-6070) | | 0.2 lb/10oz/A | II | | | 100 | 4 |
| " | | 0.1 lb/ 5oz/A | II | | | 99 | 4 |
| " | | 0.05 lb/2.5oz/A | II | | | 94 | 4 |
| " | | 0.025 lb/1.25oz/A | II | | | 64 | 4 |
| " | | 0.012 lb/.62oz/A | II | | | 52 | 4 |
| | | Check | II | | | 0 | 4 |
| " (1 part piperonyl butoxide to 1 part ABG-6070) | | 0.2 lb/16oz/A | II | | | 99 | 4 |
| " | | 0.1 lb/8oz/A | II | | | 100 | 4 |
| " | | 0.05 lb/4oz/A | II | | | 97 | 4 |
| " | | 0.02 lb/2oz/A | II | | | 96 | 4 |
| " | | 0.01 lb/1oz/A | II | | | 83 | 4 |
| | | Check | II | | | 0 | 4 |
| " (2 parts piperonyl butoxide to 1 part ABG-6070) | | 0.2 lb/24oz/A | II | | | 100 | 4 |
| " | | 0.1 lb/12oz/A | II | | | 100 | 4 |
| " | | 0.05 lb/ 6oz/A | II | | | 99 | 4 |
| " | | 0.025 lb/ 3oz/A | II | | | 89 | 4 |
| " | | 0.012 lb/1.5oz/A | II | | | 65 | 4 |
| | | Check | II | | | 1 | 4 |

| Material | Company | Dosage | Instar | Weather | Aging | % Mortality | Days After Treatment |
|---|---|---|---|---|---|---|---|
| ABG-6070 (4 parts piperonyl butoxide to 1 part ABG-6070) | Abbott | 0.2 lb/32oz/A | II | | | 100 | 5 |
| " | | 0.1 lb/16oz/A | II | | | 100 | 5 |
| " | | 0.05 lb/ 8oz/A | II | | | 97 | 5 |
| " | | 0.025 lb/ 4oz/A | II | | | 90 | 5 |
| " | | 0.012 lb/ 2oz/A | II | | | 86 | 5 |
| | | Check | II | | | 0 | 5 |
| " (6 parts piperonyl butoxide to 1 part ABG-6070) | | 0.2 lb/64oz/A | II | | | 99 | 4 |
| " | | 0.1 lb/32oz/A | II | | | 95 | 4 |
| " | | 0.05 lb/16oz/A | II | | | 94 | 4 |
| " | | 0.025 lb/ 8oz/A | II | | | 51 | 4 |
| " | | 0.012 lb/ 4oz/A | II | | | 48 | 4 |
| | | Check | II | | | 0 | 4 |
| " (Piperonyl butoxide only) | | 1.0 lb/gal/A | II | | | 5 | 5 |
| " | | 0.5 lb/gal/A | II | | | 3 | 5 |
| " | | 0.25 lb/gal/A | II | | | 0 | 5 |
| " | | 0.12 lb/gal/A | II | | | 7 | 5 |
| " | | 0.06 lb/gal/A | II | | | 0 | 5 |
| | | Check | II | | | 0 | 5 |
| Decis | Procida | 0.013 lb/gal/A | II | | | 97 | 4 |
| | | 0.0065 lb/gal/A | II | | | 98 | 4 |
| | | 0.0032 lb/gal/A | II | | | 89 | 4 |
| | | 0.0016 lb/gal/A | II | | | 90 | 4 |
| | | 0.00082 lb/gal/A | II | | | 51 | 4 |
| | | Check | | | | 0 | 4 |
| Decis | " | 0.013 lb/gal/A | II | 1" | | 85 | 4 |
| " | " | " | II | 2" | | 78 | 3 |
| " | " | " | II | 3" | | 83 | 4 |
| " | " | " | II | 1" (3% Newfilm) | | 51 | 4 |
| " | " | " | II | 1" (3% Chevron Sticker) | | 43 | 4 |
| " | " | " | II | 1" (3% Pinolene Sticker) | | 66 | 4 |

| Material | Company | Dosage | Instar | Weather | Aging | % Mortality | Days After Treatment |
|---|---|---|---|---|---|---|---|
| Decis | Procida | 0.0065 lb/gal/A | II | 1" | | 68 | 4 |
| " | " | " | II | 2" | | 66 | 3 |
| " | " | " | II | 3" | | 58 | 4 |
| " | " | " | II | 1" (3% Nu-film 17) | | 75 | 4 |
| " | " | " | II | 1" (3% Chevron Sticker) | | 41 | 4 |
| " | " | " | II | 1" (3% Pinocene Sticker) | | 53 | 4 |
| " | " | 0.0032 lb/gal/A | II | 1" | | 59 | 4 |
| " | " | " | II | 2" | | 56 | 3 |
| " | " | " | II | 3" | | 35 | 4 |
| " | " | 0.0016 lb/gal/A | II | 1" | | 34 | 4 |
| " | " | " | II | 2" | | 27 | 3 |
| " | " | " | II | 3" | | 23 | 4 |
| " | " | 0.0008 lb/gal/A | II | 1" | | 22 | 4 |
| " | " | " | II | 2" | | 24 | 3 |
| " | " | " | II | 3" | | 21 | 4 |
| | | Checks | | | | 0 | 4 |
| " | " | 0.013 lb/gal/A | II | (2 hr. artificial UV light) | | 100 | 7 |
| " | " | 0.0065 lb/gal/A | II | " | | 87 | 7 |
| " | " | 0.0032 lb/gal/A | II | " | | 28 | 7 |
| " | " | 0.0016 lb/gal/A | II | " | | 34 | 7 |
| " | " | 0.0008 lb/gal/A | II | " | | 20 | 7 |
| | | Check | | | | 0 | 7 |
| " | " | 0.0013 lb/gal/A | II | (4 hr. artificial UV light) | | 90 | 4 |
| " | " | 0.0065 lb/gal/A | II | " | | 60 | 4 |
| " | " | 0.0032 lb/gal/A | II | " | | 12 | 4 |
| " | " | 0.0016 lb/gal/A | II | " | | 9 | 4 |
| " | " | 0.0008 lb/gal/A | II | " | | 4 | 4 |
| | | Check | | | | 0 | 4 |
| " | " | 0.013 lb/gal/A | II | (2 hr. natural sunlight) | | 99 | 6 |
| " | " | 0.0065 lb/gal/A | II | " | | 97 | 6 |
| " | " | 0.0032 lb/gal/A | II | " | | 86 | 6 |
| " | " | 0.0016 lb/gal/A | II | " | | 67 | 6 |
| " | " | 0.0008 lb/gal/A | II | " | | 38 | 6 |
| | | Check | | | | 0 | 6 |
| " | " | 0.013 lb/gal/A | II | (4 hr. natural sunlight) | | 66 | 2 |
| " | " | 0.0065 lb/gal/A | II | " | | 32 | 2 |
| " | " | 0.0032 lb/gal/A | II | " | | 40 | 2 |
| " | " | 0.0016 lb/gal/A | II | " | | 29 | 2 |
| " | " | 0.0008 lb/gal/A | II | " | | 17 | 2 |
| | | Check | | | | 0 | 2 |

| Material | Company | Dosage | Instar | Weather | Aging | % Mortality | Days After Treatment |
|---|---|---|---|---|---|---|---|
| FMC 30980 | FMC | 0.062 lb/gal/A | II | | | 97 | 5 |
| " | " | 0.0312 lb/gal/A | II | | | 91 | 5 |
| " | " | 0.015 lb/gal/A | II | | | 58 | 5 |
| " | " | 0.007 lb/gal/A | II | | | 16 | 5 |
| " | " | 0.003 lb/gal/A | II | | | 7 | 5 |
| | | Check | | | | 0 | 5 |
| " | " | 0.025 lb/gal/A | II | 1" | | 61 | 7 |
| " | " | 0.012 lb/gal/A | II | 1" | | 70 | 7 |
| " | " | 0.062 lb/gal/A | II | 1" | | 15 | 7 |
| " | " | 0.003 lb/gal/A | II | 1" | | 5 | 7 |
| " | " | 0.001 lb/gal/A | II | 1" | | 4 | 7 |
| | | Check | II | | | 1 | 7 |
| FMC 35171 | FMC | 0.2 lb/gal/A | II | | | 100 | 3 |
| " | " | 0.1 lb/gal/A | II | | | 100 | 3 |
| " | " | 0.05 lb/gal/A | II | | | 100 | 3 |
| " | " | 0.025 lb/gal/A | II | | | 99 | 3 |
| " | " | 0.012 lb/gal/A | II | | | 99 | 3 |
| " | " | 0.006 lb/gal/A | II | | | 99 | 4 |
| " | " | 0.003 lb/gal/A | II | | | 100 | 4 |
| " | " | 0.001 lb/gal/A | II | | | 100 | 4 |
| " | " | 0.0007 lb/gal/A | II | | | 97 | 4 |
| | | Check | | | | 1 | 4 |
| " | " | 0.02 lb/gal/A | II | 1" | | 100 | 5 |
| " | " | 0.01 lb/gal/A | II | 1" | | 100 | 5 |
| " | " | 0.006 lb/gal/A | II | 1" | | 100 | 5 |
| " | " | 0.003 lb/gal/A | II | 1" | | 96 | 5 |
| " | " | 0.001 lb/gal/A | II | 1" | | 90 | 5 |
| | | Check | II | | | 0 | 5 |
| FMC 35497 | FMC | 0.2 lb/gal/A | II | | | 98 | 4 |
| " | " | 0.1 lb/gal/A | II | | | 95 | 4 |
| " | " | 0.05 lb/gal/A | II | | | 87 | 4 |
| " | " | 0.02 lb/gal/A | II | | | 75 | 4 |
| " | " | 0.01 lb/gal/A | II | | | 51 | 4 |
| | | Check | II | | | 0 | 4 |
| | " | 0.02 lb/gal/A | II | 1" | | 17 | 6 |
| " | " | 0.01 lb/gal/A | II | 1" | | 15 | 6 |
| | " | 0.006 lb/gal/A | II | 1" | | 10 | 6 |
| | " | 0.003 lb/gal/A | II | 1" | | 7 | 6 |
| | " | 0.001 lb/gal/A | II | 1" | | 1 | 6 |
| | | Check | | | | 0 | 6 |
| [illegible] | FMC | 0.21 lb/gal/A | II | | | 100 | 3 |
| | " | 0.10 lb/gal/A | II | | | 100 | 3 |
| | " | 0.052 lb/gal/A | II | | | 100 | 3 |
| | " | 0.026 lb/gal/A | II | | | 100 | 3 |
| | " | 0.013 lb/gal/A | II | | | 81 | 3 |
| | " | 0.006 lb/gal/A | II | | | 92 | 4 |
| | " | 0.003 lb/gal/A | II | | | 67 | 4 |
| | " | 0.0016 lb/gal/A | II | | | 29 | 4 |
| | | Check | II | | | 0 | 4 |

| Material | Company | Dosage | Instar | Weather | Aging | % Mortality | Days After Treatment |
|---|---|---|---|---|---|---|---|
| FMC 45498 | FMC | 0.026 lb/gal/A | II | 1" | | 40 | 5 |
| " | " | 0.013 lb/gal/A | II | 1" | | 49 | 5 |
| " | " | 0.006 lb/gal/A | II | 1" | | 25 | 5 |
| " | " | 0.003 lb/gal/A | II | 1" | | 10 | 5 |
| " | " | 0.001 lb/gal/A | II | 1" | | 4 | 5 |
| | | Check | II | | | 1 | 5 |
| PP 383 | ICI | 1.0 lb/gal/A | II | | | 100 | 2 |
| " | " | 0.5 lb/gal/A | II | | | 100 | 2 |
| " | " | 0.25 lb/gal/A | II | | | 100 | 3 |
| " | " | 0.12 lb/gal/A | II | | | 100 | 3 |
| " | " | 0.06 lb/gal/A | II | | | 90 | 3 |
| " | " | 0.03 lb/gal/A | II | | | 93 | 6 |
| " | " | 0.01 lb/gal/A | II | | | 69 | 6 |
| " | " | 0.007 lb/gal/A | II | | | 49 | 6 |
| " | " | 0.003 lb/gal/A | II | | | 33 | 6 |
| " | " | 0.001 lb/gal/A | II | | | 16 | 5 |
| " | " | 0.0009 lb/gal/A | II | | | 7 | 5 |
| " | " | 0.0004 lb/gal/A | II | | | 1 | 5 |
| | | Check | II | | | 0 | 5 |
| RH-218 | Rohm Haas | 0.156 lb/gal/A | II | 1" | | 86 | 3 |
| " | " | 0.078 lb/gal/A | II | 1" | | 96 | 3 |
| " | " | 0.039 lb/gal/A | II | 1" | | 96 | 3 |
| " | " | 0.019 lb/gal/A | II | 1" | | 64 | 3 |
| " | " | 0.009 lb/gal/A | II | 1" | | 28 | 3 |
| | | Check | | | | 0 | 3 |
| Sumithion | Stauffer | 0.5 lb/gal/A | II | | | 100 | 4 |
| " | " | 0.5 lb/gal/A | II | (+15% Atlox) | | 100 | 4 |
| " | " | 0.5 lb/gal/A | II | (+15% Sorpol) | | 100 | 3 |
| " | " | 0.5 lb/gal/A | II | 1" | | 48 | 3 |
| " | " | 0.5 lb/gal/A | II | 1" | (+15% Atlox) | 26 | 3 |
| " | " | 0.5 lb/gal/A | II | 1" | (+15% Sorpol) | 17 | 3 |
| " | " | 0.5 lb/gal/A | II | 1" | (+3% Rhoplex Sticker) | 100 | 4 |
| " | " | 0.5 lb/gal/A | II | 2" | (+3% Rhoplex Sticker) | 99 | 4 |
| " | " | 0.5 lb/gal/A | II | 3" | (+3% Rhoplex Sticker) | 100 | 5 |
| " | " | 0.5 lb/gal/A | II | 1" | (+15% Atlox + 3% Rhoplex Sticker) | 100 | 4 |
| " | " | 0.5 lb/gal/A | II | 2" | (+15% Atlox + 3% Rhoplex Sticker) | 64 | 4 |
| " | " | 0.5 lb/gal/A | II | 3" | (+15% Atlox + 3% Rhoplex Sticker) | 81 | 5 |

