versity of California representative in Washington and of Senator John Tunney. In January, 1976, I wrote to an Egyptian colleague who was stationed in Riyadh, Saudi Arabia, asking for shipment of *Aphytis* but nothing came of this.

Foreign exploration plans for 1977 emphasized acquisition of the Saudi Arabian *Aphytis* as well as search in the stringent climatic zones of southern Iran, Pakistan, and India. My colleague, Chuck Kennett of the Division of Biological Control, Berkeley, agreed to undertake this trip.

After finally obtaining a visa, Kennet left for Saudi Arabia in May, 1977. His first shipment of parasitized *Aonidiella orientalis* and living specimens of *Aphytis* arrived at Riverside on May 26, 1977; a second shipment arrived on May 30. Both were from Riyadh or nearby localities.

From 17 original female specimens a culture of this *Aphytis* was successfully started on the California red scale as well as on the oleander scale, *Aspidiotus nerii* Bouche, in our quarantine facility. Microscopic examination of the specimens showed them to be identical taxonomically to the original specimens sent by H.E. Martin and to consist only of females. Thus this population is reproductively isolated from *A. melinus*, its closest relative, and is, at least functionally, a new species.

Releases

The culture was released from quarantine July 8, 1977, and was built-up as rapidly as possible for field colonization in the summer and fall, especially in interior climatic zones, and the San Joaquin and Imperial valleys. The first small releases (24 females) were made July 13, 1977 on California red scale-infested citrus trees in the San Bernardino County area of Loma Linda. Immediate interest in, and oviposition on, California red scale was observed, indicating that this scale is a preferred host for the new *Aphytis*. More releases in all areas will follow as the culture is expanded. It will be at least six months before we have any indication as to whether this parasite may become a significant addition to the complement of California red scale natural enemies in the field, but it appears to be the most hopeful prospect imported in several years.

As a sort of bonus, the parasitized oriental scale material from Riyadh also yielded live specimens of *Habrolepis rouxii* Compere and *Aspidiotiphagus citrinus* (Crow). These parasites are currently being cultured in quarantine on California red scale. Following their release from quarantine, they will be colonized in the field. Both have been imported from other countries previously and released in California, but the new cultures might represent geographical races possessing different genetic capabilities.

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Aphid control on chrysanthemums and carnations

Ronald D. Oetting ■ Frank S. Morishita ■ Roland N. Jefferson ■ Wesley A. Humphrey ■ Seward T. Besemer

Aphids commonly occur as pests on chrysanthemums and carnations as well as on many other plants grown in plastic or glass houses in California. They are usually found in colonies on plant tips, shoots of new growth, or flowers. Aphids multiply so rapidly under favorable conditions that a light infestation may increase to alarming proportions in a week. They are generally more numerous during cooler months when the most serious damage occurs. However, damage can be observed throughout the year.

Aphids injure plants by inserting their long proboscis or beak into the plant tissue and sucking out the juices. Feeding on new leaves causes the leaves to curl or crinkle, and plants become stunted or may die. Also, honeydew secretions from the aphids drop to the lower leaves forming a shiny, sticky coating. These honeydew deposits attract ants and promote the growth of black smut fungus causing a black or sooty, unsightly appearance. Aphids can transmit several plant virus diseases. For example, the green peach aphid transmits carnation streak and several other viruses.

In this investigation, several insecticides were evaluated for: (a) aphid pest control on chrysanthemums and carnations grown for cut flowers, and (b) phytotoxicity. On February 29, 1972 Pompon (Hurricane variety) chrysanthemums in the tight bud stage were treated with four insecticides for the green peach aphid (*Myzus persicae*) and the leaf curl plum aphid (*Brachycaudus helichrysi*) in El Modeno, California (table 1). Separate plots were established for phytotoxicity observations of four compounds on 19 chrysanthemum varieties. On June 1, 1972 four compounds were tested on chrysanthemums in propagating beds in Encinitas, California for leaf curl plum aphid control (table 2) and 26 varieties were sprayed with Pirimor for phytotoxicity observations. In 1974, on February 7, 11 different treatments were applied on carnations in Encinitas, California for green peach aphid control (table 3). Three insecticides were sprayed on 8 carnation varieties at the same location at 2 and 4 week intervals between April 19, 1974 and April 12, 1975 for phytotoxicity observations. A total of 15 applications were applied on each plot.

In three experiments, Pirimor and Orthene gave effective and long-lasting aphid control. No phytotoxicity was ob-

served, except on 2 Hurricane varieties of chrysanthemum sprayed with Furadan.

Test plots

Plants were maintained by the owner and grown in polyethylene plastic houses in standard ground beds except in one experiment (table 2), in which propagation beds were of peat moss and perlite. Treatment replicate areas on chrysanthemums were 300 square feet in El Modeno and 270 square feet in Encinitas, arranged in a randomized block design. There were three replications in each experiment. The phytotoxicity tests on carnations were not replicated and the treatment areas were 6,375 square feet each for Pirimor and Orthene treatments and 10,500 square feet each for the Lannate treatments. Materials were applied as full coverage sprays with a power sprayer at 200 psi pressure using a Spraying Systems 8006 TeeJet nozzle on a spray wand. In each experiment, the sprays were applied at a rate of 400 gallons per acre.

