New Control for Alfalfa Aphid

systemic insecticide protects insect enemies of aphid, allows compatibility of chemical treatment with biological control

Vernon M. Stern, Robert van den Bosch, and Dewey Born

There is little doubt that the insecticides parathion, malathion, and TEPP prevented a widespread devastation of California's alfalfa industry following the 1954 appearance of the spotted alfalfa aphid—*Therioaphis maculata* (Buckton) but the materials also proved to be toxic to insect enemies of the aphid.

This complicating factor became evident in the late summer of 1956 during a survey of an area near Hinkley where the aphid had developed a low degree of resistance to certain organo-phosphorus insecticides. Where resistance had developed and growers had repeatedly treated their fields, natural enemies of the aphid were largely eliminated by spray materials. In the absence of biological checks the resistant aphids multiplied to tremendous numbers and caused severe damage despite the frequent chemical treatments. A similar development threatened to occur in several other important alfalfa growing areas.

Therefore it was imperative to find an insecticide that would give adequate aphid control but also would allow native predators and the newly introduced aphid parasites to survive and destroy any aphids not killed by the insecticide application. Furthermore, the natural enemies would destroy aphids migrating into the field after the insecticide had broken down. The preservation of natural enemies of the aphid in the treated area would prolong the effectiveness of the chemical.

Parasites and predators of innumerable other insect pests would also survive treatment and continue to attack their hosts either in alfalfa or on other adjoining crops. Moreover, there was the possibility that extensive and repetitious use of parathion and malathion on alfalfa might cause resistance to develop in a wide variety of other insect pests frequently found in alfalfa fields, which—though not necessarily damaging to alfalfa—might carry resistance problems to other crops.

Numerous compounds were evaluated in the research program to find a selective insecticide for aphid control and several were subjected to thorough analyses of their effects on the spotted alfalfa aphid as well as on the enemies of the aphid.

The insecticides were applied as sprays with a ground rig in three experiments and by airplane in the fourth. The ground sprayer was equipped with No. 4-X hollow-cone nozzles arranged 18" apart for broadcast spraying. The rig was operated at 60 p.s.i.—pounds per square inch—and 12–14 gallons of water were used per acre. Each treatment was replicated four times where the ground sprayer was used.

In the first trial, sprays were applied on alfalfa at Hemet on February 5, 1957, to test the comparative toxicities of low dosages of Systox—demeton—to the recommended dosage of parathion.

The Systox was applied at 0.9 and 1.4 ounces per acre. Both dosages gave 99% control one day after application. Parathion applied at three ounces per acre also gave effective control. This and other tests show that Systox applied at less than an ounce per acre by ground equipment gave adequate aphid control. However, growers frequently can not apply insecticides under the ideal conditions prevailing in controlled experiments, but one ounce of Systox per acre applied with ground equipment has given good results. With airplane application, Systox applied at two ounces per acre gave satisfactory aphid control. In areas where the aphid has developed a low degree of resistance to phosphate insecticides a higher dosage of Systox may be required.

In the second experiment, sprays were applied by ground rig at Thermal in the Coachella Valley on April 10, 1957, to test the relative toxicities of several insecticides to ladybeetles, the most important native predators of the aphid. Three other predators, *Nabis* sp.—damsel bug

Effectiveness of Sprays Applied by Ground Equipment for Control of the Spotted Alfalfa Aphid on Alfalfa at Hemet, on February 5, 1957

Insecticide	Ounces toxicant/acre	Interval between treatment and sampling: 1 Day — No. apterous aphids/100 stems	1 Day — % Reduction from untreated plots	3 Days — No. apterous aphids/100 stems	3 Days — % Reduction from untreated plots	7 Days — No. apterous aphids/100 stems	7 Days — % Reduction from untreated plots
Systox	0.9	18	99	3	99	10	99
Systox	1.4	7	99	0	99	11	99
Parathion	3.0	95	99	10	99	31	99
Untreated	..	15044	..	10819	..	6869	..