| Material | Company | Dosage | Instar | Weather | Aging | % Mortality | Days After Treatment |
|---|---|---|---|---|---|---|---|
| Sumithion | Stauffer | 0.5 lb/gal/A | II | 1" | (+15% Sorpol + 3% Rhoplex Sticker) | 99 | 4 |
| " | " | 0.5 lb/gal/A | II | 2" | (+15% Sorpol + 3% Rhoplex Sticker) | 99 | 4 |
| " | " | 0.5 lb/gal/A | II | 3" | (+15% Sorpol + 3% Rhoplex Sticker) | 80 | 5 |
| " | " | 0.25 lb/gal/A | II | | | 100 | 4 |
| " | " | 0.25 lb/gal/A | II | | (+15% Atlox) | 100 | 3 |
| " | " | 0.25 lb/gal/A | II | | (+15% Sorpol) | 99 | 3 |
| " | " | 0.25 lb/gal/A | II | 1" | | 32 | 3 |
| " | " | 0.25 lb/gal/A | II | 1" | (+15% Atlox) | 11 | 3 |
| " | " | 0.25 lb/gal/A | II | 1" | (+15% Sorpol) | 13 | 3 |
| " | " | 0.25 lb/gal/A | II | 1" | (+3% Rhoplex Sticker) | 95 | 4 |
| " | " | 0.25 lb/gal/A | II | 2" | | 74 | 6 |
| " | " | 0.25 lb/gal/A | II | 3" | | 85 | 5 |
| " | " | 0.25 lb/gal/A | II | 1" | (+3% Atlox + 3% Rhoplex Sticker) | 97 | 4 |
| " | " | 0.25 lb/gal/A | II | 2" | (+3% Atlox + 3% Rhoplex Sticker) | 71 | 6 |
| " | " | 0.25 lb/gal/A | II | 3" | (+3% Atlox + 3% Rhoplex Sticker) | 30 | 5 |
| " | " | 0.25 lb/gal/A | II | 1" | (+15% Sorpol + 3% Rhoplex Sticker) | 94 | 4 |
| " | " | 0.25 lb/gal/A | II | 2" | (+15% Sorpol + 3% Rhoplex Sticker) | 76 | 6 |
| " | " | 0.25 lb/gal/A | II | 3" | (+15% Sorpol + 3% Rhoplex Sticker) | 66 | 5 |
| | | Checks | | | | 0 | 6 |
| VEL 3883 | Velsicol | 1.0 lb/gal/A | II | | | 99 | 6 |
| " | " | 0.5 lb/gal/A | II | | | 99 | 6 |
| " | " | 0.25 lb/gal/A | II | | | 100 | 6 |
| " | " | 0.12 lb/gal/A | II | | | 89 | 6 |
| " | " | 0.06 lb/gal/A | II | | | 85 | 6 |
| " | " | 0.0312 lb/gal/A | II | | | 77 | 6 |
| " | " | 0.0156 lb/gal/A | II | | | 65 | 6 |
| " | " | 0.0078 lb/gal/A | II | | | 26 | 6 |
| " | " | 0.0039 lb/gal/A | II | | | 10 | 6 |
| | | Check | II | | | 0 | 6 |

| Material | Company | Dosage | Instar | Weather | Aging | % Mortality | Days After Treatment |
|---|---|---|---|---|---|---|---|
| VEL 3883 | Velsi-col | 1.0 lb/gal/A | II | 1" | | [illegible] | 5 |
| " | " | 0.5 lb/gal/A | II | 1" | | 2 | 5 |
| " | " | 0.25 lb/gal/A | II | 1" | | 2 | 5 |
| " | " | 0.12 lb/gal/A | II | 1" | | 2 | 5 |
| " | " | 0.06 lb/gal/A | II | 1" | | 0 | 5 |
| | | Check | II | | | 0 | 5 |

Work continued with the new Sevin®-4-oil formulation. The viscosity of 6 formulations was tested.

The Triton® X-190 and Sevin®-4-oil formulation was field tested at:

1.0 lbs. ai./qt./A
0.5 lbs. ai./qt./A
0.25 lbs. ai./qt./A

This formulation was compared to Sevin®-4-oil and kerosene at:

1.0 lbs. ai./40oz./A
0.5 lbs. ai./qt./A

We are happy to report that Orthene® 75S and Dimilin® 25 W/P were registered by the United States Environmental Protection Agency for gypsy moth use.

Orthene 75S

By air - 2/3 to 1 lb. ai./2 qt. $H_2O$/A

Dimilin 25 W/P

By air - 0.03 to 0.06 lb. ai./1 or 2 gal/A

The Otis laboratory and field crews played a great part in the success of both materials.

Sixteen gallons of northern red oak acorns were collected and stored in cold storage.

A total of 23 insecticide samples were received for laboratory and field tests.

Much of this reporting period was spent working in the field on experimental insecticide plots.

A suitable land-fill for the disposal of empty insecticide containers was located in Plainvillle, Mass. This is about 60 miles from Otis and is recommended by the Boston office of the United States Environmental Protection Agency.

Most laboratory equipment was packed ready for moving into the new building.

Meetings

USDA, Gypsy Moth Field Demonstration, Lewisburg, PA.

Mr. McLane gave a talk on the APHIS treatment made in 1976 and demonstrated the mixing of Sevin®-4-oil and Triton® X-190 with $H_2O$.

Mr. McLane and Mr. Hornbaugh spent 2 days in Hyattsville, MD working on applications for experimental use permits.

Project Number: GM 6.1.2
Project Title: 1976 Field Studies of Different Formulations of Dimilin and Sevin-4-Oil
Report Period: April 1, 1976 - September 30. 1976
Report Type: Interim
Project Leaders: Larry L. Herbaugh, W. H. McLane, C. R. Stacy, J. A. Finney

Introduction: Each year for the past 3 generations, the gypsy moth, *Lymantria dispar* (L.) has defoliated thousands of acres of forested land in the northeast. Because of this, investigations are continually being carried out to evaluate new materials and new formulations of current registered materials.

Materials and Methods: In 1976 the following materials and formulations were tested for gypsy moth control: Dimilin 25 W/P; Dimilin 3.3 oil + kerosene; Dimilin 3.3 oil + Triton X-190 + water; Sevin-4-oil + kerosene; and Sevin-4-oil + Triton X-190 + water. Each of the materials was aerially applied to 50 acre plots in 3 replicates for evaluation. Table I gives the details on chemical concentration and application rate.

Table I. Details of 1976 formulations field tested.

| Material | Chemical Concentration and Application Rate | Remarks |
|---|---|---|
| Dimilin (25 W/P) | 0.06 lb ai/gal/A | applied at less than 5% foliage expansion |
| | [illegible] lb ai/gal/A<br>0.06 lb ai/gal/A | Dimilin and water<br>no sticker added |
| Dimilin 3.3 oil + Kerosene | 0.03 lb ai/gal/A | 96% Kerosene |
| Dimilin 3.3 oil + Triton X-190 + water | 0.03 lb ai/gal/A | .00007% T X-190 |
| Sevin-4-Oil + Kerosene | 0.5 lb ai/qt/A<br>1.0 lb ai/40 oz/A | 16 oz Kerosene<br>8 oz Kerosene |
| | 0.25 lb ai/qt/A | 25.00% Sevin-4-Oil<br>.16% T X-190<br>74.84% water |
| Sevin-4-Oil + Triton X-190 + water | [illegible] lb ai/qt/A | [illegible]% Sevin-4-Oil<br>[illegible]% T X-190<br>[illegible]% water |
| | 1.0 lb ai/40 oz/A | 80.0% Sevin-4-Oil<br>1.6% T X-190<br>18.4% water |

Plot Establishment: The test plots were established in an area adjacent to the 1975 study area in Clinton County, Pennsylvania. This area met the following requirements: (1) a building population in which there had been no more than 1 year's noticeable defoliation prior to the test year (2) a readily measureable population of egg masses and (3) a predominance of preferred host trees (oaks).

Each 50 acre square plot was laid out by establishing an accessible base corner and plotting boundary lines along compass headings. Markers were placed at all four corners for aircraft guidance. Within each 50 acre plot, 5 subplots (0.1 acre) or sampling units were randomly established. These subplots were representative of the entire plot and served as sampling points throughout the experiment. Sampling points were similarly established in untreated check areas to measure natural conditions.

Application: The application schedule was designed so that material was to be applied when the majority of the larvae were in the late second instar stage and the oak foliage was 50-75% expanded. One exception to this was the early treatment of Dimilin that was applied at early 1st instar when oak foliage was less than 5% expanded.

Materials were mixed and transferred into the aircraft with conventional equipment (mixing tank, pumps, hoses, measuring devices and necessary safety equipment). All mixing and spraying equipment was thoroughly cleaned between each treatment to avoid adulteration. Radio communications were maintained between the ground conditions of wind velocity and materials dispersement.

All plots were treated with a Cessna Ag Truck aircraft equipped with a hydraulic driven impeller pump and a conventional spray system (see Table II). The airplane dispersed the material in 75 foot swaths at 100 mph as near to tree top level as possible with a ground wind velocity of less than 5 mph.

Table II. Configuration of spray systems utilized.

| Material | No. Nozzles | Orifice |
|---|---|---|
| Dimilin 25 W/P | | |
| 0.06 lb ai/gal/A (early) | 20 | D8-45° |
| 0.06 lb ai/gal/A | 20 | D8-45° |
| 0.06 lb ai/gal/A | 19 | D8-45° |
| Dimilin 3.3 oil + Kerosene | | |
| 0.03 lb ai/qt/A | 20 | 8002FF |
| Dimilin 3.3 oil + Triton X-190 + water | | |
| 0.03 lb ai/qt/A | 20 | 8002FF |
| Sevin-4-Oil + Kerosene | | |
| 0.5 lb ai/qt/A | 19 | 8002FF |
| 1.0 lb ai/40 oz/A | 28 | 8002FF |
| Sevin-4-Oil + Triton X-190 + water | | |
| 0.25 lb ai/qt/A | [illegible] | 8002FF |
| 0.5 lb ai/qt/A | [illegible] | 8002FF |
| 1.0 lb ai/40 oz/A | [illegible] | 8002FF |

Evaluation: Each treatment was evaluated from the standpoint of foliage protection and population reduction.

Foliage protection was determined from visual estimates of the degree of defoliation in each of the sampling plots at the termination of larval feeding. Estimates were all performed by the same crew so that human judgement would remain constant (see Figure 1).

Population reduction was estimated by comparing five 10 minute string counts for larvae in each of the [illegible] acre plots both pre and post spray counts were made 5 different times with the exception of Dimilin 3.3 oil + kerosene, Dimilin 3.3 oil + Triton X-190 + water and Dimilin 25 W/P which were only counted once approximately 20 days after treatment. Figure 2 shows population change by 10 minute larval counts.

Conclusion: Preliminary data show that all formulations of Dimilin and Sevin-4-oil + kerosene gave excellent results in larval reduction. Fall egg mass count will be made to determine if this condition continues to hold true.

One initial conclusion that shows excellent potential is the fact that Dimilin® 25 W/P, when applied at .06 lb/gal $H_2O$/A with less than 5% oak foliage expansion, gave good foliage protection and reduced larval activity remarkably with 10 minute counts.

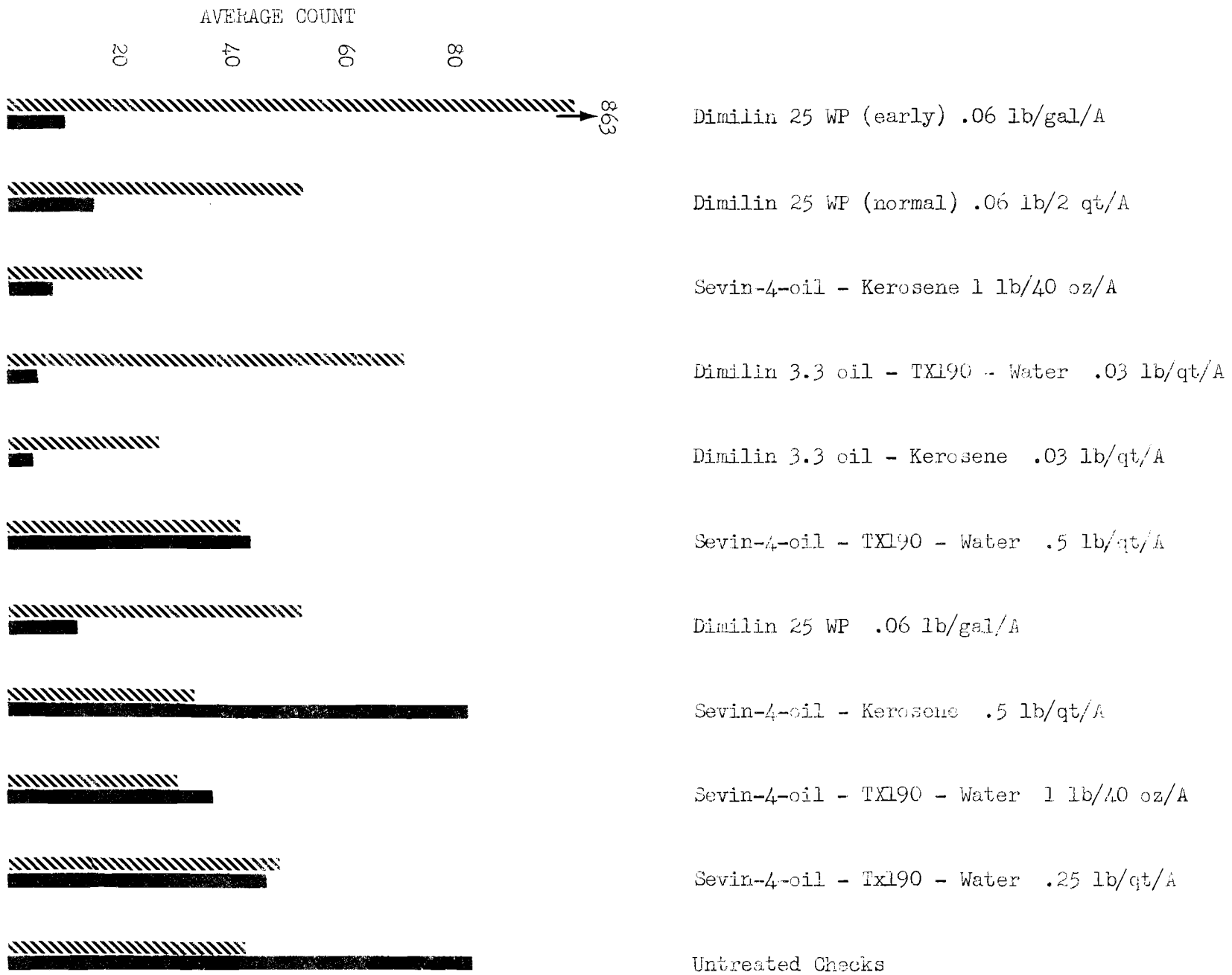



Figure 2. Ten-minute larval string counts.

