

JOURNAL OF ARBORICULTURE

March 1976
Vol. 2, No. 3

CURRENT CONTROL OF INSECT PESTS¹

by J. E. Appleby

Labeled Pesticides. Table 1 is a list of pesticides registered for use on ornamental plants. The pesticides are listed in alphabetical order according to their common names. Trade names are placed in parenthesis and capitalized. If the chemical has no common name the trade name is used. Applications of certain pesticides have restricted usages and are indicated by asterisk(s) or lower case letters following the name of the pesticide. Explanations appear as footnotes at the bottom of the table.

Under the heading of "Ornamental Plants" the plant names are listed as common or scientific names, and general categories. Notice such categories as *annual plants, Christmas trees, deciduous trees, eastern hardwoods, evergreens, forest trees, herbaceous plants, nursery stock, ornamental foliage plants, ornamentals, ornamental trees, shade trees, shrubs, trees, and woody plants.* After each plant category is listed the number of the corresponding pesticide(s) that is registered on that particular plant. The pesticide usage is as a foliar spray unless otherwise indicated by the upper case letters referring to the footnotes. Insects and mites are listed according to their common names. After each name the numbers correspond to the pesticide(s) that is registered for control use. As an example of how Table 1 can be used, the question may arise as to whether carbaryl can be applied to ash for the control of plant bugs. Note that no. 12 (carbaryl) is not included in the listing of numbers following ash, however, under the category of trees no. 12 is listed. As ash is a tree species, then it is safe to assume that carbaryl can be used. Under the heading of "Insects and Mites" note that no. 12

follows the plant bug listing, and therefore, it is legal to use carbaryl on ash to control plant bugs. I have only listed the pesticide information as it appears on the label, so it is very important to check the general categories as stated previously.

At the bottom of Table 1, the pesticides are arranged according to their oral and dermal toxicities. The footnote indicates the pesticide ranking according to toxicity.

There are many hundreds of insects that attack ornamental plants. I have chosen a few of the more important pests and give here a brief life history description and the control measures for each.

Bronze Birch Borer. The bronze birch borer is one of the most serious insect pests of white, paper, and yellow birch trees. Dieback, especially of the terminal branches, is a symptom of birch borer attack. Evidence of small ridges and bumps, as well as occasional "D" shaped holes in the bark of the affected branches or trunk, are additional proof of birch borer injury. It is not uncommon for heavily infested trees to die.

The bronze birch borer adult is a small beetle slightly more than $\frac{3}{4}$ inch in length and has a rather bronze appearance. In northern Illinois adults of the bronze birch borer emerge from the birch branches from late May into the 4th week of June, with the peak of emergence during the 1st week of June. A few days after their emergence the beetles mate and the female beetles deposit oval shaped eggs in crevices of the tree bark. The eggs hatch in a period of 10 to 14 days. The young larvae bore into the bark and

¹Paper presented at 51st International Shade Tree Conference, August 12, 1975, Detroit, Michigan.

begin feeding. The winter is passed as a light yellow larva inside the branch or trunk of a tree.

Table 2 summarizes the results of dimethoate (Cygon) sprays applied onto birch trees during the 1st and 3rd weeks of June for 2 consecutive years (Appleby et al. 1973). After 2 consecutive years, no beetles emerged from branches treated with dimethoate.

Ash Borer. Ash borer is becoming an extremely important pest of ash. During the months of August and September, as well as April and May in Illinois, frass can be found coming from tiny holes in trunks of infested ash trees. The borer overwinters in the larval stage and emerges as an adult moth in Illinois during the months of May and June. The adult moth is about 1 inch in length and dark purple with some rust-colored markings, especially near the base of the wings. The moth is very wasp-like in appearance as well as in behavior. Nielsen (1974) has been working several years on the life history and use of pheromones in studying this insect. In central Illinois from May to August, pheromone traps were placed among infested ash trees. The adult male ash borers are attracted to the sex pheromone and when they fly inside the traps, are caught in a sticky substance painted on the sides of the trap. Ash borer adults were caught from the 3rd week in May until the 1st week of July, with the largest number caught during the 3rd week in June. Although our control results are not yet completed, it appears that trees treated with Dursban during the 4th week in May and 2nd week of June are borer free.

Fall Cankerworm. The fall cankerworm feeds on many species of deciduous trees. When abundant the larvae may cause complete defoliation. In metropolitan areas people not only are annoyed by the damage to the trees, but usually are more disturbed by the larvae falling onto their sidewalks, patios, automobiles, and clothing. This insect overwinters in the egg stage. The tiny eggs can be found on the lower bark surfaces of the branches. The eggs hatch about the time the spring foliage appears. The larvae consume the foliage of the host plant, generally eating the entire leaves except for the main veins. When mature the larvae usually has a black stripe down

the back and the sides of the larva are slightly yellowish, however, the larvae vary considerably in coloration.