Comparative Toxicities of Several Insecticides to Four Predator Species. Insecticides Applied by Ground Rig on April 10, 1957, at Thermal

Insecticide	Ounces toxicant/acre	Time of sampling after treatment: 1 Day — No. beneficial insects per 100 insect net sweeps: Lady beetles	1 Day — *Nabis* sp.	1 Day — *Orius* sp.	1 Day — Green lacewings	2 Days — No. beneficial insects per 100 insect net sweeps: Lady beetles	2 Days — *Nabis* sp.	2 Days — *Orius* sp.	2 Days — Green lacewings	9 Days — No. beneficial insects per 100 insect net sweeps: Lady beetles	9 Days — *Nabis* sp.	9 Days — *Orius* sp.	9 Days — Green lacewings
Malathion	9.1	14	5	23	0	6	21	34	0	100	20	266	7
Parathion	4.0	15	2	39	1	17	1	55	1	146	9	307	4
Phosdrin	0.7	19	12	116	2	14	22	100	4	306	14	348	10
Trithion	7.2	57	11	220	12	51	41	175	12	149	8	272	10
Systox	0.5	90	12	394	7	176	47	206	23	413	12	142	6
Systox	0.9	80	10	403	4	119	32	215	17	547	14	250	5
Untreated	..	136	13	349	8	601*	33	306	33	342	17	175	8

* A possible inadvertent sampling error occurred on this date since the count is not consistent with the 1-day or 9-day counts.

—*Orius* sp.—pirate bug—and *Chrysopa* sp.—green lacewing—all known to feed on the aphid and many other agricultural pests, were included in the study.

Systox was definitely the least harmful material to the tested beneficial insects. When the plots were sampled one day after treatment, parathion, malathion, and Phosdrin had reduced the ladybeetle population by approximately 88%. These three insecticides were very toxic to pirate bugs and green lacewings. Parathion was quite toxic also to damsel bugs. In other tests all three materials were more toxic than Systox to damsel bugs.

Although pirate bugs, damsel bugs, and the green lacewing are of secondary importance as aphid feeders they are of primary importance in destroying other agricultural pests.

Trithion—a relatively new insecticide—had little effect on ladybeetles one day after application but appears to exhibit a delayed toxic action on ladybeetles, as shown by samples taken two days after application. Trithion is more harmful than Systox to beneficial insects but not nearly as toxic as parathion or malathion. In plots sampled nine days after treatment the numbers of ladybeetles in the plots treated with parathion, malathion, and Trithion were still substantially below those in the Systox plots.

In the third trial, sprays were applied by ground rig at Famoso, Kern County, on June 10, 1957, to test the relative toxicities of several insecticides to adults of the wasp—*Praon palitans* Mues.— one of the aphid parasites imported from the Middle East.

Parathion applied at 3.0 ounces and malathion at 9.7 ounces were extremely toxic to the parasite adults. Five hours after application approximately 97% of the adults were eliminated in the plots treated by these two materials. Phosdrin and Trithion were slightly less toxic, killing about 90% of the adult parasites five hours after treatment. Systox applied at one ounce per acre gave 80% and at two ounces, 66%, reduction in the parasite population, conspicuously less drastic than the other materials tested.

One day after application the adult aphid parasites were still at relatively low levels in the plots treated with parathion and malathion. These two materials have residual toxicity and apparently kill the tiny parasitic wasps as they emerge from their cocoons or as they migrate into treated areas. Three days after application there was little difference in numbers of adult parasites in the various treatments. Mummified aphids—containing parasite cocoons—were collected 24 hours after treatment, and brought into the laboratory to determine whether the sprays had had a toxic effect on the cocooned wasp. None of the tested sprays had affected the parasite in the cocoon stage.

In the fourth test, sprays were applied by airplane at Famoso, on August 13, 1957, to determine the toxicity of parathion, Phosdrin, and Systox on four predator species. Each treatment was replicated three times.