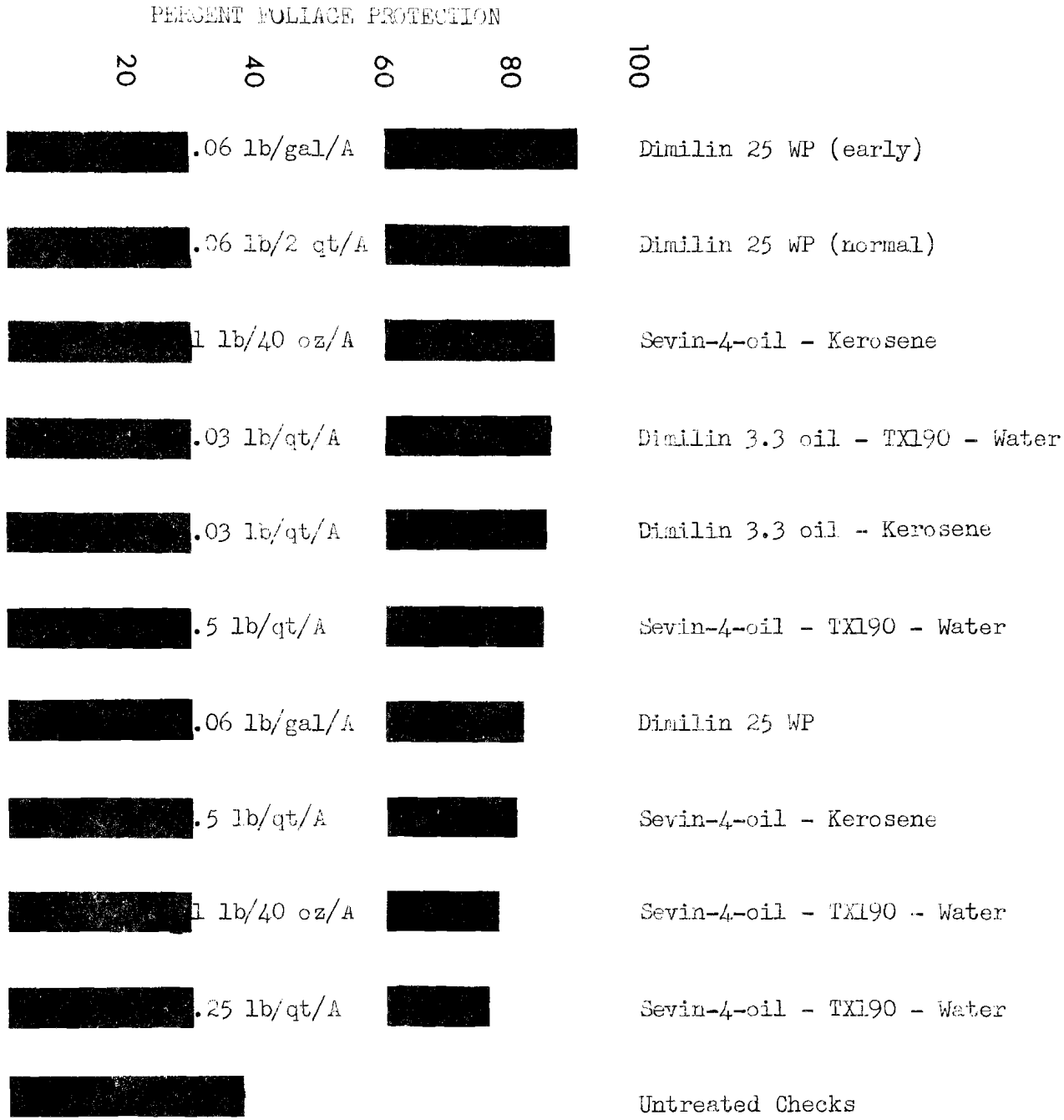



Figure 1. Foliage Protection. Pre-spray defoliation was less than 10%.

Project Number: GM 6.1.3
Project Title: Field Testing of Ground Applied Insecticides
Report Period: April 1, 1976 - September 30, 1976
Report Type: Interim
Project Leaders: Larry L. Herbaugh, W. H. McLane, C. R. Stacy, J. A. Finney

Introduction: Experimental use permits were received from EPA in early June 1976 for testing Orthene® 75S, Imidan® 50 W/P, Sevin® 80S. In addition to the above, Sevin-4-oil with water and NTN 9306 were tested.

One-acre plots were established in the Bald Eagle State Forest lands in Centre and Clinton Counties, Pennsylvania. These plots contained a measureable population of gypsy moth eggs and were located in heavily wooded areas representative of campground situations.

These plots were established so that they were ca. 200 feet square with a small dirt road dividing them. Within each one-acre plot, two subplots or sampling units were established. Each of these units comprised 1/40 of an acre and was placed on each side of the road. These 1/40 acre sampling units were used for all evaluations throughout the program.

Application: Only a small quantity of materials were needed for application. Because of this, materials were mixed on site using conventional mixing equipment and a "nurse" tank for a water supply. All mixing and spraying equipment was thoroughly cleaned between treatments to avoid any adulteration.

The materials were applied with a John Bean Mist Blower mounted on a 1-1/2 ton 4-wheel drive truck at the following rates:

| | |
|---|---|
| Orthene 75S, Imidan 50 W/P and Sevin 80S | .25 lb ai/5 gal $H_2O$/A |
| | .50 lb ai/5 gal $H_2O$/A |
| | 1.0 lb ai/5 gal $H_2O$/A |
| | 1.5 lb ai/5 gal $H_2O$/A |
| | 2.0 lb ai/5 gal $H_2O$/A |
| | 3.5 lb ai/5 gal $H_2O$/A |

Each of these dosages was replicated 3 times for each material.

| | |
|---|---|
| NTN 9306 | .125 lb ai/5 gal $H_2O$/A |
| | .50 lb ai/5 gal $H_2O$/A |
| Sevin-4-oil and T X-190 + water | 2.0 lb ai/5 gal $H_2O$/A |
| | 3.5 lb ai/5 gal $H_2O$/A |

Evaluation: Each treatment was evaluated from the standpoint of percent foliage protection, larvae reduction using a 15 foot string count, and egg masses/acre reduction. The latter data is not yet available at this writing.

Foliage protection and larvae reduction are shown in the following table.

| Material | Dosage | % Foliage Protection | Average Larval String Counts Pre-Treatment | Average Larval String Counts Post-Treatment 1/ |
|---|---|---|---|---|
| Imidan 50 W/P | .25 lb ai/5 gal/A | 49.5 | 20 | 46 |
| | .50 lb ai/5 gal/A | 66.7 | 25 | 22 |
| | 1.0 lb ai/5 gal/A | 85.4 | 30 | 20 |
| | 1.5 lb ai/5 gal/A | 58.0 | 18 | 33 |
| | 2.0 lb ai/5 gal/A | 56.5 | 25 | 16 |
| | 3.5 lb ai/5 gal/A | 42.0 | 33 | 14 |
| Check | - | 3.5 | 19 | 8 |
| Sevin 80S | .25 lb ai/5 gal/A | 11.5 | 26 | 5 |
| | .50 lb ai/5 gal/A | 62.0 | 22 | 2 |
| | 1.0 lb ai/5 gal/A | 43.5 | 23 | 2 |
| | 1.5 lb ai/5 gal/A | 55.5 | 22 | 1 |
| | 2.0 lb ai/5 gal/A | 82.7 | 26 | 1 |
| | 3.5 lb ai/5 gal/A | 89.4 | 25 | .5 |
| Check | - | 5.0 | 42 | 40 |
| Orthene 75S | .25 lb ai/5 gal/A | 80.0 | 29 | 6 |
| | .50 lb ai/5 gal/A | 91.4 | 25 | 3 |
| | 1.0 lb ai/5 gal/A | 94.0 | 26 | 2 |
| | 1.5 lb ai/5 gal/A | 94.0 | 29 | 0 |
| | 2.0 lb ai/5 gal/A | 94.0 | 22 | 0 |
| | 3.5 lb ai/5 gal/A | 94.0 | 19 | 0 |
| Check | - | 7.5 | 48 | 51 |
| Sevin-4-oil + T X-190 + $H_2O$ | 2.0 lb ai/5 gal/A | 77.0 | 39 | 6 |
| | 3.5 lb ai/5 gal/A | 87.0 | 35 | 9 |
| NTN 9306 | .125 lb ai/5 gal/A | 75.0 | 15 | 1 |
| | .5 lb ai/5 gal/A | 73.0 | 15 | 2 |
| Check | - | 2.0 | 9 | 10 |

1/ Post-treatment readings based on 5th day after treatment.

Conclusion: Initial results show that Imidan® 50 W/P gave ca. 52% foliage protection and ca. 16% larval reduction at the 3 higher dosages.

Sevin® 80S gave ca. 76% foliage protection and ca. 99% reduction in larval activity at the 3 higher dosages.

Orthene® 75S gave ca. 94% foliage protection and ca. 100% larval control at the 3 higher dosages.

In comparison, the two new formulations of Sevin-4-oil and T X-190 and $H_2O$ and NTN 9306 gave ca. 82% and 74% foliage protection respectively and ca. 78% and 87% reduction in larval activity respectively.

Data in the following table indicate that Orthene® 75S and Sevin® 80S will give the greatest degree of foliage protection as well as reducing larval activity on a 15 foot string count.

Project Number: GM 6.1.4
Project Title: Evaluation of Pesticides for Browntail Moth
Report Period: April 1, 1976 - September 31, 1976
Report Type: Interim
Project Leaders: Winfred H. McLane, Joyce A. Finney

The primary objective of this project is to screen candidate materials against the browntail moth.

Orthene ® was the only material tested against browntail larvae.

| Dosage | Instar | % Mortality | Days After Treatment |
|---|---|---|---|
| 1 lb.a.i./gal/A | II | 92 | 2 |
| 0.5 lb.a.i./gal/A | II | 100 | 2 |
| 0.25 lb.a.i./gal/A | II | 96 | 2 |
| 0.12 lb.a.i./gal/A | II | 90 | 2 |
| 0.06 lb.a.i./gal/A | II | 98 | 2 |
| Check | II | 1.5 | 2 |

Mr. McLane, Mr. Stockbridge, Mr. Stelle, Mr. Mosley and Mr. Cartier met with Cape Cod National Seashore personnel to discuss future browntail work on the Cape. A 5 year program was proposed as a result of the meeting and phone conversations with the Department of Interior and APHIS personnel.

1976: Aerial plots with Sevin-4-oil; ground plots with Sevin 80S.

1977: Aerial plots with Sevin-4-oil; Pyrethrin and Dimilin.

1978: Select the most promising from the ones experimentally tested in 1976 and 1977, treat the entire infestation on Cape Cod using aircraft, backpacks and mistblowers.

1979: Clean up any infestation left.

1980: Clean up any infestation left.

However, after a meeting with the Seashore Advisory Committee, park superintendent Hadley made a decision that no spraying should be done until the committee was informed of our plans and their approval was obtained. To date, this meeting has not come about.

Meetings

Area I Managerial Meeting, Hartford, Conn. Mr. McLane gave a talk on the proposed 5 year browntail moth program for Cape Cod, Mass.

Mr. McLane met with Mr. J. Killan, Chief Environmentalist for the Cape Cod National Seashore to discuss the browntail problem at the Seashore.

Project Number: GM 6.1.5
Project Title: Regulatory Treatments (Laboratory - Field)
Report Period: April 1, 1976 - September 30, 1976
Report Type: Interim
Project Leaders: Winfred H. McLane, L. L. Herbaugh, J. A. Finney

The lack of effective treatment methods for recreational vehicles and mobile homes is a major deficiency in the APHIS Gypsy Moth regulatory program. Experimental laboratory and field tests are conducted to develop improved techniques for dealing with this and other regulatory problems.

On December 19, 1975 a residue test was started with 7 insecticides. Two hundred tar paper squares (6" x 6") each were treated with insecticide using a 0.5 lb ai/gal solution. Seven insecticides were tested with 1 set of tar paper used as a check. The papers were treated to the point of run-off. Half of the papers were aged outdoors, tacked under (4' x 8') sheets of masonite; half were held inside the laboratory. None were exposed to sunlight.

Ten newly hatched gypsy moth larvae were exposed to tar paper sheets at 10 day intervals for the first 100 days of aging following treatment. This was achieved by placing the paper in a cylindrical cardboard container with artificial diet. Mortality readings were made after 24 hours and 48 hours.

| Material | Aged | Hr. Larvae Exposed to Material | % Mortality After Material Aged 100 Days | 200 Days | 260 Days |
|---|---|---|---|---|---|
| DDT 50 W/P | Inside | 24 | 100 | 100 | 32 |
| | Inside | 48 | 100 | 100 | 100 |
| | Outside | 24 | 100 | 92 | 20 |
| | Outside | 48 | 100 | 100 | 100 |
| Resmethrin (EC) | Inside | 24 | 86 | 28 | 40 |
| | Inside | 48 | 98 | 84 | 56 |
| | Outside | 24 | 26 | 28 | 0 |
| | Outside | 48 | 92 | 74 | 24 |
| SBP-1513 (EC) | Inside | 24 | 96 | 86 | 84 |
| | Inside | 48 | 94 | 98 | 100 |
| | Outside | 24 | 100 | 86 | 90 |
| | Outside | 48 | 100 | 100 | 100 |
| FMC-33297 (EC) | Inside | 24 | 96 | 92 | 74 |
| | Inside | 48 | 100 | 100 | 98 |
| | Outside | 24 | 100 | 94 | 84 |
| | Outside | 48 | 100 | 100 | 96 |

| Material | Aged | Hr. Larvae Exposed to Material | % Mortality After Material Aged 100 Days | 200 Days | 260 Days |
|---|---|---|---|---|---|
| Phoxin (EC) | Inside | 24 | 100 | 98 | 100 |
| | Inside | 48 | 100 | 100 | 100 |
| | Outside | 24 | 100 | 100 | 100 |
| | Outside | 48 | 100 | 100 | 100 |
| Pyrenone (EC) | Inside | 24 | 34 | 46 | 2 |
| | Inside | 48 | 60 | 72 | 46 |
| | Outside | 24 | 38 | 16 | 0 |
| | Outside | 48 | 64 | 42 | 28 |
| Monitor (EC) | Inside | 24 | 100 | 78 | 72 |
| | Inside | 48 | 100 | 92 | 100 |
| | Outside | 24 | 80 | 66 | 46 |
| | Outside | 48 | 100 | 92 | 94 |
| Check | Inside | 24 | 32 | 26 | 0 |
| | Inside | 48 | 54 | 34 | 6 |
| | Outside | 24 | 4 | 20 | 2 |
| | Outside | 48 | 42 | 40 | 6 |

Based on laboratory results presented in the last report, a field test was started August 3, 1976 with Top Job, pine scent, wax, wax remover, Dimilin and fire extinguisher agent. Ten egg masses are being treated each month from August 3, 1976 until April 1, 1977. Five masses are being covered with black building paper and 5 are being left exposed. Three dosages of each material are being used along with a check.

During April 1977, all eggs will be collected and incubated in the laboratory for hatch. If hatch can be prevented, it may be possible to use one or more of the materials as a treatment on trailers and RV's.

To date 3 treatments have been made.

On June 23, 1976, 4 materials (Sevin 80S, Sevin-4-oil, Orthene and Imidan) most generally used for gypsy moth control were sprayed to the point of run-off on 1/10 acre plots using a back-pack mist blower. Dosages used were same as recommended in the APHIS regulatory manual.

Every 3 days following treatment, foliage was collected and bioassayed against 3rd instar larvae with 72 hour mortality reading being made. After 90 days, treated foliage was still giving excellent mortality.

| Material | % Mortality After 30 Days | 60 Days | 90 Days |
|---|---|---|---|
| Sevin 80S | 100 | 97 | 98 |
| Sevin-4-oil | 93 | 100 | 68 |
| Orthene | 96 | 75 | 99 |
| Imidan | 99 | 63 | 100 |
| Check | 24 | 1 | 17 |

Project Number: GM 6.1.6
Project Title: Field Testing of Juvenile Hormone Analogs for Ovicidal Activity
Report Period: April 1, 1976 - September 30, 1976
Report Type: Interim
Project Leaders: Charles P. Schwalbe, A. P. Morris

The juvenile hormone analogs, Altozar 4E and ZR-619 5E, have been reported as having ovicidal properties. When gypsy moth egg masses are deposited on recently treated surfaces, hatchability of eggs is reduced. ZR-619 also appears to inhibit female moths from laying their full complement of eggs. Compounds with these properties may be useful for regulatory treatments.

Boles of white and red oak trees were sprayed to the point of run-off with water emulsions of Altozar and ZR-619 at 8g/l. Treatments were aged for 1, 3, 7, 14, 21 and 28 days before bioassay. At the end of each aging period, 5 or more 3 day old, mated female moths from field collected pupae were imprisoned on each of 5 trees (total of 25 replicates/treatment). There were 10 replicates (2 trees) for each control. The female moths that deposited egg masses were recovered (generally after one day), placed in polyethylene bags and frozen until they could be dissected to determine the number of unlaid eggs. Egg masses will be collected from the treated and control surfaces during December 1976 and tested for embryonation, parasitization and hatchability.