Control studies were conducted at the Morton Arboretum in northern Illinois, where selected tree branches heavily infested with cankerworms were sprayed with different insecticides and then enclosed in large nylon nesh bags (Appleby et al. 1974). Foliar sprays of the listed chemicals were applied on May 15 (Table 3). Three days later on May 18 the bags were removed and the larvae examined. Note that on May 18, with the exception of the *Bacillus thuringiensis* treatment, all other treatments gave 100% control. The larvae treated with *B. thuringiensis* were still alive on May 18, but were not feeding. However, 7 days later the *B. thuringiensis* treatment gave 100% mortality. Unfortunately, in some cities having municipal insect control programs, the public is not informed about the expected results of *B. thuringiensis* treatments and quickly conclude that the treatment is ineffective and demand that another insecticide be used. It is very important to know that sufficient time is required for the bacteria to invade the digestive tract of the cankerworms. The larvae stop feeding soon after an ingestion of the lethal dosage although they may remain alive. In areas that have had a history of cankerworm outbreaks, and where an abundance of larvae might result in great annoyance to the public, tree branches should be examined carefully for fall cankerworm eggs in late winter. The eggs appear as large masses of tiny kegs tightly packed against one another. If a large number of eggs are found, branches containing eggs should be pruned and held at room temperatures for about 2 or 3 weeks to ascertain their viability. If egg viability is high, control preparations should be planned. Unfortunately, in most municipal areas, public complaints are voiced when the larvae are mature and the damage has already occurred.

Mimosa Webworm. The matted foliage of honey locust and mimosa trees is a common sight in early summer until late fall in eastern and central regions of the United States. The insect responsible for this damage is the mimosa webworm. The webworm overwinters in the pupal stage in white cocoons on the trunk of the tree or

in nearby debris. In late spring the tiny gray moths emerge and the female moths deposit their eggs on the honey locust foliage. The eggs hatch and the tiny gray-yellow-green larvae begin constructing the characteristic mats of foliage.

Foliar sprays of insecticides applied in early July (Table 4) gave 100% control of the actively feeding larvae (Appleby et al. 1973). It is very important that this insect be controlled when the tiny webs are first noted on the tree, as larvae were not killed when insecticides were applied after the larvae had matured and finished feeding.

Schuder (1973) has found that certain clones of honey locust are much less susceptible to mimosa webworm attack (Table 5). The clone Moraine appears much less susceptible to attack than Imperial. Unfortunately, Moraine is the preferred host of the honey locust mite which is responsible for the near complete defoliation of that clone during the late summer and fall months. Shademaster or Skyline might be a better choice of honey locust clones so that there would be a compromise between mite and mimosa webworm susceptibility.

Gypsy Moth. The most serious defoliator of trees in the eastern half of the United States is the gypsy moth. During certain years thousands of forested acres are defoliated by the feeding of this pest. During the winter and early spring months in heavily infested areas the egg masses, which are covered with what appears to be brownish hairs, can be found on tree trunks and other debris. The mature larva is almost 2 inches long with brownish or gray background. Except for the first segment behind the larva's head, the upper surface of each segment has a pair of tubercles. The first 5 pairs are blue, the last 6 are a dark red. In heavily infested areas, roadways, the sides of buildings, picnic tables, and almost any object outside may be covered with the larvae and/or their droppings. In New Jersey, Kegg (1973) conducted a host preference study and found that all oak species are preferred by the gypsy moth larvae, especially the white oak and chestnut oak (Table 6). Trees that were not preferred were the white ash and the yellow birch. It might be wise for city governments to encourage future plantings of less preferred and nonpreferred tree species so that some tree specimens will not be attacked as severely as

others. Kegg stated that, in New Jersey, infestations build rapidly and severely defoliate the host trees for 2 or 3 consecutive years, then the population dramatically lapses. This is generally due to a very high incidence of virus disease. When the larvae die from the virus disease, they become very flaccid and hang from the branches. Kegg suggested that in new infestations of gypsy moth, if the objective is to prevent economic tree loss, direct control measures using chemical insecticides should be considered, especially when the forest is threatened with a second consecutive year of defoliation. Insecticides having label clearance for gypsy moth control are *Bacillus thuringiensis*, carbaryl (Sevin), Imidan, Phosvel, and trichlorofon (Dylox).

When the female gypsy moth emerges in early summer it gives off a very strong sex pheromone which attracts the male moth. When scientists found how to synthetically produce the sex lure it opened a new frontier on gypsy moth control. This method is the application of a sex lure to prevent male moths from finding the female moths. Beroza et al. (1974) conducted such an experiment in Massachusetts using Disparlure, the sex pheromone of the gypsy moth. Two separate 24 square miles of forested lands infested with the moth were chosen. One area was left untreated. The other area was treated with an aerial spray application of Disparlure. In each of the areas baited traps containing the sex lure were distributed. In the untreated area, 2,193 male moths were caught in the baited traps, whereas in the treated area most of the males were confused as to finding the female moths or the sex lure and only 63 male moths were caught. Similarly, when live females were placed in baited traps in the untreated area, 1,136 male moths were caught, whereas in the treated area, only 1 male moth was caught. These data indicate the potential use of microencapsulated Disparlure for suppressing low level gypsy moth populations. Beroza and Knipling (1972) stated that a reasonable strategy is to suppress the gypsy moth population to a very low level by applying an insecticide to larvae emerging in the spring, and then following with an application of Disparlure microcapsules during the mating season to prevent males from finding female survivors.