Evaluation

Adult and immature aphids were counted weekly beginning the first week after application. Weekly sampling was carried out for 3 weeks in El Modeno and for 5 weeks in Encinitas. Aphids were counted on ten growing tips (or, on the chrysanthemums in the bud stage, on the crown, stems, and buds) per replicate. Plants were observed for signs of phytotoxicity throughout the test periods.

Control

The results of the experiments are summarized in tables 1 to 3. Pirimor (a contact poison) and Orthene (a contact and systemic poison) were the most effective materials with quick and long lasting aphid control. Each material provided good control of aphids for up to 5 weeks. In the experiment on carnations, Orthene at the 8 ounce rate provided excellent protection for 4 weeks but was beginning to lose its effectiveness at 5 weeks. Orthene, with acute oral LD_{50} of between 860 and 950 mg per kg in rats, and Pirimor, with around 1,000 mg per kg are among the safer insecticides.

Meta-Systox-R also provided excellent protection on chrysanthemums but its activity was somewhat slower because it is a systemic insecticide and it took about a week before its activity reached a level high enough to control all of the aphids. On carnations Meta-Systox-R was not as effective as Pirimor and Orthene. Furadan gave good initial results but lost its activity before 2 weeks.

Phytotoxicity

Chrysanthemums and carnations were observed for phytotoxicity resulting from the aphid control treatments. Pirimor (4 ounces AI/100 gallons), Meta-Systox-R (12 ounces AI/100 gallons), Orthene (12 ounces AI/100 gallons), and Furadan (8 ounces AI/100 gallons) were applied in the tight bud stage. Phytotoxicity was observed on both Hurricane varieties sprayed with Furadan; slight discoloration on the upper leaves after 2 weeks, no further discoloration after 3 weeks. No phytotoxicity was observed from the application of the other compounds.

The chrysanthemum varieties treated were: POMPONS – Hurricane white, Hurricane yellow, Bonnie-jean white, Bonnie-jean yellow, Alabaster white, Alabaster yellow, Starburst white, Jackstraw yellow, Polaris white, Polaris yellow, and Dramatic bronze; STANDARDS – Wildfire bronze, Shoesmith #2 golden, Shoesmith white, and Improved Fred Shoesmith white; and SPIDERS – Luyona yellow, Yellow Knight, Donlope white, and Nightingale green.

When Pirimor (4 ounces AI/100 gallons with 6 ounces of spreader) was applied to chrysanthemum propagating

TABLE 1. Green Peach and Leaf Curl Plum Aphid Control on Chrysanthemums in the Tight Bud Stage (Pre-disbud), Treated February 29, 1972

Material and rate	Average number of aphids per crown, Days after treatment: 7	14	22
AI/100 gal			
Pirimor 50% WP, 4 oz	0	0	0
Orthene 75S, 12 oz	0	0	0
Meta-Systox-R 2 EC, 12 oz	0	0	0
Furadan 4 Flowable, 8 oz	0	10	80
Check	10+	10+	80+

TABLE 2. Control of Leaf Curl Plum Aphid on Chrysanthemum Propagating Beds, Treated June 1, 1972

Material and rate	Average number of aphids per tip, Days after treatment: 7	14	21	28
AI/100 gal				
Pirimor 50% WP, 4 oz	0	0	0	0
Orthene 75S, 12 oz	0	0	0	0
CGA 13608 50% WP, 8 oz	0	0	0	0
Meta-Systox-R 2 EC, 12 oz*				7.9
Check	6.4	21.3	24.7	—

*Meta-Systox-R plots sprayed June 23, 1972.

TABLE 3. Green Peach Aphid Control on Carnations, Treated February 7, 1974

Materials and rate	Average number of aphids per tip, Days after treatment: 7	14	21	28	35
AI/100 gal					
Pirimor 50% WP, 4 oz	0.3	0	0	0	0.7
Orthene 75S, 8 oz	0.1	0.2	0	0.4	7.8
Meta-Systox-R 2 EC, 8 oz	3.7	15.9	17.8	13.2	—
Cygon 2 EC, 6 oz	4.2	12.8	16.7	11.8	—
SBP 1382 2 EC, 1 oz	6.4	7.9	12.1	13.2	—
Tetralate 2 EC, 1 oz	9.2	26.8	25.0	10.5	—
Pyrenone 6% EC, 4 oz*	9.1	7.1	20.3	14.7	—
Meta-Systox-R 2 EC, 8 oz + SBP 1382 2 EC, 0.5 oz	5.4	3.2	9.7	11.0	22.6
Meta-Systox-R 2 EC, 8 oz + Tetralate 2 EC, 0.5 oz	3.6	0.9	8.7	9.4	19.0
Meta-Systox-R 2 EC, 8 oz + Pyrenone 6% EC, 4 oz*	3.3	4.5	10.6	6.5	26.1
SBP 1382 2 EC, 1 oz + 4 oz Nu-film (spreader-sticker)	5.0	6.4	21.1	14.4	—
Check	24.0	44.5	45.3	32.1	26.2

*Formulation instead of AI.

beds, no phytotoxicity was observed on any varieties.