Females from the 1, 3, 7 and 28 day exposure periods have been dissected and unlaid eggs counted. The results are shown by the accompanying table. Preliminarily, it appears that with the exception of the 1 day, ZR-619 treatment, there was no effect of treatment on the number of eggs laid by female moths. It is interesting to note that laboratory reared moths were used for the 1 day ZR-619 treatment. Detailed discussion of these data will be deferred until all results on egg embryonation, parasitization and hatchability have been obtained.

EGGS UNLAID BY FEMALES EXPOSED TO TRUNKS TREATED WITH ALTOZAR 4E AND ZR-619 5E

| Compound | Days Treatment Aged | Number of Females Used Treat. | Number of Females Used Control | Number of Females Recovered Treat. | Number of Females Recovered Control | Number Unlaid Eggs Total Treat. | Number Unlaid Eggs Total Control | Number Unlaid Eggs Average Treat. | Number Unlaid Eggs Average Control |
|---|---|---|---|---|---|---|---|---|---|
| Altozar 4E | 1 | 36 | 14 | 32 | 14 | 1238 | 380 | 38.7 | 27.1 |
| ZR-619 5E* | 1 | 53 | 21 | 26 | 13 | 7634 | 1797 | 293.6 | 138.2 |
| Altozar 4E | 3 | 40 | 16 | 30 | 15 | 1394 | 619 | 46.5 | 41.3 |
| ZR-619 5E | 3 | 50 | 20 | 28 | 12 | 1519 | 592 | 54.3 | 49.3 |
| Altozar 4E | 7 | 36 | 15 | 32 | 13 | 1044 | 660 | 32.6 | 50.8 |
| ZR-619 5E | 7 | 42 | 18 | 39 | 14 | 1137 | 885 | 29.2 | 63.2 |
| Altozar 4E | 28 | 25 | 12 | 25 | 10 | 805 | 256 | 32.2 | 25.6 |
| ZR-619 5E | 28 | 27 | 11 | 25 | 10 | 888 | 276 | 35.5 | 27.6 |
| Altozar 4E | 22 | 35 | 14 | 25 | 11 | 1059 | 1350 | 42.4 | 122.7 |
| ZR-619 5E | 21 | 30 | 15 | 25 | 12 | 1398 | 469 | 55.9 | 39.1 |

* Laboratory reared females and males used; all others were from field collected pupae.

Project Number: GM 6.2.2
Project Title: Responses of Male Gypsy Moths to Traps as Affected by the Rate of Pheromone Release
Report Period: April 1, 1976 - September 30, 1976
Report Type: Interim
Project Leaders: Charles P. Schwalbe, E. C. Paszek

Preliminary trapping experiments with disparlure indicated that attractiveness is affected by the rate at which the pheromone is released from the trap. Large amounts of lure seemed to have an inhibitory or repellent effect. Confirmatory studies were planned in which multiples of Conrel® fibers would be used to bait standard delta traps in order to define the pheromone release rate at which maximum attractiveness resulted. Such information would be exceedingly useful in preparing specifications for commercial production of program pheromone dispensers. Unfortunately, certain difficulties were encountered in developing a sound experimental program and it was suggested that this work be carried out by scientists at the Pennsylvania State University. Preliminary data have been made available to us, but we are unable to utilize them in this report.

Experiments in this project area were conducted in collaboration with the ARS. Optically active enantiomers of cis-disparlure were generously made available by Dr. Marumo, Nagoya University, Nagoya, Japan. The objective of the tests was to determine the attractiveness (or other biological properties) of the optically active enantiomers of disparlure. Similar experiments were conducted by scientists from Michigan State University and the New York and Connecticut State Agricultural Experiment Stations.

These tests were conducted in a natural infestation in Fall River State Forest, MA. Traps were baited with cotton dental wicks to which had been applied the indicated amounts of (+) and/or (-) disparlure. Delta traps were used in all tests on a 25 m grid pattern. The number of male moths captured was recorded at regular intervals.

In one experiment, the attractiveness of racemic disparlure was compared with that of (+) enantiomer. The results of this test are given in Table I.

Table I. Number of moths captured in traps baited with varying amounts of racemic and optically active disparlure.

| μg/trap | (±) | (+) |
|---|---|---|
| 1 | 1.5 | 4.3 |
| 10 | 3.4 | 23.1 |
| 100 | 5.3 | 54.0 |
| 1000 | 5.2 | - |

These data clearly reflect the superior attractancy of the (+) enantiomer compared with that of racemic material. Approximately 10 X more moths were captured with 100 ug (+) disparlure than with an equal amount of racemic pheromone. Unfortunately, limited amounts of the enantiomers prohibited testing at dosages greater than 100 ug, and, therefore, it is not known if greater dosages would lead to repellent or inhibitory effects. It should also be noted that the optically active material contained ca. 6.6% of it's antipode. Highly purified pheromone would likely yield somewhat different data. This is the first report of a clear relationship between dosage and response, where increased pheromone concentration yields a corresponding increase in moth response.

In another test, the inhibitory properties of the (-) enantiomer were quantified by determining the attractiveness of various ratios of (+) and (-) disparlure. These data are presented in Table II.

Table II. Number of male moths captured in traps baited with various enantiomer ratios.

| ug/trap (+) | (-) | ug (-) per 10 ug (+) | Average catch per trap |
|---|---|---|---|
| 9.34 | 0.66 | 0.68 | 16.9 |
| 9.36 | 1.64 | 1.75 | 12.0 |
| 9.9 | 3.5 | 3.68 | 6.8 |
| 10.0 | 10.0 | 10.0 | 2.4 |
| 12.5 | 47.5 | 38.0 | 3.2 |
| 15.9 | 94.1 | 59.2 | 0.8 |

As additional amounts of (-) were added to wicks containing 10 ug (+), attractiveness steadily decreased, demonstrating the inhibitory nature of the (-) enantiomer. Again, since our samples contained 6.6% of the opposite enantiomers the actual attractiveness of (+) disparlure could not be determined. Extrapolation of the plotted data suggests that 99% (+) disparlure would capture 15-20 times as many moths as racemic pheromone at the 10 ug level.

A more detailed report is currently being prepared for publication. The manuscript will be included in the next Laboratory Report.

Project Number: GM 6.2.3
Project Title: Periodicity of Pheromone Release of Female Gypsy Moths
Report Period: April 1, 1976 - September 30, 1976
Report Type: Interim
Project Leader: Charles P. Schwalbe

There is no progress to report on this project. A prototype apparatus is being assembled which will permit systematic evaluation of various collection substrates. Recent papers report successful collection of airborn volatiles on Porapak Q and Molecular sieve. If quantitative collection of disparlure from female moths is successful, pheromone emission will be used as a standard for determining quality of insects mass reared under various conditions.

Project Number: GM 6.2.6
Project Title: Comparative Study of Trap Adhesives
Report Period: April 1, 1976 - September 30, 1976
Report Type: Final
Project Leader: Edward C. Paszek

Tree Tanglefoot, a natural product made from castor oil, gum resins and vegetable wax, was used as an adhesive for gypsy moth traps for 56 years, 1913-1969. It was replaced in 1970 with Tack Trap, a synthetic plastic type adhesive (polyisobutylene), which was less costly and, through field testing, found to be more effective than Tree Tanglefoot in holding captured moths in a trap. Tack Trap has gone up in price from $0.42/lb in 1970 to $1.30/lb in 1976. A number of companies are marketing synthetic sticky compounds to protect trees from climbing insects and as bird repellants. These compounds were compared with Tack Trap and Tree Tanglefoot to determine their effectiveness in holding captured gypsy moths.

8±.5 of the following six compounds were weighed and applied to approximately 286 $cm^2$ of the interior surface area of Delta traps. An aging study on 1/2 these open traps was conducted in the greenhouse at a temperature range of 10°C to 32°C for 5.5 months (1/19-6/23/76). A field bioassay was made on 7/14/76 after 6 months of aging in a natural infestation followed by a laboratory bioassay 9/16/76 after 8 months of aging.

Table I. Mean number of ♂ moths per trap after 1 hour field bioassay in heavy infestation. 24 hour laboratory chamber bioassay with 500 released ♂ moths.

| | Field | Laboratory |
|---|---|---|
| Tack Trap (new sample) | 14.5 | 6.0 |
| Bird Tanglefoot | 12.0 | 9.0 |
| Excelcide Bird Repellant | 10.5 | 20.0 |
| Tack Trap (old sample) | 8.0 | 10.5 |
| Stikem-Special | 6.5 | 14.5 |
| Tree Tanglefoot | 0.5 | 1.5 |

After 6 months of aging in open traps, Tack Trap, Bird Tanglefoot, Excelcide Bird Repellant and Stikem-Special held captured native moths. Tree Tanglefoot glazed over and was a poor adhesive. When bioassayed in a laboratory chamber after 8 months of aging with released moths, many moths entered and flew out of the traps indicating that the adhesive tend to dry out and stiffen after long periods of aging.

The remaining samples were stored folded flat on the shelf in a closed paper carton at room temperature (approximately 22°C). Both sets of traps were weighed after 6 weeks of aging (3/1/76) to determine weight loss of the adhesives due to volatilization of solvents.

Table II. Weight loss in grams of open Delta traps hung in greenhouse and folded traps (unassembled).

| | Tack Trap (new) | Tack Trap (old) | Tree Tangle-foot | Excelcide Bird Repellant | Stikem-Special | Bird Tangle-foot |
|---|---|---|---|---|---|---|
| Greenhouse | 0.80 | 0.85 | +1.50 | 0.00 | +0.55 | +0.25 |
| Shelf | 1.30 | 0.60 | 0.10 | 0.20 | 0.00 | 0.00 |

After 6 weeks of aging under greenhouse conditions of high humidity and fluctuating temperatures, the new sample of Tack Trap lost 0.8 g/trap and the old sample 0.85 g/trap. Excelcide had no weight loss while the remaining adhesives, Tree Tanglefoot, Bird Tanglefoot and Stikem-Special, gained small amounts of weight hygroscopically. In the folded traps aged on the shelf at room temperature with low humidity, the new samples of Tack Trap lost 1.3 g/trap; old samples of Tack Trap lost 0.6 g/trap; Tree Tanglefoot, Bird Repellant lost small amounts while Stikem-Special and Bird Tanglefoot had no weight loss. The weight of Tack Trap in both sets of traps could be partially due to the evaporation of the solvent from the adhesive and a loss of moisture from the trap. In a test to check on moisture loss, 20 folded 1975 Delta traps with Tack Trap were removed from a sealed container, weighed and air dried singly for 10 days (1/9-1/19/76) at room temperature of 22°C. The folded traps with Tack Trap lost an average of 1.08 g of weight/trap. Twenty opened (unfolded) Delta traps without Tack Trap similarly air dried lost an average of 1.56 g of weight/trap.

The six traps with adhesives prepared 1/19/76 and stored on a shelf at room temperature in a paper carton were opened at 8 months (9/17/76) to check on the ease of separating the folded sections of the trap for assembly. Both traps with the old and new samples of Tack Trap adhesives are a little difficult to open and they should be pulled apart gently to prevent tearing. The remaining four adhesive samples opened up easily.

The preliminary screening of 5 trap adhesives was followed with a field bioassay of 20 replicates placed out in 5 blocks in a natural infestation for 2 months (7/16-9/16/76). Approximately 8.5 g of the trap adhesives were applied to these traps. The traps were checked 5 times; no moths were removed and the adhesive not disturbed. The following table tabulates the results of this study.

Table III.

| | Mean No. of Male Moths/Trap a/ Age (67 days) |
|---|---|
| Tack Trap | 15.2 a |
| Excelcide Bird Repellant | 14.9 a |
| Bird Tanglefoot | 14.0 a |
| Stikem-Special | 11.4 b |
| Tree Tanglefoot | 7.9 c |

a/ means followed by the same letter are not significantly different at 5% level of confidence based on Student-Newman-Keal's test.

This study indicates that after 60 days of field use in a natural infestation, Tack Trap, Excelcide Bird Repellant and Bird Tanglefoot have similar moth-holding characteristics. Excelcide Bird Repellant or Bird Tanglefoot can be substituted as a replacement for Tack Trap.

Project Number: GM 6.2.7
Project Title: Greenhouse Aging of Various Encapsulated Disparlure Formulations
Report Period: April 1, 1976 - September 30, 1976
Report Type: Final
Project Leaders: Robert G. Reeves, D. Simser

Objectives: This test was designed to compare six encapsulated disparlure formulations in respect to moth catch and residual disparlure after varying periods of aging the materials in the greenhouse. The materials were bioassayed and analyzed for disparlure residues after 4, 8, 14, 28, 42 and 63 days.

NCR AC 1016 - 1975 2% FORMULATION

| | Aged (days) 4 | 8 | 14 | 28 | 42 | 63 |
|---|---|---|---|---|---|---|
| Moth Catch 1/ | | | | | | |
| Slide (1) | 5 | 16 | 7 | 15 | 9 | 16 |
| Slide (2) | 5 | 13 | 16 | - | 13 | 7 |
| Std-1.0 ug 2/ | 2 | 0 | 3 | 1 | 6 4/ | 3 |
| Std-10 ug | 2 | 2 | 4 | 1 | 29 4/ | 2 |
| Blank (1) | 0 | 2 | 1 | 0 | 1 | 0 |
| Blank (2) | 0 | 0 | 3 | 0 | 0 | 2 |
| % Disparlure Residue | | | | | | |
| Slide (1) | 2.8 | 1.34 | 2.06 | 1.6 | 0.50 | 0.58 |
| Slide (2) | 2.9 | 1.31 | 1.44 | 0.88 | 0.68 | 0.46 |

NCR RH 1374 - 1976 2% FORMULATION

| | 4 | 8 | 14 | 28 | 42 | 63 |
|---|---|---|---|---|---|---|
| Moth Catch | | | | | | |
| Slide (1) | 9 | 13 | 17 | 22 | 27 | 30 |
| Slide (2) | - | 5 | 9 | - | 35 | 19 |
| % Disparlure Residue | | | | | | |
| Slide (1) | 1.9 | 1.28 | 1.22 | 0.84 | 0.51 | 0.31 |
| Slide (2) | 1.3 | 1.26 | 1.34 | 1.1 | 0.37 | 0.21 |

NCR 1377 - 10% FORMULATION

| | 4 | 8 | 14 | 28 | 42 | 63 |
|---|---|---|---|---|---|---|
| Moth Catch | | | | | | |
| Slide (1) | - | 6 | 26 | - | 40 | 26 |
| Slide (2) | 2 | 11 | 9 | 44 | [illegible] | 30 |
| % Disparlure Residue | | | | | | |
| Slide (1) | 6.9 | 5.65 | 11.69 | 8.1 | 4.2 | 4.47 |
| Slide (2) | 7.2 | 5.17 | 11.10 | 8.7 | 5.0 | 1.79 |

NCR 1374-77 - MIXTURE OF 1377-1374

| | Aged (days) | | | | | |
|---|---|---|---|---|---|---|
| | 4 | 8 | 14 | 28 | 42 | 63 |
| Moth Catch | | | | | | |
| Slide (1) | 11 | 13 | 20 | 15 | 39 | 25 |
| Slide (2) | - | 30 | 14 | 22 | 21 | 13 |
| % Disparlure Residue | | | | | | |
| Slide (1) | 3.0 | 3.47 | 3.03 | 2.5 | 0.89 | 0.49 |
| Slide (2) | 3.8 | 2.95 | 3.09 | 2.7 | 0.97 | 0.47 |
| STAUFFER - 14-3 MICROCAPSULES | | | | | | |
| Moth Catch | | | | | | |
| Slide (1) | 14 | 17 | 8 | 0 | 0 | 0 |
| Slide (2) | - | 14 | 18 | 0 | 0 | 4 |
| % Disparlure Residue | | | | | | |
| Slide (1) | 0.84 | 0.38 | 0.28 | 0.07 | 0.03 | 0.02 |
| Slide (2) | 0.91 | 0.34 | 0.27 | 0.05 | 0.03 | 0.02 |
| DISPARLURE ON DIATOMACEOUS EARTH | | | | | | |
| Moth Catch | | | | | | |
| Slide (1) | 7 | 10 | 22 | 0 | 8 | 5 |
| Slide (2) | - | 13 | 9 | - | 8 | 3 |
| % Disparlure Residue | | | | | | |
| Slide (1) | 3.0 | 0.95 | 1.29 | 0.71 | 0.20 | 0.12 |
| Slide (2) | 3.3 | 0.97 | 1.38 | 0.67 | 0.29 | 0.13 |

1/ Bioassay conducted by placing coated glass slides in Delta traps. Two chambers were used and 350 male moths were released in each chamber.