Spruce Needleminer. There are several insect species that act as needleminers in spruce, however, they all have similar life histories. The larvae overwinter as tiny leafminers and in the spring begin feeding on the needles and incorporating them into web mats. When such a nest is pulled apart, a greenish larva is often found inside. After completing the feeding, the larvae change into the pupal stage and a few weeks later to the adult stage. Adult moths emerge in the spring and lay their eggs on the spruce needles.

Tests conducted by Tashiro (1974) in New York have shown that when foliar sprays were applied in late June to spruce trees heavily infested with needleminers most of the insecticides gave very good control (Table 7). None of the insecticide treatments resulted in any phytotoxicity to the spruce.

Eastern Spruce Gall Aphid. Another pest common on species of spruce is the eastern spruce gall aphid. Close up the galls resemble tiny pineapples. The immature aphids overwinter on the lower surfaces of the branches. In the spring the aphids mature and produce large numbers of eggs. These eggs hatch and the tiny nymphs crawl to the galls and begin feeding inside. In the fall months the adult aphids emerge from the galls and produce the eggs which later hatch into the overwintering nymphs. Cameron et al. (1973) in Pennsylvania found that when foliar sprays were applied in early spring before the aphids began producing their eggs that carbaryl and diazinon gave particularly good control (Table 8). Later, when the aphids began producing eggs, treatments were not very effective. In October, after all the eggs had hatched, Cameron found that insecticide applications gave extremely good control (Table 8). None of the treatments resulted in any symptoms of phytotoxicity.

Table 1.—A list of some pesticides registered on ornamental plants.

PESTICIDES

Code No.	Pesticide
1	acephate (Orthene)
2	aldicarb (Temik)*
3	aldrin 20G
4	Aldrite
5	azinphosmethyl (Guthion)

6	Azodrin 3.2*
7	Bidrin 2EC* a/g/
8	<i>B. thuringiensis</i> (Biotrol-Plus)
9	<i>B. thuringiensis</i> (Biotrol XK)
10	<i>B. thuringiensis</i> (Dipel)
11	<i>B. thuringiensis</i> (Thuricide)
12	carbaryl (Sevin)
13	carbofuran (Furadan)
14	carbophenothion (Trithion)
15	chlordane
16	chlorobenzilate (Acaraben)
17	chlorpyrifos (Dursban)
18	dieldrin 1.5 EC* *
19	demeton (Systox)*
20	diazinon (Spectracide)
21	dichlorvos (Vapona)
22	dicofol (Kelthane)c/
23	dimethoate (Cygon)
24	disulfoton (Di-Syston)*
25	endosulfan (Thiodan)
26	endrin
27	ethion
28	fensulfothion (Dasanit)*
29	fenthion (Baytex & Entex)*
30	heptachlor
31	Imidanb*
32	Inject-A-Cide B (Bidrin)e/
33	Inject-A-Cide (Metasystox R)* d/
34	Karathane
35	malathion (Cythion)
36	Mesuroil
37	methomyl (Lannate)
38	methoxychlor (Marlate)
39	Morestan
40	Nemagonf/
41	Nudrin
42	oxydemetonmethyl (Metasystox-R)
43	Pentac
44	Phosdrin
45	Phosvel
46	Pirimor
47	Plictran
48	Pyrenone
49	tetradifon (Tedion)
50	trichlorofon (Dylox & Proxol)
51	trichlorofon (Dylox + oil)
52	Zectran

ORNAMENTALS AND PLANTS

Plant	Labeled Pesticide
Acacia	1
African violet	14,34,40(J),48
Ageratum	1,40(J)
Alder	1
Almonds	47
Aloe	28(A),40(J)
Alyssum	1,45
Annual plants	12
Aralia	40(J)
Arborvitae	1,7,12,14,15,16,20,27,29 31,40(J),43
Ardisia	28(A),40(J)
Ash	1,29,31,32(N)