Parathion was the most harmful to predators. One day after treatment, 98% of the ladybeetles, 95% of the damsel bugs, 96% of the pirate bugs, and 100% of the green lacewings were eliminated in the plots treated with parathion. Phosdrin was not quite so harmful to predators as was parathion. Systox—although it did destroy some of the beneficial insects—was the least harmful of the three insecticides. It reduced ladybeetles by only 24%, damsel bugs by 4%, pirate bugs by 28% and green lacewings by 58%. Where parathion was used, enemies of the aphid remained at a low level throughout the testing period.

During the experiment large numbers of winged aphids invaded the test area, enabling a study of the advantages of a selective insecticide—Systox—which gave good initial kill of the aphid and allowed the enemies of the aphid to survive treatment.

One day after application there was an average of less than one aphid per alfalfa stem where parathion, Phosdrin, and Systox were used. The plots were again sampled seven days after treatment. At this time the insecticides had broken down and no longer killed winged aphids flying into the treated plots or their young. Aphids averaged 11 per stem in the parathion plots and 8 per stem in the Phosdrin plots.

Because of the drastic reduction of natural enemies—where these two materials were used—invading aphids reproduced essentially unhindered, particularly in

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Relative Toxicity of Various Insecticide Sprays to the Aphid Parasite *Praon palitans* Mues.

Insecticide	Ounces toxicant per acre	Time of sampling after treatment and number of adult parasites per 100 insect net sweeps		
		5 hours	1 day	3 days
Parathion	3.0	11	108	410
Malathion	9.7	10	147	364
Phosdrin	1.0	39	206	397
Trithion	5.0	39	255	586
Systox	1.0	76	265	472
Systox	2.0	126	318	473
Untreated	..	384	331	629

Population Trends of Spotted Alfalfa Aphid in the Experimental Plots Summarized in Larger Table Below

Insecticide	Ounces toxicant per acre	Time of sampling after treatment and average number of apterous aphids per alfalfa stem		
		1 day	7 days	10 days
Parathion	4	less than one	11	14
Phosdrin	1.5	less than one	8	8
Systox	2.0	less than one	less than one	1.5
Untreated	..	201	426	138

Comparative Toxicities of Several Insecticides to Four Predator Species. Insecticides Applied by Airplane on August 13, 1957, at Famoso

Insecticide	Ounces toxicant/ acre	Time of sampling after treatment											
		1 Day				3 Days				7 Days			
		No. beneficial insects per 150 insect net sweeps				No. beneficial insects per 150 insect net sweeps				No. beneficial insects per 150 insect net sweeps			
		Lady beetles	*Nabis* sp.	*Orius* sp.	Green lacewings	Lady beetles	*Nabis* sp.	*Orius* sp.	Green lacewings	Lady beetles	*Nabis* sp.	*Orius* sp.	Green lacewings
Parathion	4	7	26	19	0	35	24	62	16	189	34	155	49
Phosdrin	1.5	151	169	93	6	193	243	199	80	400	284	687	133
Systox	2.0	372	468	313	18	899	849	490	85	779	703	1017	97
Untreated	..	491	490	435	43	1105	776	596	80	2249	455	563	114

A new strawberry variety—the Solana—is released by the University of California for unrestricted propagation. California nurserymen were supplied a few plants in 1957 to establish foundation stock. Plants should be generally available by December 1958. The University of California does not have plants for distribution.

Solana Strawberry

new variety yields fruit of high quality in southern California trial plantings

R. S. Bringhurst and Victor Voth

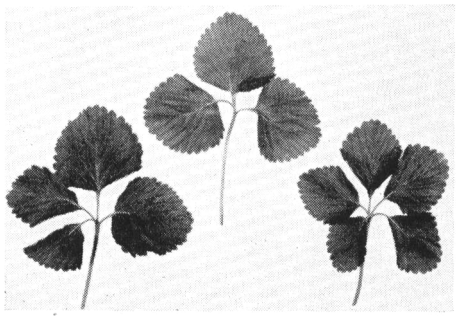
The new Solana strawberry may prove to be a good supplemental variety to Lassen for commercial and home-garden culture because of superior fruit quality. However, Solana does not yield as well as Lassen, nor does it start production as early.

Solana originated in 1935 as a cross between selections Cal. 177-19 and Cal. 103-22 and has been tested as Cal. 35.93-11. The selection is named for the town of Solana Beach, near where much of the testing was done.