2/ Standards were cotton wicks with 1 ug and 10 ug disparlure on them. The standards for each aging period corresponds to all formulations, therefore, they are only tabulated once.

3/ Empty Delta traps were in the chambers during each bioassay.

4/ Standards for the 42 day test were 10 and 100 ug.

Project Number: GM 6.2.8
Project Title: Field Evaluation of Controlled Release Formulations of Disparlure for Mating Disruption
Report Period: April 1, 1976 - September 30, 1976
Report Type: Interim
Report Leaders: Charles P. Schwalbe, E. C. Paszek

Considerable effort has gone into field evaluation of microcapsular formulations of disparlure for disruption of adult mating. The most recently studied material was prepared by NCR, Dayton, Ohio and contained 2% disparlure by weight in xylene. It has been reported that this formulation "weathers" poorly and fails to release significant amounts of disparlure within 2-3 weeks after application, thus necessitating multiple applications to achieve acceptable levels of mating disruption. This project was conducted in cooperation with the ARS in an effort to develop improved controlled release broadcast formulations of pheromones. Similar tests were performed in Cecil County, MD.

Formulations used in the field tests were selected by laboratory screening of candidate materials. Characteristics that were measured included pheromone release rates, weathering properties, adhesive properties of various stickers and ease of handling. These evaluations were conducted on formulations exposed to laboratory, field and greenhouse conditions. All of these tests were performed by ARS, Organic Chemical Synthesis Laboratory, BARC. The following products were recommended for field evaluation.

| Formulation | Sticker | Nozzle | Rate (l/ha) | Dosage (g/ha) |
|---|---|---|---|---|
| Conrel fiber | Polybutene | 8010 | $10^5$ fiber/ha | 20 |
| MGK | 1.1% RH-1645 | 8010 | 3.5 | 20 |
| Stauffer | Unknown | 8010 | 2.1 | 20 |
| 1976 2% NCR | 1.1% RH-1645 | 8010 | 5.2 | 20 |
| 1976 4% NCR 1/ | 1.1% RH-1645 | 8010 | 2.6 | 20 |
| 1976 10% NCR | 1.1% RH-1645 | 8008 | 1.1 | 20 |
| 1975 2% NCR 2/ | 1.1% Rhoplex B-15 | 8010 | 5.2 | 20 |

1/ Mixture of 2% and 10% formulations
2/ This formulation is used as the "standard"

Test plots (16 ha each) were established near Fall River, MA. There were 4 replicates for each treatment and 8 check plots. Egg mass survey in 9 (out of 36) plots showed the insect population density to be ca. 1 egg mass/A (based on 30% of total plot surveyed). All liquid formulations were sprayed by air June 24 and 25. The fibers were applied on or about June 30. Efficacy was determined by monitoring the incidence of mating of female moths placed in the study plots. No male moths were released. Field collected females were used up to July 29, after which laboratory-

reared insects were used. One or two day old virgin female moths were placed at breast height under slab shelters. Depending upon availability of insects, up to 12 moths were in place at a given time in each plot. The insects were recovered after 3 days in the field and returned to the laboratory for dissection to determine the presence of sperm. Any eggs deposited were also collected; percent embryonation was determined from these eggs. The results of the insemination determinations are given in Table I. Egg embryonation examinations are presently incomplete and will be reported later.

Table I. Incidence of mating of females in plots treated with test formulations.

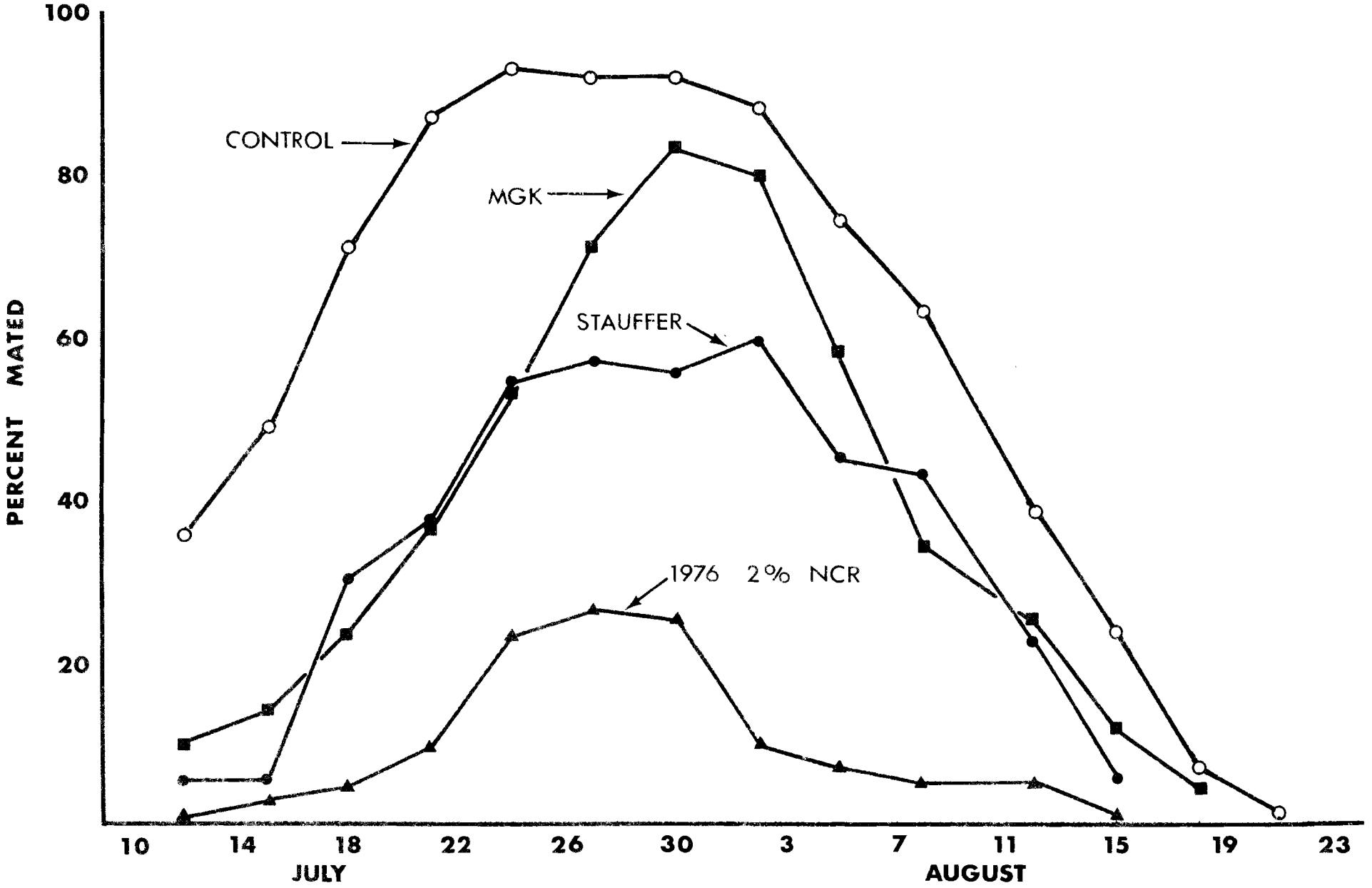
| Formulation | # Determined | # Mated | % Mated |
|---|---|---|---|
| 1976 2% NCR | 364 | 29 | 8.0 |
| 1976 4% NCR | 273 | 33 | 12.1 |
| 1976 10% NCR | 270 | 37 | 13.7 |
| 1975 2% NCR | 292 | 45 | 15.4 |
| Conrel | 282 | 59 | 20.9 |
| Stauffer | 356 | 105 | 29.5 |
| MGK | 358 | 129 | 36.0 |
| Check A | 268 | 111 | 41.4 |
| Check B | 376 | 204 | 54.0 |

Data presented in Table I represent total (season long) mating in study plots. It is clear that certain formulations disrupted mating to an extent greater than others. From these tests, 1976 2% NCR microcapsule formulation was more efficacious than any other. Interestingly, the ranking of the same 7 test formulations in similar studies conducted in MD was identical to that in Table I. Since data are yet incomplete, statistical analysis has not been performed and differences used to rank the formulations may not be statistically significant. It should be noted that all 1976 NCR formulations contained a new sticker, RH-1645. Material formulated in 1975 contained Rhoplex B-15. Since this is the only difference between the 1975 and 1976 2% formulations, it appears that the sticker used may have a significant effect on the field "performance" of a formulation.

When data are plotted with time, an interesting element of the data appears. An unexpectedly high incidence of mating occurs in the treatment plots at the same time mating "peaks" in the control plots (Figures I and II). Thus, at a time when, presumably, most adult moths are present, mating in the 1976 2% NCR plots was ca. 27%. This likely represents unsatisfactory control. This may be due to increased "pressure" on the disruption system (mating disruption with pheromone is thought to be density dependent) by large number of native males present. The "burst" of mating should, therefore, be smaller at lower population densities. However, these studies were conducted at population densities of ca. 1 egg mass/A (generally considered very sparse) and if disparlure is to be useful in a control or

eradication context, the limits within which it will satisfactorily disr mating must be defined. Additional formulation research may provide the solution. Further study with mixtures of behavioral chemicals and multipl applications of these materials may also be important.

This work is currently being written for publication and a final, complete manuscript will be included in the next Laboratory Report.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PERCENT MATED
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MGK
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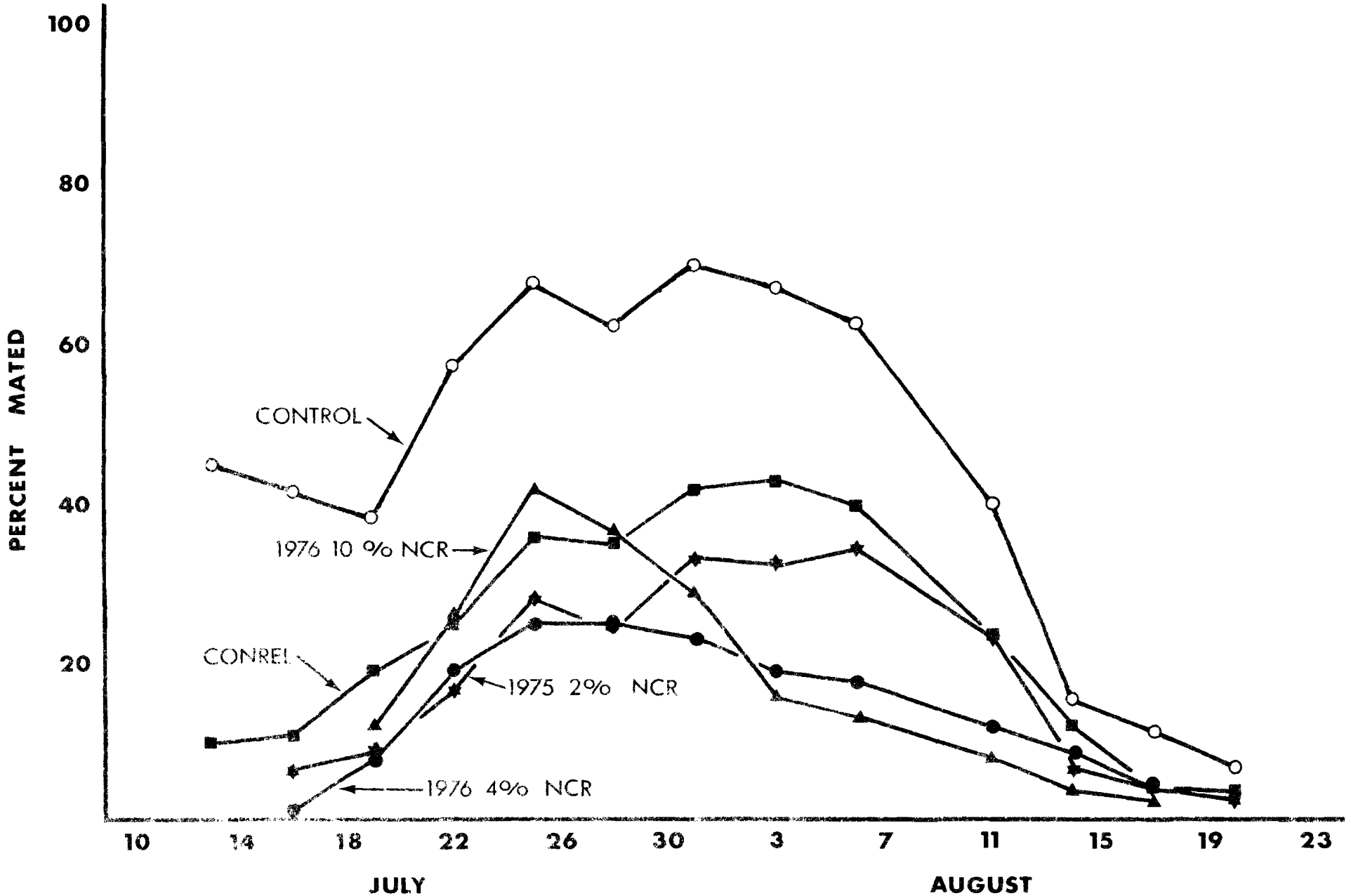
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1975 2% NCR
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Project Number: GM 6.2.9
Project Title: Field Aging Test of Six Slow Release Encapsulated Disparlure Formulations on Oak Foliage
Report Period: April 1, 1976 - September 30, 1976
Report Type: Final
Project Leaders: Robert G. Reeves, D. Simser

Objective: Compare different formulations of disparlure on oak foliage for release of disparlure, adherence to foliage and residual life.

Sampling of the Disparlure Formulations: The samples were collected from the spray tank of the aircraft prior to field application of the materials. All samples were placed in the field on July 9, 1976.

Application of Materials to Seedlings: The formulations were quantitatively applied to foliage on oak seedlings with a 100 µl syringe. Thirty-two seedlings were spotted with each formulation. One-half the samples were placed in direct sunlight; the other half placed in a forested area shaded under the forest canopy.

Extractions:

1. Foliage - Five to 8 leaves were placed in 125 ml Erlenmeyer flasks containing 75 ml of a 1:1 hexane-acetone mixture. The samples were aged for 24 hours then placed on a mechanical shaker (slow speed) for 1 hour. No cleanup of these samples was required prior to injection on the instrument.

2. Soil - Soil in the seedling pots was extracted by putting the upper 1-1/2" into a 250 ml Erlenmeyer flask containing 150 ml of a 1:1 hexane-acetone mixture and aging the same as foliage. Fifty ml was decanted through a $Na_2SO_4$ filter into 50 ml centrifuge tubes and concentrated to 5 ml. No further cleanup was necessary.