Asparagus fern	14	Dogwood	1,12,25,29,31,40(J)
Aspen	12(F),29	Douglas fir	6,20,25,33(N)
Asters	1,8,34,40(J),48	Dracaena	40(J)
Azalea	1,7,12,14,16,20,23,28(A),40(J),43(I)	Dwarf Japanese holly	28(A)
Baby tears	40(J)	Dwarf yaupon	28(A)
Beech	1,12(G),14,31	Easter lily	28(A)
Begonia	1,14,29,34,40(J),48	Easter lily (greenhouse)	2(A)
Belladonna	34	Eastern hardwoods	12(F)
Bignonia	14	Eastern redbud	1
Birch	1,2(A),12,20,23,29,31	Elms	12,14,15,18,20,31,32(N),33(N),40(J)
Bird-of-paradise	14	Eucalyptus	14
Black cherry	1	Euonymus	1,7,14,23,28(A),29,34,40(J)
Black gum	1	Eurya	28(A)
Black locust	14	Euryops	1
Blue mist	28(A)	Evergreens	17,18,52
Bottlebrush	1	Ferns	1,8,14
Bougainvillea	28(A)	Ficus (Cuban Laurel)	1
Boxelder	1,25	Fig	22
Boxwood	1,14,20,23,28(A),40(J)	Firs	1,14,31
Butterfly iris	28(A)	Flowering almond	1
Candlesticks	7	Flowering cherry	1,40(J)
Cactus	14,40(J)	Flowering currant	14
Caladium	40(J)	Flowering plum	1
Calceolaria	8	Flowering quince	1
Calendulas	1,8,34	Flowers	6,9,11,17,18,19(E),22,24(A),26,35,38,39,42,50,52
Callas	8	Forest trees	5,10,24(A),45,51(F)
Callistephus	14	Fuchsia	14
Calluna (heather)	14	Gallardia	1
Camellias	1,7,14,15,20,23,28(A),40(J),48	Galberry	28(A)
Carnations	1,8,12,14,20,43(I),48	Gardenia	1,7,14,28(A),40(J),43(I)
Carnations (greenhouse)	2(A),47	Geranium	1,8,29,48
Catalpa	1	Gerbera	1,34
Cedar	1,14,31	Gerbera (greenhouse)	2(A)
Celosia	1	Gladiolus	1,12,20,23,28(A),40(J),45,48
Century plant	28	Gloxinia	28(A)
Cherry laurel	1	Godseffiana	40(J)
Cherry tree	25	Greenhouse plants	25
Chinese hibiscus	28(A)	Guava	12
Chinese elm	1	Hackberry	1,7(N)
Chinese holly	1	Haworthia	40(J)
Choke cherry	1	Hawthorn	1,14,15,20,31
Christmas trees	42	Hemlock	1,12(F),14,16,23,31,43
Chrysanthemums	1,7,8,12,14,19(E),20,29,34,37,40(J),42(E),43(I),48	Herbaceous plants	12
Chrysanthemums (greenhouse)	2(A),28(A),43,47	Hibiscus	1,7,40(J)
Chrysanthemums (commercial plantings)	41	Hickory	1,31
Cinerari	2(A),8,14	Holly	1,2(A),7,14,15,16,20,28(A),40(J)
Coleus	1,14	Hollyhock	1,14
Columbine	1	Holly leaf osmanthus	28(A)
Cosmos	14	Honey locust	1
Cotoneaster	14	Honeysuckle	28(A)
Cottonwood (commercial)	13(D)	Hydrangea	12,14,34
Cottonwood (nursery)	13(D)	Ilex	7
Crapemyrtle	1,7	Impatiens	1
Croton	1,14,28(A),40(J)	Iris	25
Cuban laurel	42(E)	Ivy	1,14,40(J)
Cyclamen	28(A)	Ixora	7
Cypress	1	Jade plant	40(J)
Daffodils	19(E)	Japanese yew	28(A)
Dahlias	1,2(A),8,14,34,42(E),48	Jasmine	14,28(A)
Daisy	1	Jungleflame	28(A)
Daylily	1	Juniper	1,7,12,14,15,20,23,28(A),29,31,40(J)
Deciduous trees	6	Kalanchoe	1
Delphinium	14,34,40(J),43(I)	Lantana	1,14
Dianthus	1	Larkspur	34
Dieffenbachia	1,40(J)	Laurel	1