Although Solana is as old as the Shasta Variety and tested—in a limited way—in northern California from 1939 to 1950, it was not tested in southern California until 1953. Since then, Solana has been compared with Lassen at Torrey Pines, Fallbrook, San Luis Rey, and Santa Ana. Trials have been completed on both winter—December—and spring—April—plantings. During 1957, Solana has been successfully established in summer plantings, growing more vigorously than Lassen.

Quantity fruit production on Solana begins 7–10 days later than Lassen at Torrey Pines and Santa Ana. First-year production from plants set in early to mid-December—winter—has been about one half that harvested from Lassen plants handled the same way. Solana has compared more favorably with Lassen during the full production season that follows. The plants have persisted as long as Lassen in test plantings.

The fruit of the Solana is large to medium large in size and has a very symmetrical, conic to blunt conic shape. The color is bright red with a glossy finish and the yellow seeds are flush with the surface and medium in size and spacing. The slightly pubescent skin is relatively resistant to injury. The flesh is moderately firm and juicy and uniformly red and aromatic when ripe. The pleasing subacid flavor gives the fruit a good dessert quality. Also, the fruit holds well in storage and does not darken.



Characteristic 3, 4, and 5-foliate leaves of the new Solana strawberry. Note the long leaflet petioles—petiolules.

The plant of the Solana is vigorous and large with a medium open crown. It is a prolific runner maker. The leaves are large, borne on long petioles, and of a medium deep green. The leaflets are broad obovate, upcupped, and borne on exceptionally long petiolules. Often there are 4–5 leaflets instead of three. The flower stocks are long to medium long and high branching. The pedicel pubescence is appressed—slanted upward. The flowers produce copious amounts of pollen.

Solana is highly susceptible to Verticillium wilt but is more resistant to mildew than Lassen and has resisted infestation with cyclamen mite better than Lassen on several occasions. It reacts to virus infection similarly to Lassen and appears to be moderately tolerant of salinity.

In southern California, the most first-year production from winter plantings of Solana has been obtained from plants set by December 10–20. Those set later have gone to runners too early to produce well. Also, plants set too early lack vigor.

Relatively high yields have been realized from spring-planted test plots of Solana near Berkeley and at the Deciduous Fruit Field Station at San Jose. Low to near-acceptable yields were obtained from winter plantings made in early December 1956 in the central coast area at San Jose, Salinas, and Watsonville. All of the above plots were small, and further tests should be made.

Solana has yielded reasonably well in small plots at Davis and Wheatland and should be further evaluated in the central valleys.

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The above progress report is based on Research Project No. 1386.

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trained in animal feeding are factors to be studied before antibiotics are incorporated in a cattle ration.

Blaine McGowan is Assistant Professor of Veterinary Medicine, University of California, Davis.

Reuben Albaugh is Extension Animal Husbandman, University of California, Davis.

Norman E. Nichols, Modoc County; Jesse W. Baquette, Shasta County; and Alva W. Mitchell, Butte County; Farm Advisors, University of California, cooperated in the feeding trials reported here.

The experiments with antibiotics in Iowa referred to in the above progress report were carried on by Dr. Wise Burroughs; those in Florida, by Dr. T. J. Cunha; and in Indiana, by Dr. T. W. Perry.

ALFALFA APHID

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the parathion treatment. By contrast, in the Systox plots where beneficial insects survived the treatment in goodly numbers, aphids were destroyed as they reinvaded the plots. Thus, seven days after application there was still less than one aphid per alfalfa stem where Systox was used. Ten days after application aphids averaged 14 per stem in the parathion plots, 8 per stem in the Phosdrin plots and only 1.5 per stem in the Systox plots.

The use of Systox should lower long-term costs of treatment because of fewer applications. Moreover, there probably will be a reduced tendency for the development of resistance by the aphid, and a reduced threat of secondary insect outbreaks which might develop following use of more widely toxic insecticides.

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The above progress report is based on Research Projects Nos. 1443 and 1650.