Analysis and Recovery Tests:

1. One hundred µl of each formulation was analyzed for exact weight of disparlure.

2. Recovery tests were carried out by applying 100 µl of each formulation to oak leaves and to soil. Samples were extracted by the previously described procedures and compared with standards. Recoveries of disparlure from foliage and soil ranged from 95% to 105% and averaged about 100%, therefore, no correction was made for recoveries in the analyses of field samples.

3. Analyses were accomplished on a Tracor 222 gas chromatograph equipped with a 6' x 1/4" glass column packed with 3% OV1 on 80/100 chromosorb W HP and a flame ionization detector. Instrument conditions were: injector - 225°C; oven - 200°C; detector - 200°C with $N_2$ carrier gas at 7 on flow meter.

## MGK FORMULATION

| Aged (Days) | % Lure Recovered-Foliage Woods | Sun | % Lure Recovered-Soil Woods | Sun |
|---|---|---|---|---|
| 5 | 11.95 | 17.09 | | |
| 12 | 8.22 | 9.67 | | |
| 19 | 5.81 | 4.12 | | |
| 26 | 4.02 | 1.56 | 18.91 | 2.25 |
| 33 | 0.63 | 0.20 | 1.5 | 0.52 |
| **STAUFFER FORMULATION** | | | | |
| 5 | 29.36 | 8.34 | | |
| 12 | 9.64 | 3.55 | | |
| 19 | 1.51 | 1.42 | 24.50 | 3.65 |
| 26 | 0.55 | 1.51 | 4.16 | 0.31 |
| 33 | 0.03 | 0.30 | | |
| **NCR 2% - 1975 FORMULATION** | | | | |
| 5 | 18.76 | 32.72 | | |
| 12 | 15.28 | 18.77 | | |
| 19 | 10.45 | 14.86 | 7.90 | 5.64 |
| 26 | 9.86 | 11.89 | 5.40 | 1.03 |
| 33 | 6.72 | 5.78 | | |
| **NCR 2% - 1976 FORMULATION** | | | | |
| 5 | 23.66 | 47.55 | | |
| 12 | 13.86 | 38.55 | | |
| 19 | 9.52 | 18.34 | 9.61 | 16.98 |
| 26 | 11.79 | 14.92 | 1.82 | 2.75 |
| 33 | 13.13 | 13.93 | | |
| **NCR 4.3% - FORMULATION** | | | | |
| 5 | 26.88 | 16.48 | | |
| 12 | 21.42 | 32.55 | | |
| 19 | 17.41 | 28.01 | 2.35 | 1.49 |
| 26 | 16.84 | 23.03 | 1.81 | 0.20 |
| 33 | 15.67 | 18.38 | | |
| **NCR 10% - FORMULATION** | | | | |
| 5 | 54.49 | 63.57 | | |
| 12 | 38.70 | 46.59 | 9.25 | 0.37 |
| 19 | 24.92 | 35.20 | 1.18 | 0.08 |
| 26 | 8.97 | 25.51 | | |
| 33 | 22.62 | 27.48 | | |

Rainfall: 7/12 - 2.5"; 7/16 - 0.[illegible]"; 7/26 - 3.8"; 8/3 - [illegible]".

Project Number: GM 6.2.10
Project Title: Analytical and Bioassay Tests of Glass Slides Coated with Four Disparlure (7, 8 Epoxy, 3 Methyl Octadecane) Formulations and Aged in a Greenhouse
Report Period: April 1, 1976 - September 30, 1976
Report Type: Final
Project Leaders: Robert G. Reeves, D. Simser

The objective of this test was to monitor the release rate of disparlure from encapsulated material formulated by four different companies. Each formulation was quantitatively applied to glass microscope slides which were aged for 10 weeks in a greenhouse. The sampling schedule was 1 and 4 days, 1, 2, 4, 6 and 10 weeks for each group of slides. Some 5, 6 and 10 week slides were bioassayed with male gypsy moths in chambers prior to residue analysis. Disparlure residues were determined by gas chromatography. The following table gives the results of this test.

| Material | Time Aged | % Residual Disparlure 1/ | Time Aged | Moth Catch |
|---|---|---|---|---|
| NCR AC 1016 + 4 drops Supernate AV. Lure= 1.75% | 1 day | 1.67 | 5 wks. | 20 |
| | 4 days | 1.65 | 5 wks. | 23 |
| | 1 wk. | 1.61 | 10 wks. | 8 |
| | 2 wks. | 1.40 | | |
| | 4 wks. | 1.12 | | |
| | 6 wks. | 0.31 | | |
| | 10 wks. | 0.42 | | |
| Lytron 2119 Average Lure= Undetermined | 1 day | 1.55 | 5 wks. | 2 |
| | 4 days | 1.85 | 5 wks. | 1 |
| | 1 wk. | 1.55 | 6 wks. | 3 |
| | 2 wks. | 1.63 | 10 wks. | 2 |
| | 4 wks. | 1.51 | | |
| | 6 wks. | 1.0 | | |
| | 10 wks. | 0.72 | | |
| MGK 2% Lure | 1 day | 1.36 | 5 wks. | 5 |
| | 4 days | 1.37 | 5 wks. | 2 |
| | 1 wk. | 1.05 | 6 wks. | 0 |
| | 2 wks. | 0.82 | 10 wks. | 0 |
| | 4 wks. | 0.5[illegible] | | |
| | 6 wks. | [illegible] | | |
| | 10 wks | [illegible] | | |
| Stauffer 4380-14-1 Microcapsules Average Lure = 0.91% | 1 day | 1.[illegible] | 5 wks. | 0 |
| | 4 days | 1.1[illegible] | 5 wks. | 1 |
| | 1 wk. | 0.[illegible] | 6 wks. | 1 |
| | 2 wks. | 0.96 | 10 wks. | [illegible] |
| | 4 wks. | 0.8[illegible] | | |
| | 6 wks. | 0.7[illegible] | | |
| | 10 wks. | 0.7[illegible] | | |

1/ Average of [illegible] replicates

Project Number: GM 6.3.1
Project Title: Hatch Rate of *L. dispar* Eggs as Affected by Pre-cooling Storage Techniques
Report Period: April 1, 1976 - September 30, 1976
Report Type: Interim
Project Leaders: John Allen Tanner, L.F. Kennedy

Tests have been completed and data collected are currently being analyzed.

Project Number: GM 6.3.2
Project Title: The Hatch Rate of L. dispar Eggs as Affected by the Precooling Period and the Duration of the Embryonation Period
Report Period: April 1, 1976 - September 30, 1976
Report Type: Final
Project Leaders: John Allen Tanner, L. F. Kennedy

The objectives of this test are to determine the minimum embryonation period required for survival of L. dispar embryos during refrigeration and to determine the necessity of a precooling period prior to refrigeration.

Methods: This study was a refinement of tests conducted during 1974-75 concerning the duration of the embryonation period. Rates of embryonation and hatch were determined from egg masses held under the following conditions prior to refrigeration at 4°C for 150 days.

| Days Exposed | |
|---|---|
| 22°C | 15°C |
| 7 | 10 |
| 17 | - |
| 14 | 10 |
| 24 | - |
| 21 | 10 |
| 31 | - |
| 28 | 10 |
| 38 | - |
| 35 | 10 |
| 45 | - |

After refrigeration each egg mass was individually incubated (22°C, 95-99% RH, 14L:10D) until eclosion ceased; records were maintained as to the number of incubation days to initiate and complete hatch, and the percent embryonation and eclosion.

Results: Eggs embryonated 17 days produced little or no hatch (Table I) and were excluded from any statistical analysis.

With the exception of the precooled 24 day treatment, increasing the embryonation period did not significantly alter hatch rates (Table I). However, reducing the embryonation temperature did increase the mean hatch rates slightly but not significantly.

Extending the embryonation period significantly increased the number of incubation days necessary to commence eclosion (Table I). Increase was in a linear fashion with $r^2$ of .94 and .99 for precooled and non-precooled eggs respectively (Fig. 1). Precooled eggs required 21 additional hours of incubation with each week increase in the embryonation period while non-precooled eggs required 28 hours per week. Precooling the eggs significantly reduced the number of incubation days.

The number of incubation days over which 50% of the neonates emerged was lowest for eggs embryonated 24 days (Table I). However, no concrete trend of increase was observed in the number of incubation days with longer embryonation periods. Precooling the eggs reduced the number of incubation days necessary to obtain 50% hatch.

Conclusion: Gypsy moth eggs should be given the shortest embryonation period that will allow the embryos to reach the stage of development necessary to survive refrigeration. This will yield maximum hatch with the fewest incubation days to initiate hatch and result in a decrease of generation time.

Reducing the temperature during the latter part of the embryonation period would likewise reduce the number of incubation days to initiate hatch. It will also decrease the number of days for neonate emergence and slightly increase the hatch rate.

Table I. The effects of duration of embryonation and temperature of embryonation on the hatch rate and the number of incubation days to initiate hatch for 50% neonate emergence.

| | PRECOOLED 2/ | | | NON-PRECOOLED 2/ | | |
|---|---|---|---|---|---|---|
| Days Embryonated | % Hatch | Days to Initiate Hatch | Days for 50% Neonate Emergence 3/ | % Hatch | Days to Initiate Hatch | Days for 50% Neonate Emergence 3/ |
| 17 1/ | 00.0 | - | - | 00.3 | - | - |
| 24 | 66.3A | 6.2A | 2.8 | 74.9A | 7.4A | 3.8 |
| 31 | 95.1B | 7.1B | 3.9 | 84.4A | 8.2B | 5.5 |
| 38 | 89.6B | 8.4C | 3.8 | 78.3A | 9.6C | 4.6 |
| 45 | 95.5B | 8.7C | 4.1 | 80.0A | 10.8D | 5.1 |

1/ 17 day embryonation period not included in statistical analysis

2/ Means within a column not followed by the same letter are significantly different at the .05 level

3/ Calculated from date of first hatch

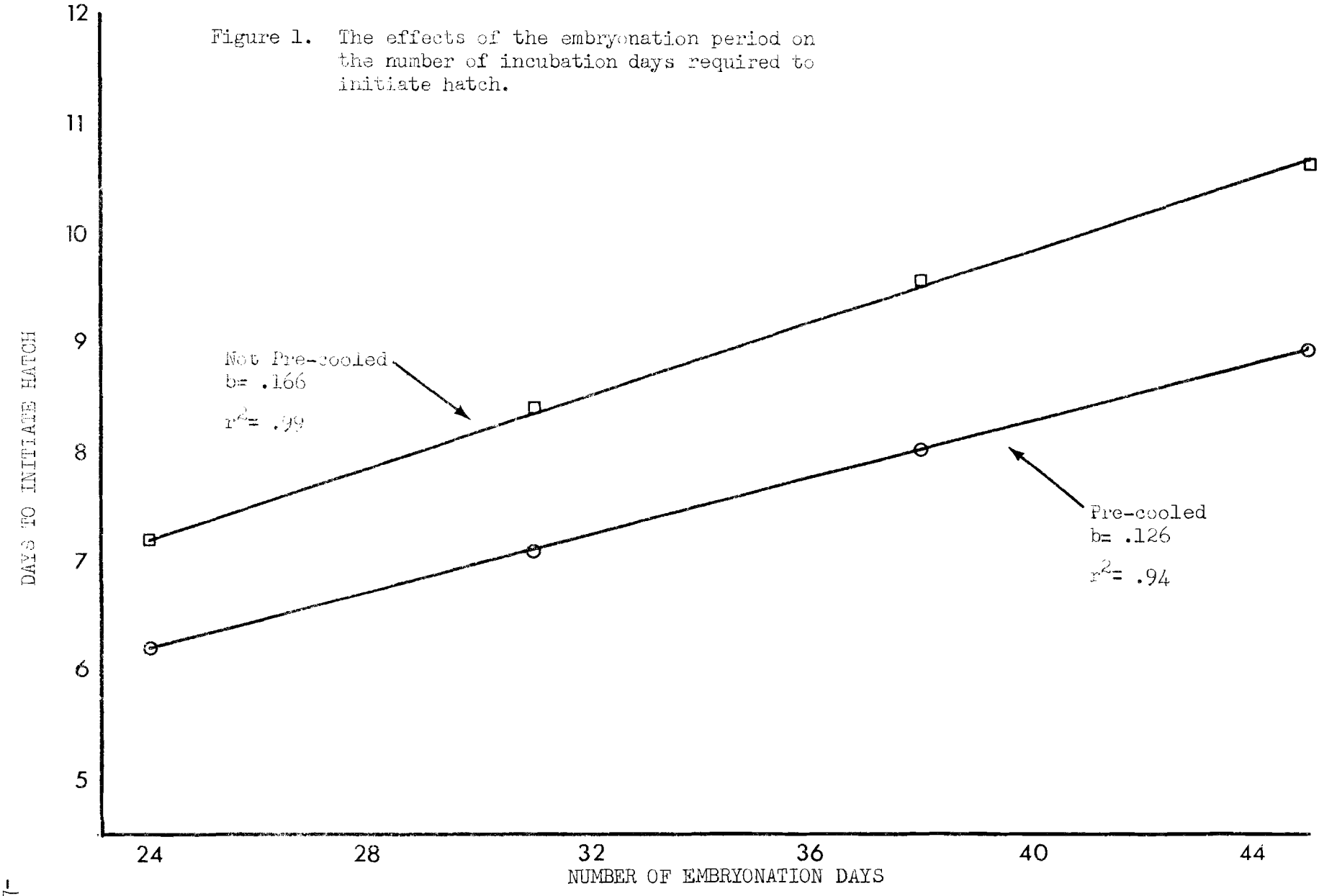


Figure 1. The effects of the embryonation period on the number of incubation days required to initiate hatch.

Project Number: GM 6.3.3
Project Title: The Hatch Rate of *L. dispar* Eggs as Affected by Treatment with Clorox® and Captan®
Report Period: April 1, 1976 - September 30, 1976
Report Type: Interim
Project Leaders: John Allen Tanner, L. F. Kennedy

Tests have been completed and data collected are currently being analyzed.

Project Number: GM 6.3.4
Project Title: Gypsy Moth Mass Rearing: Evaluation of Methods for Surface Sterilization of Eggs and/or Pupae
Report Period: April 1, 1976 - September 30, 1976
Report Type: Interim
Project Leaders: Martin Shapiro, R. A. Bell

In a series of tests, gypsy moth eggs were exposed to various chemical disinfectants (Clorox and formalin) and germicidal UV light (2537 A). In an initial test to determine the effect of such treatments on egg hatch and subsequent growth and development, each of 20 egg masses was divided into 4 parts. Each fraction of the egg mass was subjected to a different treatment or was used as an untreated control. By keeping data on separate egg masses, variations between egg masses could be observed.

The treatments (Table I) did not adversely affect the incidence of egg hatch or subsequent development as judged by weights of pupae and egg masses from moths arising from the treated eggs. Egg masses from this test are being chilled after which time determinations of egg hatch in the $F_1$ generation will be made.

A second series of tests was conducted to determine the effect of the above treatments on suppression of NP virus. For this test we used field collected egg masses (Taunton, MA) known to be heavily contaminated with virus. The treatments were similar to those previously described. Larvae that hatched from the treated and control groups of eggs were placed on diet, reared in aggregate, and observed daily for presence of virus disease. Results (Table II) showed that formalin was most effective in suppressing virus incidence. However, since formalin was not 100% effective (i.e., 8% of the test larvae died from virus disease) further tests were carried out to determine if modifications of the formalin treatment (i.e., higher concentrations or extended treatment times) would give better results. Unfortunately, additional tests on virus suppression have been delayed until eggs collected this past season have undergone sufficient chilling to break diapause.