Ligustrum	40(J)
Lilac	12,14,20,25,34,40(J)
Lilies	2(A),8,14,19(E),29
Linden	1,14,32(N)
Locust	1,20
Magnolia	1,14,15
Mahonia (Calif. barberry)	1,28(A),40(J)
Maples	1,12(G),15,20,29,31,40(J)
Marigolds	1,29,48
Metrosideros	28(A)
Mimosa	1,20
Moonflower	14
Mountain ash	14
Myrtle	14
Narcissus	50
Nasturtium	14,30
Natal plum	28(A)
Norfolk Island pine	14
Northern hardwoods	12(G)
Nursery crops	18,40(J)
Nursery ornamentals	26
Nursery plants	5
Nursery stock	3(A),5,18,22,43,49(H)
Nursery trees	42
Oak	1,12,15,20,29,31,32(N),40(J)
Oleander	1,14
Orchids	14
Orchids (greenhouse)	2(A)
Ornamental foliage plants	28(A),45
Ornamental pear	1
Ornamentals	3(A),5,9,11,17,18,22,28,40(J),47,49(H)
Ornamental trees	31
Palms	1,14
Pansy	1,14
Pecans	5,27
Peony	29,40(J)
Periwinkle	1
Petunia	1,29
Philodendron	40(J)
Phlox	1,14,29,40(J)
Photinia	1
Pine	1,7,12(G),14,20,23,25,30,31,32(N),40(J)
Pine seedlings	13(D)
Pittosporum	1,14,40(J)
Plum	1,20,22,25,31
Poinsettia	1,14,43(I)
Poinsettia (greenhouse)	2(A),47
Poplar	1,14,20
Primrose	14,19(E)
Privet	1,7,14,15,28(A),40(J)
<i>Prunus</i> spp.	14
Pyracantha (firethorn)	1,14,28(A)
Red leaf barberry	28(A),40(J)
Rhododendron	14,15,20
Roses	1,2(A),7,8,12,15,20,23,28(A), 40(J),42(E),43(H),48
Roses (greenhouse)	2(A),34,40
Rubber plant	14
Sago palm	14
Salvia	1
Sasangua	7
Sassafras	1
Shade trees	5,9,11,17,20,25,26,31,35,36, 38,42,50,51(F)
Shrubs	1,11,12,17,18,19(E),24(A),25,27,35, 36,38,39,42,50,52

Siberian elm	1
Silver maple	1
Slash pine	5
Small-leaf spirea	1,40(J)
Snapdragon	1,8,14,29,34,43(I)
Snapdragon (greenhouse)	2(A)
Spirea	1
Spruce	1,6,12(F),16,20,25,27,29,31,40(J),43
Staghorn sumac	1
Sumac	1
Surinam cherry	28(A)
Sweet bay	15
Sweetgum	1,29
Sweet peas	8,14
Sycamore	1,14,32(N)
Trees	12,17,18,19(E),24(A),42,50,52
True fir	31
Tulip tree	29
Verbena	29
Viburnum	1,28(A),29,40(J)
Vinca	1
Vines	17,52
Violets	14,40(J)
Walnuts	5,12,16,27,39,44,47
Willow	1,15,20,31
Woody plants	12
Yaupon	1
Yew (<i>Taxus</i>)	1,7,15,16,27,28(A),29,31,40(J)
Zinnia	1,12,29,43(I)

INSECTS AND MITES

Pest	Labeled Pesticide
Andromeda lace bug	45
Ant	18,29
Aphid	1,2(A),5,6,7,8,14,17,19(E),20,23,24(A), 25,27,29,32(N),35,39,42(E),44,46,48,52
Aphid (greenhouse)	2(A),25
Apple & thorn skeletonizer	20
Apple aphid	12,14
Arborvitae leafminer	20
Armyworm	29,45,50,52
Ash borer	17
Ash hornworm	1
Azalea leafminer	20,45
Azalea scale	35
Bagworm	1,7,10,12,14,15,17,18,23,29,35,50
Barberry looper	1
Beet armyworm	37,40,45
Birch leafminer	12,18,19(E),20,24(A),31(K),35,42,45,52
Birch sawfly	1
Black bean aphid	14
Black nut casebearer	25
Black pecan aphid	25
Black pine leaf scale	5
Black scale	1
Black scale crawler	14,35
Black vine weevil	15,18,25
Blister beetle	12,18,38
Boisduval's scale	14
Borer	15
Boxelder bug	12,25
Boxwood leafminer	12,19(E),20,35,45
Brownheaded ash sawfly	1
Brown mite	27