The following varieties were treated: Goldstar, Deep Ridge, Illini Trophy, Pink Champagne, Malabar, Dramatic, Mt. Sun, Yellow Mandalay, Sunny Mandalay, Glowing Mandalay, Mt. Snow, Bronze Gold Ann, Golden Gate, Gay Ann, Margarita #773, Indianapolis Golden Yellow, Indianapolis Yellow #4, Indianapolis White #3, Cr. Yellow Princess Ann, Cr. 48 Dark Red Star, Fuji MEFO, Yellow Spider #48, Goldburst MEFO, and Puritan.

In an experiment to determine the phytotoxicity of test insecticides on carnations, plots were treated throughout the year with at least one application each month; a total of 15 applications were made on the same plots between April 1974 and April 1975. The compounds tested were Orthene 75S (4 and 8 ounces AI/100 gallons), Pirimor 50W (2 and 4 ounces AI/100 gallons), Lannate 90S (3.6 ounces AI/100 gallons), and Lannate L 1.8E (3.6 ounces AI/100 gallons). In addition, plots were sprayed three times during December and January with Pentac (6 ounces AI/100 gallons) to control an infestation of mites. No phytotoxic responses were observed on any of the varieties from any of the treatments during the test period. The carnation varieties treated were: White Sim, Pink Sim, S. Arthur Sim, Scania, Dusty, Portraits, Orchid Beauty, and Elegans-Miniature.

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Downy mildew of lettuce controlled by systemic fungicide

Albert O. Paulus ■ Jerry Nelson ■ Marvin Snyder ■ Judy Gafney

Downy mildew of lettuce, caused by the fungus *Bremia lactucae,* can cause considerable damage especially to early spring and late fall crops in coastal areas. It is favored by cool, moist weather and may occasionally cause economic damage in the Imperial Valley during the winter lettuce season. Trials were initiated in the summer and fall of 1976 to compare new systemic fungicides from Ciba Geigy with commonly used materials.

1976 trials

The Calmar variety was used in the first trial and plots were conducted in the Santa Maria Valley. Fungicide treatments were started immediately after thinning and applied on August 24 and September 13. Sprays were applied with a Hudson 2 gallon CO_2 pressurized sprayer at 30 psi and rates of materials are per 100 gallons of water per acre. Plots were 25 feet long and replicated four times. Downy mildew was present in a light infestation before application of the first spray. Results are shown in table 1.

Both Ciba Geigy materials gave excellent commercial control of lettuce downy mildew to harvest, although CG 48988 gave significantly better control than CG 38140. Maneb provided intermediate control.

Second trial

The Moran Gold variety was used in this trial and plots were again conducted in the Santa Maria Valley. Fungicide treatments were started immediately after thinning and applied on September 13 and October 4. Procedure was the same as in the previous trial. Plots were 25 feet long and replicated four times. Results are shown in table 2.

Ciba Geigy 48988 gave better control of downy mildew than Ciba Geigy 31840, as in the previous trial. Addition of maneb to Copper Count N improved control over Copper Count N used alone, but after 2 sprays, plots containing Copper Count N + maneb showed yellowing of wrapper leaves. Light brown necrotic areas were noted on leaf and leaf blades where Copper Count N was used alone.

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TABLE 1. Comparison of Fungicides For the Control of Downy Mildew of Lettuce, Calmar Variety

Treatment*	Disease Rating† Sept. 28
Ciba Geigy 48988 50W, 8oz	0.12 a
Ciba Geigy 38140 50W, 8 oz	0.87 b
Maneb 80W, 2 lb	1.62 c
Copper Count-N 8%, ½ gal	2.62 d
Control (No treatment)	2.75 d

*Significant at the 5% level. Treatments with same letter are not significantly different from each other.
†Disease incidence was rated on a scale of 0 to 4. 4 = a plant severely diseased with downy mildew.

TABLE 2. Comparison of Fungicides for the Control of Downy Mildew of Lettuce, Moran Gold Variety

Treatment*	Disease rating† Oct. 18
Ciba Geigy 48988 50W, 8 oz	0.25 a
Ciba Geigy 38140 50W, 8 oz	1.1 b
Maneb 80W, 2 lb + Copper Count N 8%, ½ gal	1.7 b
Copper Count N 8%, ½ gal	2.6 c
Control (No treatment)	2.8 c

*Significant at the 5% level. Treatments with same letter are not significantly different from each other.
†Disease incidence was rated on a scale of 0 to 4. 4 = a plant severely diseased with downy mildew.