In the meantime, we have examined the effects of immersion of eggs in 10% formalin for extended time periods on incidence of hatch. The results of these tests (Table III) show that eggs immersed in formalin for 60 and 90 minutes hatched as well as those of the control group. However, observations at 17 days post-hatch on larval development showed that 90.2, 85.9, 77.6 and 52.3% had attained the 4th instar in the control, 30, 60 and 90 minute formalin treatment respectively. Thus a significant developmental delay in the 90 minute treated group is indicated. Based on the results of these experiments, we have tentatively adopted the use of 10% formalin (immersion of eggs for 60 minutes; tap water rinsed for 60 minutes and air dried) for surface sterilization of egg masses. The completed results of the tests in progress will indicate whether this procedure should be altered.

Table I. Incidence of hatch in gypsy moth eggs subjected to various surface disinfection treatments. 1/

| Treatment | No. Eggs | No. Hatch | % Hatch |
|---|---|---|---|
| Control | 815 | 541 | 66.4 |
| Clorox (10%)[2] | 777 | 523 | 67.3 |
| Formalin (10%)[2] | 1009 | 687 | 68.1 |
| UV Light (10 min.)[3] | 999 | 695 | 69.6 |

[1] New Jersey $F_{13}$ strain; numbers based on samples from 10 egg masses.

[2] Eggs immersed in aqueous solution of Clorox or formalin for 30 minutes followed by a similar period of rinsing in running tap water and allowed to air dry.

[3] Eggs subjected to UV light (2537 A) for 10 minutes at a distance of 15 centimeters.

Table II. Effect of various methods for surface decontamination of eggs on subsequent incidence of virus in larval gypsy moths.

| Treatment | Egg Hatch (%) | No. Larvae Observed | Larval Mortality Due to Virus | |
|---|---|---|---|---|
| | | | Number | % |
| Control | 87 | 430 | 369 | 85.8 |
| Clorox (10%) | 89 | 611 | 270 | 44.2 |
| Formalin (10%) | 87 | 686 | 60 | 8.7 |
| UV Light (10 min.) | 79 | 335 | 260 | 77.6 |

Table III. Effect of duration of exposure to formalin on egg hatch of the gypsy moth. [1]

| Treatment | Number Eggs Treated | % Hatch |
|---|---|---|
| Control | 1545 | 79.3 |
| Formalin (30 min.)[2] | 1700 | 79.1 |
| Formalin (60 min.)[2] | 1642 | 80.9 |
| Formalin (90 min.)[2] | 1794 | 77.5 |

[1] New Jersey $F_{14}$; eggs were sampled from each of 20 egg masses.

[2] 10% aqueous solution; following treatment, eggs were rinsed in running tap water for the same time period and allowed to air dry.

Project Number: GM 6.3.5
Project Title: Gypsy Moth Mass Rearing: Evaluation and Development of More Economical Diets and More Efficient Techniques for Rearing and Handling Larval Gypsy Moths
Report Period: April 1, 1976 - September 30, 1976
Report Type: Interim
Investigators: Robert A. Bell, M. Shapiro, O. T. Forrester

In the last laboratory report (September 1975-March 1976) we noted that the gypsy moth could be reared on a wheat germ-casein diet previously used for rearing tobacco hornworms. This diet was less expensive than other diets used for rearing gypsy moths and contained fewer ingredients. In this report, we present the results of more extensive tests with the modified hornworm diet and certain preliminary results of tests involving several simpler and less costly diet formulations.

Rearing Procedures: Since the rearing procedures that we have adopted are somewhat different from those employed by other workers, a brief description of these techniques is presented here.

Experimental diets were prepared in a 1 gallon Waring blender. Agar was suspended in boiling water by using a hot plate-magnetized stirrer. The water-agar mixture was poured into the blender container and cooled to 70°C; all remaining ingredients were added with the blender stirring motor operating at low rpm. The speed was regulated by a rheostat. All ingredients were then blended at 1550 rpm for 1 minute and immediately poured into rearing containers. The diet was covered with tissue toweling (Kaydry®) and cooled to room temperature. Generally, the larvae were placed on the diet the same day it was prepared but sometimes the diet was placed in plastic bags, held overnight at room temperature and infested the next day.

Until this past summer, field collected egg masses used to obtain test larvae were not surface sterilized. However, during the summer an increased incidence of viral and incidental mold contamination necessitated the use of procedures for surface decontamination of eggs. The procedures used were those developed by M. Shapiro and involved a 1 hour immersion of broken egg masses in 10% Formalin followed by an equal period of rinsing with tap water.

Unless specified otherwise, test insects were reared individually in 1.5 ounce polystyrene cups (Thunderbird Container Corp.) with plastic coated paper lids (Standard Cap and Seal). For aggregate rearing, 10-15 larvae were reared from neonate to late 3rd or early 4th instars in either 1.5 ounce styrene cups or 1.75 ounce paper cups (Dixie®, wax coated) with uncoated paper lids. Thereafter, larvae were transferred to 16 ounce unwaxed paper food containers (15 larvae/container) with a 3.5 ounce plastic Solo® cup of fresh diet. The 16 ounce container was fitted with a transparent plastic "snap-on" type lid. (The 16 ounce containers have been in use for some time at several locations where gypsy moths are being reared including the APHIS rearing unit here at Otis).

Generally, no additional feeding or handling was required and larvae were permitted to pupate in the 16 ounce containers. After pupation was completed, the pupae were sexed, weighed and segregated according to sex in 16 ounce containers (up to [illegible] ♀'s and 40 ♂'s/container respectively).

Moths (♂'s and ♀'s) were collected on the day of eclosion and placed in paper bags (5-10 pr./bag) for mating and oviposition. The bags, sealed with masking tape, were opened the following day and moths were removed with a vacuum cleaner. The egg masses were cut out, incubated for 14 days (25°C) [illegible] and placed in a cold chamber at 8°C to terminate diapause.

Except during egg diapause, all stages of development were maintained in controlled environmental chambers maintained at [illegible] ± 1°C) 60% RH and 17 hr light/day.

Results and Discussion: [illegible] gypsy moth (wild and colonized strains) were reared this past summer on a modified tobacco hornworm diet (Table IV). The diet costs about $.[illegible]/liter and, depending upon the mode of rearing, is sufficient to feed [illegible] larvae or about $3.33-5.00/1000 insects. The performance of the gypsy moth reared on this diet has been quite satisfactory (Table [illegible]). The colonized (NJ F13) strain reared aggregately yielded 8[illegible]% adults, the females of which laid an average of 745 eggs on the first day of oviposition (under the test conditions, 80-90% of the eggs were laid within 1 day after mating). The wild strain (Dighton, MA) yielded 61% adults. The lower yield of the wild strain was due to virus contamination which was particularly prevalent during the summer when these tests were conducted. Pupal weights and egg production of the wild strain was only slightly less than that of the colonized strain. Further testing of the wild stock will be delayed until larvae are available from this year's field [illegible] of eggs. [illegible] conducted earlier (i.e. during this past winter and spring) when virus was not observed, the yield of adults from wild stock [illegible] exceeded 80%. Thus with a reasonably virus free wild strain, adult yields should be quite satisfactory. It is believed that virus contamination is probably the most important single factor affecting performance and quality of mass reared insects. Thus considerable effort is being made (1) to find better methods for surface decontamination of eggs, (2) to reduce or eliminate virus from the rearing areas and (3) to detect virus in colonies when present at sub-lethal levels. A continuous supply of healthy insects that are reasonably free of virus is essential for obtaining reliable data from experiments.

Several tests [illegible] the minimum dietary ingredients required [illegible] virus production. A rather simplified formulation [illegible] wheat germ-casein diet has been developed that shows [illegible] promise. Performance of the NJ colonized strain [illegible] reproaches [illegible] observed when gypsy moths are reared [illegible] hornworm diet. Further tests are in progress [illegible] have been substituted for casein

and the agar content is reduced 40% by adding 2 to 4% wheat starch. Such formulations can be prepared for 35¢/L.; thus the cost of rearing insects on this diet amounts to $2.25-2.50/1000. So far these inexpensive diet formulations appear to be adequate at least to rear larvae for virus production.

Rearing Containers: Although the ideal container has not been found, we obtained good results with 4 or 6 ounce translucent plastic containers with "snap-in" uncoated paper lids. Preliminary results of tests to determine the optimal density of insects/4 ounce container are shown in Table VIII. It is envisioned that these containers may be used in rearing larvae for virus production but they may also prove satisfactory for rearing insects to the adult stage for colony maintenance or other purposes. No difference between treatments was seen in the developmental rate but the percentage reaching the pupal stage was lower in treatments involving 8 and 10 larvae/container. Also, pupal weights were higher in the treatment with 4 larvae/container. There was a decrease in pupal weight of the males as the population density increased although this was not strictly true for the females in that no difference was seen in the treatments involving 6, 8 or 10 larvae/container. It must be emphasized that there was no considerable competition for available food, but there was competition for space for molting and pupation. Thus in the treatments involving higher densities, many pupae were malformed. Also differences in oxygenation in the different treatments may account for the lack of a linear relationship between density and female pupal weight. The main point of emphasis is that the 4 ounce containers appear suitable for aggregate rearing of 6-8 larvae/container at low cost, i.e. approximately $2.50-3.00/1000 larvae. Further studies will be carried out to evaluate other containers for aggregate rearing that offer additional cost reductions.

Table IV. Yamamoto's tobacco hornworm diet (slightly modified).

| | INGREDIENT | AMT/LITER |
|---|---|---|
| 1 | Wheat Germ | 80.0 g |
| 2 | Casein | 36.0 g |
| 3 | Sucrose | 32.0 g |
| 4 | Torula Yeast | 16.0 g |
| 5 | Salt Mixture | 8.0 g |
| 6 | Vitamin Mix [1] | 5.0 g |
| 7 | Cholesterol | 0.2 g |
| 8 | Methyl Paraben | 1.0 g |
| 9 | Sorbic Acid | 1.5 g |
| 10 | Agar | 20.0 g |
| 11 | Water | 800.0 ml |

[1] Vitamin mix (Hoffman-LaRoche formulation) includes B-vitamins, ascorbic acid, choline chloride and inositol

COST/LITER = $0.50

Table V. Performance of a colonized vs wild strain of gypsy moths reared on a modified tobacco hornworm diet.

| Strain | Avg Pupal Wt (g) ♂ | Avg Pupal Wt (g) ♀ | Adult Yield | Avg Eggs Per ♀/Day |
|---|---|---|---|---|
| NJ $F_{13}$ | 0.52 | 2.1 | 89 | 745 |
| Dighton (wild) | 0.51 | 1.9 | 61 | 718 |

Mode of Rearing = Aggregate
No. Reared = 5225 NJ $F_{13}$ Strain
1930 Dighton (wild)

Table VI. Simplified wheat germ-casein diet for rearing gypsy moths.

| | Ingredient | Amt/Liter |
|---|---|---|
| 1 | Wheat Germ | 102 g |
| 2 | Casein | 25 g |
| 3 | Salt Mixture | 8 g |
| 4 | Vitamin Mix [1] | 5 g |
| 5 | Sorbic Acid | 1 g |
| 6 | Methyl Paraben | 1 g |
| 7 | Agar | 20 g |
| 8 | Water | 850 ml |

[1] Vitamin mix (Hoffman-LaRoche) contains B-vitamins, ascorbic acid, choline and inositol

COST/LITER = $0.42

Table VII. Performance of gypsy moths on a simplified wheat germ-casein diet (26°C; 60 RH).

| Number Insects | Days to Pupation | Avg Pupal Wt (g) | Adult Yield (%) | Eggs/♀ Per Day |
|---|---|---|---|---|
| 360 | 28-35 (♂)<br>31-39 (♀) | .55 (♂)<br>2.22 (♀) | 79 | 709 |

Aggregately reared

Strain: NJ $F_{13}$

Table VIII. Developmental rate, pupal yield and weight of gypsy moths (NJ $F_{14}$) reared at different densities.

| No. Infested | No. per Container | Days to Pupation[1] ♂'s | Days to Pupation[1] ♀'s | Pupal Yield (%) | Pupal wt(g)[1] ♂'s | Pupal wt(g)[1] ♀'s |
|---|---|---|---|---|---|---|
| 40 | 4 | 31.7(1.4) | 34.3(3.0) | 100.0 | .70(.08) | 2.4(.41) |
| 48 | 6 | 31.5(1.6) | 34.7(3.1) | 98.0 | .67(.10) | 1.9(.37) |
| 80 | 8 | 32.1(1.4) | 35.1(3.7) | 88.0 | .63(.08) | 2.1(.31) |
| 100 | 10 | 31.7(1.2) | 35.0(2.8) | 84.0 | .55(.08) | 1.9(.34) |

[1] Figures represent mean value; standard deviation in parentheses; pupal wts based on N=lo ♂'s and 10 ♀'s/treatment.

Project Number: GM 6.3.6
Project Title: Establishment of Standards for Monitoring Performance and Quality of Mass Reared Gypsy Moths
Report Period: April 1, 1976 - September 30, 1976
Report Type: Preliminary
Project Leaders: Robert A. Bell, M. Shapiro

Colony performance can be measured by taking into account (1) developmental time (2) pupal weights (3) yield and (4) fecundity. Taken together, these components, excepting pupal weight, are a measure of the fitness of the population under the conditions of the rearing environment.

Further work on this project will be carried out when the prototype rearing facility and virus production unit are completed. Assessment of quality of insects with regard to suitability for virus production is being carried out in cooperation with the FS lab at Hamden, CT. Work on assessment of mass reared insects for pheromone tests is being done in conjunction with APHIS. Progress in this area can begin as soon as a reliable pheromone assay method is developed.

Project Number: GM 6.3.7
Project Title: Monitoring for Pathogens and Adventitious Microbes Associated with Gypsy Moth Rearing and Development of Effective Sanitation Procedures
Report Period: April 1, 1976 - September 30, 1976
Report Type: Preliminary
Project Leaders: Martin Shapiro, R. A. Bell

The kinds and amounts of pathogens and other microbes depends, to a great extent, upon the physical environment of the rearing facility. The use of a clean air system should drastically reduce or eliminate microbial and, perhaps, virus contamination. A prototype rearing facility presently under construction will be used for assessing the capacity of HEPA filters to suppress microbial contamination under a simulated mass production situation. After this assessment is made, we will be able to determine what, if any, further sanitation procedures may be required.

Project Number: GM 6.3.8
Project Title: Development of Methods for Avoiding Contact with Insect Scales and Urticating Hairs Associated with Adults, Eggs and Larvae of the Gypsy Moth
Report Period: April 1, 1976 - September 30, 1976
Report Type: Preliminary
Project Leaders: Charles Owens, R. A. Bell

A prototype rearing facility is under construction which includes a laminar flow type clean air system. Room air is drawn through a system of pre-filters mounted in one end of the rearing unit. Air is then partially routed through a by-pass duct for conditioning, i.e. heated, cooled, humidified or dehumidified and returned to the main duct. The conditioned air is then discharged into the room through a bank of HEPA filters. The prototype rearing unit is equipped with a variable speed blower and the HEPA filters are mounted so that they can be easily changed. Thus air velocity and filter types can be varied and tested to determine the best combination. A clean air system is also being constructed in the kitchen-diet preparation area. The clean air system should serve a dual purpose; that of reducing or eliminating airborn microbial contaminants and simultaneous removal of urticating hairs, scales and dust.