Brown soft scale	5	Foliar nematodes	19(F)
Cabbage looper	1,6,8,10,37,41	Forbes scale	14
Calendula budworm	1	Forest tent caterpillar	1
Calico scale	12	Fourlined leaf bugs	35
California oak worm	1	Frosted scale	12
California red scale	14	Fruit tree leafroller	12,44
Camellia scale	7,19(E),23,24(A)	Grasshopper	17,18
Canadensis mite	49(H)	Great basin tent caterpillar	11(M),12(F)
Carnation bud mite	20	Greedy scale	14
Carnation shoot mite	20	Green peach aphid	6,46
Carpini mite	49(H)	Gypsy moth	1,9,10,11(K),12(G),31(K),45
Catalpa sphinx moth	1	Gypsy moth larvae	1,10,11(K),51(F)
Cerococcus scale	5,7	Hackberry psyllid	32(N)
Cherry laurel leaf-tier	1	Hemispherical scale	1,14
Citricola scale	14	Hemlock chermes	20
Citrophilus mealybug	14	Hemlock scale	1,23
Citrus mealybug	14	Hickory shuckworm	5
Citrus red mite	14	Holly bud moth	20
Citrus rust mite	14	Holly leafminer	18,19(E),20,24(A),42
Clearwing borer	13(D)	Honey locust pod gall midge	1
Climbing cutworm	18,50	Imported cabbage worm	8,10
Clover mite	16,20,46	Iris borer	25
Codling moth	5,12	Ivy scale	14
Cone midge	5	Jackpine budworm	45
Cone moth	5,33(N)	Japanese beetle adult	12,15,18,35,38
Coneworm	5	Japanese wax scale crawler	1
Cooley spruce gall aphid	25	June beetle adult	12,18
Corn earworm	37,41	Juniper scale	5,27,29,35
Cotoneaster webworm	20	Juniper webworm	20
Cottonwood leaf beetle	13(D)	Juvenile dusky wing moth	1
Cottonwood twig borer	13(D)	Kuno scale	1
Cottony cushion scale	1,14,20	Lace bug	1,2(A),5,12,15,18,19(E),23,24(A),35
Cottony maple scale	27	Larch sawfly	45
Cottony scale	7	Latania scale	14
Cuban laurel thrips	1,6	Leaf beetle	15
Cucumber beetle	38	Leafhopper	2(A),5,6,12,17,20,24(A),29,38,42,48,52
Cutworm	17,52	Leafhopper (nymphs)	8
Cyclamen mite	20,26	Leafminer	1,2(A),6,7,15,23
Cyclamen mite (greenhouse)	25	Leafroller	1,8,11,12
Cypress tip moth	1	Lecanium scale	14,20,27,29
Desert mite	22	Lilac borer	18,25
Dipterous leafminer	20,50	Looper	52
Dogwood borer	18,25	Lygus bug	50,52
Douglas fir needle midge	25	Magnolia scale	27,35
Dusky sawfly	1	Maple shoot moth	1
Eastern tent caterpillar	1,17	McDaniel mite	14,49(H)
Elm bark beetle	18	Mealybug	1,12,17,19(E),20,23,35,52
Elm leaf aphid	12	Mealybug (greenhouse)	2(A)
Elm leaf beetle	1,12,18,24(A),32(N),33(N)	Mexican long-tailed mealybug	14
Elm spanworm	10,31(K)	Millipede	12
Euonymus scale	5,7,20,23,27,35	Millipede (in greenhouse)	27
European elm scale	5,24(A),27,32(N)	Mimosa webworm	1,12,17,20,24(A)
European fruit scale	37	Mite	2(A),5,6,7,17,19(E),20,22,23,24(A),27,29,39,42(E),44,52
European fruit lecanium scale	12	Mite eggs	39
European pine sawfly	1,32(N),45	Monterey pine aphid	14
European pine shoot moth	5,14,20,23,25,49(H),52	Monterey pine scale	35
European red mite	16,20,22,47	Myzocalles aphid	32(N)
Fall cankerworm	1,10,11,12(F),18,38	Nantucket pine tip moth	1,5,23,50
Fall webworm	1,10,11,17,18	Narcissus bulb fly	30,50
Filbert worm leafroller	12	Nematodes	2(A),28(A),40(J)
Flea beetle	12,18,20,38,45,48	Nesting pine sawfly	1
Fleahopper	38	Nipple gall psyllid	32(N)
Fletcher scale	35	Oak kernes	35
Florida red scale	14,35	Oak leafminer	12,20
Flower thrips	1,38		

Oak lecanium scale	17	Southern pine beetles (spp)	32(N)
Oak looper	20	Southern red mite	16
Oak moth larvae	11	Spider mite	1,2(A),27,35
Oblique-banded leafroller	1	Spider mite (greenhouse)	2(A)
Obscure root weevil	20	Spiny elm caterpillar	1
Obscure scale	32(N)	Spring cankerworm	1,10,11,18,31(K)
Oleander aphid	14	Spittlebug	1,17,18,26
Oleander caterpillar	1	Spruce budworm	45
Olive parlatoria scale	14	Spruce gall aphid	25
Olive scale	5	Spruce spider mite	14,16
Omnivorous leafroller	7,40	Stink bug	50
Omnivorous leaf-tier	20	Sunflower moth	1
Omnivorous looper	1	Sweetgum leaf-tier	1
Orange-striped oakworm	1,17	Sycamore leaf-tier	1
Orange tortrix	12,44	Sycamore scale	32(N)
Oystershell scale	5,7,14,27,35	Tarnished plant bug	35,50
Pacific spider mite	47	Taxus bud mite	25
Pales weevil	13(D)	Taxus mealybug	7
Peach tree borer	25	Tea scale	1,7,17,18(E),24(A)
Pear slug	20	Tent caterpillar	11,12,15,18,20,35,38
Pecan casebearer	5	Texas citrus mite	14,49(H)
Periodical cicada	12	Thorn bug	12
Pine leaf scale	35	Thrips	1,2(A),5,6,7,12,15,17,18,20,24(A),35,37,41,42(E),52
Pine needle scale	1,17,20,27,35	Tobacco budworm	1,6,50
Pine sawfly	1,7	Tree cricket	15
Pine spittlebug	18,32(N)	Tropical mite	49(H)
Pine tip moth	7	Tulip tree scale	27
Pine tortoise scale	1	Tussock moth	1
Pine tube moth	1	Twig girdler	5
Pink bark aphid	14	Twospotted spider mite	1,14,16,20,22,27,45,49(H)
Pitch eating weevil	13(D)	Variable oak leaf caterpillar	1
Pit-making scale	32(N)	Viburnum plant hopper	1
Pit scale	20	Walnut aphid	27
Plant bug	6,12,18	Walnut caterpillar	1,5
Poplar tentmaker	1	Walnut husk fly	27
Potato leafhopper	1,14,35	Wax scale	35
Privet mite	20	Western tussock moth	44
Privet thrips	45	Whitefly	1,2(A),7,8,17,19(E),20,23,24(A),35,42,52
Psyllid	1,12,18	Whitefly (greenhouse)	2(A),25
<i>Pulvinaria</i> scale	5	White peach scale	17
Puss caterpillar	12	White pine weevil	30,42
Putnam scale	5,14	Willow leaf beetle	1,12,15
Redheaded pine sawfly	1	Woolly apple aphid	14
Redhumped caterpillar	1,11(L),12,17	Yellownecked caterpillar	1,17
Red pine sawfly	52	Yellow scale	14
Red spider mite	32(N),34	Yellow striped armyworm	1
Rhododendron scale	19(E)	Yuma mite	14
Rose aphid	12,14	Zimmerman pine moth	23,25,50
Rose chafer	18,38		
Rose leafhopper	35	X = foliar	
Rose slug (sawfly)	12,38	A = granular	
Rose stem sawfly	1	B = drench	
Rosy apple aphid	14	C = clay slurry	
Rosy maple moth	1	D = clay slurry or granular	
Saddled prominent caterpillar	1,12(F)	E = drench or foliar	
San Jose scale	14,20,27,31	F = aircraft application only	
Sawfly	6,18	G = aircraft or foliar	
Scale crawler	50(J),52	H = greenhouses and outside	
Scurfy scale	27,35	I = greenhouses only	
Seedworm	5	J = soil fumigant	
Sixspotted mite	14	K = Northeast states only	
Soft brown scale	19(E)	L = California only	
Soft scale	5,14,20,24(A),27,35,52	M = Western United States only	
Southern armyworm	1	N = injection	
Southern green stink bug	5		

- a/ Do not use this product for implant treatments of trees or ornamentals.
- b/ Commercial applicators only in northeastern states.
- c/ For use in greenhouses or outdoors.
- d/ All government and private application organizations must be approved by the J.J. Mauget Company.
- e/ For use only under the supervision of personnel specifically trained in the use of Bidrin insecticide as an implant in elm trees as specified in Shell Chemical Company's Instruction Manual ACD: 64: 64-100.
- f/ Additional plants may have label clearance.
- g/ No longer labeled by Shell.
- * For use by commercial growers or professional applicators only — read label.
- ** For use only by commercial spray operators and nurserymen.

CHEMICAL TOXICITY

Oral LD	Chemical	Dermal LD ₅₀
2-6	demeton (Systox)	8-14
2-7	disulfoton (Di-Syston)	6-15
2-11	fensulfoton (Dasanit)	3-30
4-6	Phosdrin	4-5
5-10	aldicarb (Temik)	1,400
8-14	carbofuran (Furadan)	10,200
8-18	endrin	15-18
10-30	carbophenothion (Trithion)	27-54
11-13	azinphosmethyl (Guthion)	220
17-24	methomyl (Lannate)	1,500
18-43	endosulfan (Thiodan)	74-130
20	Nudrin	—
21	Azodrin 3.2	354
22	Bidrin 2 EC	225
25-37	Zectran	1,500-2,500
27-65	ethion	62-245
56-80	dichlorvos (Vapona)	75-107
65-75	oxydemetonmethyl (Metasystox-R)	250
76-108	diazinon (Spectracide)	455-900
91	Phosvel	800
97-276	chlorpyrifos (Dursban)	2,000
100-162	heptachlor	195-225
130-135	Mesurol	200
147	Pirimor	—
147-216	Imidan	3,160
173	Nemagon	2,400
215	dimethoate (Cygon)	400-610
215-245	fenthion (Baytex & Entex)	330
335-430	chlordan	690-840
500-850	carbaryl (Sevin)	4,000+
560-630	trichlorofon (Dylox)	2,000+
700	chlorobenzilate (Acaraben)	—
866-945	acephate (Orthene)	2,000+
980-1,190	Karathane	4,700-9,400
1,000	Pyrenone	—
1,000-1,100	dicofol (Kelthane)	1,000-1,230
1,000-1,375	malathion (Cythion)	4,444
1,100-1,800	Morestan	2,000+
1,675	Plictran	—
3,160	Pentac	3,160+
5,000	methoxychlor (Marlate)	6,000+
14,700	tetradifon (Tedion)	10,000

50 or less = very high toxicity
 50-150 = moderately high toxicity
 150-750 = moderate toxicity
 750 or greater = low toxicity

Table 2. Effectiveness of insecticidal sprays applied to white birch trees at the Morton Arboretum, Lisle, Ill. for control of the bronze birch borer. Sprays applied June 3 and 20, 1969; June 3 and 24, 1970.