Special precautions are being taken in areas where moths are being handled and egg masses are to be collected. The incidence of wing scales and body hairs is extremely high and constitutes a special hazard to the workers. In this area, HEPA filters cannot be used because they would become quickly clogged with scales. A system had to be devised that was effective in removing not only the insect scales but also the moths after completion of oviposition. With this in mind, a system was designed in cooperation with Toyenco, Inc. of Coventry, RI (a manufacturer of dust collecting and clean air equipment) that would remove and trap intact moths, moth scales and also provide a clean air system for the adult and egg holding room.

Thus the final collection-clean air system involves a cyclone separator for removal of moths and a filter bag unit to collect particles down to 0.5 micron. After these particulates are removed, the air is drawn through an electronic filter and, if necessary, activated charcoal filter placed in return air duct. This system has just been delivered to us and we will be testing it within the next month or two.

Project Number: GM 6.3.9
Project Title: Insect Production and Distribution
Report Period: April 1, 1976 - September 30, 1976
Report Type: Interim
Project Leaders: Leonard F. Kennedy, J. J. Baker, O. T. Forrester

The primary object of the rearing facility of this laboratory is to produce sufficient quantities of all phases of the gypsy moth life cycle in support of research projects at this laboratory and several universities and experiment stations in the United States and foregin countries. Following is a summary of production and distribution of such material.

Production:

| | |
|---|---|
| Eggs incubated | 3,900,000 |
| Larvae hatched | 1,140,750(29.3%) |
| Larvae harvested | 682,610(60%) |
| Larvae infested | 659,591(97%) |
| Larvae canned | 511,648(79%) |
| Pupae harvested | 114,000 ♂ |
| | 84,000 ♀ |
| Matings | 18,688 |
| Number egg masses produced | 17,480(93.5%) |

Distribution:

| | | |
|---|---|---|
| Methods Development and ARS - Otis | | |
| Insecticide Screening | 1st instar | 2,534 |
| | 2nd instar | 19,320 |
| | 3rd instar | 17,265 |
| Pheromones | adults | 9,903 ♂ |
| Diet tests | newly hatched | 20,485 |
| Parasite Maintenance | 2nd instar | 710 |
| | 6th instar | 279 |
| Cooperators | | |
| Michigan State University, Carde | pupae | 2,760♂, 50♀ |
| University of Massachusetts, Barbosa | 3rd, 4th instar | 1,445 |
| | ♀ pupae | 1,400 |
| New York State Agricultural Experiment Station, Miller | pupae | 1,300 |
| Forest Service, Hamden, CT | 3rd, 4th instar | 13,055 |
| | ♂ adults | 4,894 |
| | ♀ adults | 1,510 |
| Franklin Institute, Goodman | ♂ pupae | 60 |
| BioServ | eggs | 3,252,000 |
| Pennsylvania, Reardon | ♀ pupae | 994 |
| Massachusetts | ♀ pupae | 995 |
| Maryland, McComb | ♀ pupae | 994 |

# REPELLENTS OF LATE INSTAR GYPSY MOTH LARVAE

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THE GYPSY MOTH, PORTHETRIA DISPAR (L.), FREQUENTLY SPREADS FROM INFESTED TO NON-INFESTED AREAS BY HITCH-HIKING ON RECREATIONAL EQUIPMENT AND TRANSPORTED MATERIALS. ANY OF THE DEVELOPMENTAL STAGES CAN BE TRANSPORTED IN THIS MANNER BUT PUPAE AND EGG MASSES POSE THE GREATEST PROBLEM.

IN 1973, A PROGRAM WAS INITIATED AT THE GYPSY MOTH METHODS DEVELOPMENT LABORATORY, OTIS AFB, MA., TO FIND CHEMICAL COMPOUNDS THAT WOULD PREVENT LATE INSTAR LARVAE FROM CRAWLING ONTO RECREATIONAL EQUIPMENT AND PUPATING, THEREBY REDUCING SPREAD BY PASSIVE TRANSPORTATION OF PUPAE AND EGG MASSES. IN THE CONTEXT OF THIS TALK, THESE COMPOUNDS ARE CONSIDERED REPELLENTS.

IN LABORATORY TESTS, 2 QT. CYLINDRICAL ICE CREAM CONTAINERS WITH GLASS PETRI DISH TOPS AND SCREEN BOTTOMS SERVED AS BIOASSAY CHAMBERS. THE CONTAINERS WERE LINED WITH STRIPS OF SUBSTRATE (CALLED INSERTS) 8.3" x 13.3" (21.1cm x 33.8cm), TREATED WITH CANDIDATE CHEMICAL COMPOUNDS. FIVE 5TH INSTAR MALE AND FIVE 6TH INSTAR FEMALE LARVAE WERE RELEASED INTO EACH BIOASSAY CHAMBER. AIR CIRCULATION FROM BELOW THE CHAMBERS WAS PERMITTED BY PLACING THEM ON HARDWARE CLOTH RACKS. OBSERVATIONS WERE MADE EVERY 1/2 HOUR FOR 6 HOURS WITH A FINAL OBSERVATION AT APPROXIMATELY 20 HOURS. FIVE REPLICATES AND 5 CONTROLS PREPARED WITH UNTREATED INSERTS WERE USED PER COMPOUND TESTED. LARVAE THAT AVOIDED THE INSERTS WERE CONSIDERED REPELLED.

APPROXIMATELY 167 ENT NUMBERED REPELLENTS AND 39 OTHER COMPOUNDS AND FORMULATIONS WITH REPELLENT PROPERTIES WERE SCREENED. AS A RESULT, 14 ENT AND 3 OTHER COMPOUNDS WERE SELECTED FOR FURTHER TESTING. THE RESULTS OF THE TESTS WITH THESE 17 COMPOUNDS ARE SHOWN IN TABLE 1. DOSAGES ARE EXPRESSED IN $mg/ft^2$ ($mg/929cm^2$). ACETONE WAS THE SOLVENT OR CARRIER. ONLY 2 ENT COMPOUNDS, ENT 18486 AND ENT 35700, MET THE 90% REPELLENCY STANDARD THAT WAS ARBITRARILY SET TO JUSTIFY FIELD TESTING. CHLORDIMEFORM SHOWED 82% REPELLENCY BUT WAS RETAINED FOR FURTHER TESTING BECAUSE OF GOOD RESIDUAL PROPERTIES. CHLORDIMEFORM IS AN INSECTICIDE AND ACARICIDE WITH REPORTED OVICIDAL AND REPELLENT PROPERTIES.

WHATMAN CHROMATOGRAPHY PAPER WAS USED AS THE TEST INSERTS IN THE INITIAL SCREENINGS. HEAVY CARDAULIN, LIGHT TENT CLOTH, AND TAR PAPER WERE THEN LABORATORY TESTED AS INSERTS SINCE THEY WOULD WITHSTAND FIELD CONDITIONS. REPELLENT EFFECTIVENESS FELL DRASTICALLY ON CARDAULIN AND TO A LESSER DEGREE FOR THE OTHER 2 MATERIALS. TAR PAPER WAS CHOSEN FOR FURTHER TESTS BECAUSE IT IS INEXPENSIVE AND READILY AVAILABLE.

THUS THE 3 COMPOUNDS THAT SHOWED PROMISE WHEN TESTED EARLIER ON CHROMATOGRAPHY PAPER WERE FURTHER EVALUATED, ALONG WITH 7 INSECTICIDES, ON TAR PAPER INSERTS. THE INSECTICIDES, SELECTED BECAUSE OF THEIR LOW TOXICITY TO NON-TARGET ORGANISMS, WERE TESTED TO DETERMINE IF THEY MIGHT REPEL OR CONTROL THE LARVAE WHEN USED SINGLY OR POSSIBLY IN COMBINATION WITH KNOWN REPELLENTS. THE RESULTS ARE SHOWN IN TABLE 2. THESE DATA LED TO THE REJECTION OF 4 OF THE 10 COMPOUNDS FOR FIELD TESTS, i.e., THE LAST 4 SHOWN IN THIS TABLE.

THE 3 COMPOUNDS TESTED ON TAR PAPER AT 1000 mg/ft$^2$ (1g/ft$^2$) WERE RETAINED FOR FIELD TESTS, i.e. ENT 35700 WITH 96% REPELLENCY, ENT 18486 WITH 82%, AND CHLORDIMEFORM WITH 64% REPELLENCY. CHLORDIMEFORM WAS AGAIN RETAINED BECAUSE OF ITS RESIDUAL PROPERTY. ENT 18486 WAS RETAINED BECAUSE IT HAD OUTPERFORMED ENT 35700 IN THE EARLIER TESTS.

THE INSECTICIDES SELECTED FOR FIELD TESTING WERE FMC 33297, SBP 1382, AND MGK PYRETHRINS WHICH SHOWED 98, 98, AND 92% REPELLENCY RESPECTIVELY, AT THE DOSAGES SHOWN IN TABLE 2.

DURING THE 1975 SEASON, FIELD TESTS WERE CONDUCTED USING THE 6 COMPOUNDS SELECTED BY LABORATORY TESTS. LARVAL TRAPS OF TAR PAPER, EACH 2090.32 cm$^2$ (324 in$^2$) WERE TREATED ON BOTH SIDES, FOLDED ONCE IN THE MIDDLE, AND FASTENED TO OAK TREES. A TOTAL OF 10 TRAPS, ONE PER TREE, WERE USED FOR EACH COMPOUND. AN UNTREATED TRAP WAS SIMILARLY PLACED ON THE OPPOSITE SIDE OF THE TREE FROM EACH TREATED TRAP AS A CONTROL. COUNTS OF THE NUMBERS OF LARVAE, PUPAE, AND EGG MASSES OCCURRING ON THE TRAPS WERE MADE ROUTINELY FOR THE REMAINDER OF THE SEASON.

THE RESULTS OF THESE 1975 FIELD TESTS ARE SHOWN IN TABLE 3. ONLY FMC 33297 AT 50 mg/ft$^2$ SHOWED ANY PROMISE (88% REDUCTION) IN PREVENTING LARVAE FROM CRAWLING ON TREATED TAR PAPER TRAPS TIED TO OAK TREES IN AN INFESTED AREA. IT DECREASED THE INCIDENCE OF LARVAE PUPATING ON THE TAR PAPER TRAPS 91% AND INCIDENCE OF EGG MASS DEPOSITION 95%. CHLORDIMEFORM FAILED AS A LARVAE REPELLENT (ONLY 43% REDUCTION), BUT DECREASED THE INCIDENCE OF LARVAE PUPATING ON TAR PAPER TRAPS BY 99% AND THE INCIDENCE OF EGG MASS DEPOSITION

89%. HOWEVER, A DOSAGE OF 1g/ft$^2$ FOR IT IS TOO HIGH TO CONSIDER FOR FIELD USE. THE OTHER 4 COMPOUNDS FAILED. PYRETHRINS AT A DOSAGE HIGHER THAN 5mg/ft$^2$, PERHAPS 50mg/ft$^2$, MAY BE MORE EFFECTIVE. THE 2 ENT COMPOUNDS FAILED TO GIVE THE DESIRED PROTECTION BECAUSE OF SHORT RESIDUAL ACTIVITY. SBP 1382 FAILED BECAUSE OF TOO LOW DOSAGE.

IN CONCLUSION, PROTECTION FROM LARVAE CRAWLING ON CHROMATOGRAPHY PAPER AND TAR PAPER IN THE LABORATORY WAS DEMONSTRATED BY THE SIX COMPOUNDS BUT ONLY FMC 33297 SHOWED PROMISE WHEN APPLIED TO TAR PAPER IN FIELD TESTS. THUS, NO REPELLENT OR INSECTICIDAL COMPOUNDS TO PREVENT GYPSY MOTHS (LARVAE, PUPAE, AND EGG MASSES) FROM BEING PASSIVELY TRANSPORTED CAN BE RECOMMENDED UNTIL FURTHER TESTS ARE RUN. HOWEVER, WE HAVE FOUND A DEFINITE LEAD THAT SHOWS PROMISE IN THE PYRETHROID COMPOUND 33297. OTHER PYRETHROIDS, AS WELL AS THIS ONE, SHOULD BE TESTED. SBP 1382, ALSO A PYRETHROID, SHOULD BE TRIED AT HIGHER DOSAGES AND CHLORDIMEFORM RETAINED BECAUSE OF ITS HIGH REDUCTION OF PUPAL AND EGG MASS INCIDENCE.

TABLE 1. REPELLENCY OF SELECTED COMPOUNDS AT 250 mg/ft$^2$ (SUBSTRATE = CHROMATOGRAPHY PAPER) 1/ 2/

| Compound | Repellency Maximum % | Repellency Time (Hrs.) 3/ |
|---|---|---|
| ENT 18486 | 98 | +20 |
| " 35700 | 88 | +20 |
| " 35769 | 82 | +20 |
| " 35522 | 80 | +20 |
| " 35771 | 70 | 5.5 |
| " 35770 | 68 | +20 |
| " 35614 | 58 | 6.0 |
| " 34288 | 34 | 0.5 |
| " 35768 | 28 | 6.0 |
| " 4203 | 20 | 0.5 |
| " 35898 | 18 | 0.5 |
| " 35645 | 16 | 0.5 |
| " 35659 | 12 | 1.5 |
| " 1016 | 8 | 4.5 |
| Chlordimeform (99.3%) | 82 | +20 |
| Paradichlorobenzene | 22 | 0.5 |
| Citral | 18 | 1.0 |

1/ Solvent: Acetone
2/ Used 5 replicates of 10 larvae, 5 of each sex
3/ Time in hours at which maximum repellency was recorded

TABLE 2. REPELLENCY OF SELECTED COMPOUNDS AT VARIOUS DOSAGES (SUBSTRATE = TAR PAPER)1/

| Compound | Dosage mg/ft$^2$ | Repellency Maximum % | Repellency Time(Hrs)2/ | Solvent |
|---|---|---|---|---|
| ENT 18486 | 1000 | 82 | +20 | Acetone |
| ENT 35700 | 1000 | 96 | 6.0 | " |
| Nor-Am Chlordimeform (99.3%) | 1000 | 64 | +20 | " |
| MGK Pyrethrins (20%) | 5 | 92 | 1.5 | " |
| FMC 33297 (3.2 EC) | 50 | 98 | 5.0 | " |
| SBP 1382 (24%) | 50 | 98 | 6.0 | " |
| TH 6040 (W 25) | 50 | 30 | 2.5 | " |
| CGA 18809 (97.8%) | 50 | 16 | 0.5 | " |
| CGA 18809 (50 WP) | 50 | 78 | +20 | $H_2O$ + Triton x 100 |
| Sandoz Thurcide (16B/gal) | 50 | 26 | 0.5 | " " " |
| Abbott Dipel WP (7.26b IU/lb) | 50 | 18 | 0.5 | " " " |

1/ Used 5 replicates of 10 larvae, 5 of each sex
2/ Time in hours at which maximum repellency was recorded

TABLE 3. EFFECTIVENESS OF COMPOUNDS IN REDUCING INCIDENCE OF GYPSY MOTH LIFE STAGES ON TAR PAPER TRAPS, 1975

| Compound | Dosage mg/ft$^2$ | Percentage of Reduction Larvae (5ths and 6ths) | Pupae | Egg Masses |
|---|---|---|---|---|
| FMC 33297 | 50 | 88 | 91 | 95 |
| Nor-Am Chlordimeform | 1000 | 43 | 99 | 89 |
| SBP 1382 | 50 | 22 | 70 | 43 |
| MGK Pyrethrins | 5 | 24 | 39 | 33 |
| ENT 35700 | 1000 | -28 | -22 | -9 |
| Ent 18486 | 1000 | 6 | -36 | -126 |