Treatment	Rate of 100 gal water	No. adults emerging from branches		
		1970	1971	Total
Dimethoate (Cygon) 2 EC	1 qt	2	0	2
Untreated	—	13	32	45

Table 3. Effectiveness of insecticidal sprays applied to trees at the Morton Arboretum, Lisle, Ill. for control of the fall cankerworm. Sprays applied May 15, 1973.

Treatment	Rate per 100 gal water	Mortality	
		May 18	May 25
Acephate (Orthene) 75SP	1.3 lb	100%	—
<i>B. thuringiensis</i> (Dipel)	0.5 lb	0%	100%
Carbaryl (Sevimol) 4E	1 pt	100%	—
Malathion 5EC	1 qt	100%	—
Untreated	—	0%	0%

Table 4. Results of foliar sprays of insecticides applied to honey locust trees heavily infested with mimosa webworm larvae on July 10, 1970, Urbana, Ill.

Treatment	Rate per 100 gal water	Mortality July 21
Diazinon 25E	1 qt	100%
<i>B. thuringiensis</i> (Dipel)	1 lb	100%
Acephate (Orthene) 75SP	1.3 lb	100%
Carbaryl (Sevimol) 4E	1 pt	100%
Malathion 5EC	1 qt	100%
Check	—	0%

Table 5. Susceptibility of honey locust clones to mimosa webworm and honey locust mite.

Clone	Webworm colonies	Mites
Moraine	9	71
Skyline	18	32
Shademaster	19	21
Sunburst	27	33
Imperial	38	34

Table 6. Classification of some tree hosts according to feeding preference by the gypsy moth in New Jersey by Kegg (1973).

<i>Highly preferred</i>	<i>Preferred</i>
White oak	Red oak
Chestnut oak	Black oak
	Scarlet oak
	Eastern hemlock
<i>Less preferred</i>	<i>Nonpreferred</i>
Red maple	White ash
Bitternut hickory	Yellow birch
Black birch	
Sugar maple	

Table 7. Spruce needleminer control on nursery-grown spruce in New York, with foliar sprays applied on July 24, 1974.

Treatment	Rate per 100 gal water	Control on Sept. 2
Dizainon 4EC	1 pt	100%
Carbaryl (Sevimol 4)	1 pt	100%
Trichlorofon 80WP	1¼ lb	100%
Oxydemetonmethyl 25EC	1 pt	17%
Check	—	48%

Table 8. Control of the eastern spruce gall aphid with foliar sprays of insecticides applied in Pennsylvania in 1973.

<i>Application April 23 before eggs produced</i>		
Treatment	Rate per 100 gal water	Average galls per tree in June
Carbaryl (Sevin) 80WP	1¼ lb	.5
Diazinon 2EC	1 qt	6
Acephate (Orthene) 75SP	1.3 lb	34
Untreated	—	41

<i>Application October 15 after eggs hatched</i>		
Treatment	Rate per 100 gal water	Reduction
Carbaryl (Sevin) 80S	1¼ lb	100%
Chlorpyrifos (Dursban) 4EC	1 pt	100%
Diazinon 2EC	1 qt	100%

Literature Cited

- Appleby, J.E., R. Randell, and S. Rachesky. 1973. *Chemical control of the bronze birch borer*. J. Econ. Entomol. 66: 258-9.
- Appleby, J.E., P. Bristol, and W. Eickhorst. 1974. *Control of the fall cankerworm*. J. Econ. Entomol. 68:233-4.
- Appleby, J.E., S. Pearse, and C. Chen. 1973. *Mimosa webworm control*. Nursery Business 18: 90.
- Beroza, M., C. Hood, D. Trefrey, D. Leonard, E. Knipling, and W. Klassen. 1974. *Large field trial with microencapsulated sex pheromone to prevent mating of the gypsy moth*. J. Econ. Entomol. 67:659-664.
- Beroza, M., and E. Knipling. 1972. *Gypsy moth control with the sex attractant pheromone*. Science 177: 19-27.
- Cameron, E.A., R. Campbell, and L. Adams. 1973. *Insecticidal control of Adelges abietis in Pennsylvania*. J. Econ. Entomol. 66:811-12.
- Kegg, J.D. 1973. *Oak mortality caused by repeated gypsy moth defoliations in New Jersey*. J. Econ. Entomol. 66: 639-41.
- Nielsen, D.G., and F. Purrington. 1974. *Flight periods of Podosesia and comments on the monotypic status of the genus (Lepidoptera: Sesiidae)*. Ann. Entomol. Soc. Amer. 67:959-960.
- Schuder, D.L. 1973. *Indiana nurserymen tour Purdue research plots*. Amer. Nurserymen 138(5): 10.
- Tashiro, H. 1974. *Biology and control of the spruce needleminer*. J. Econ. Entomol. 67:89-92.