

Fungi on Spotted Alfalfa Aphid

spread of fungi by natural and artificial means is resulting in excellent biological control of aphid in many counties

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Five unidentified species of parasitic entomophthorous fungi are now known to be attacking the spotted alfalfa aphid—*Therioaphis maculata* (Buckton)—in California.

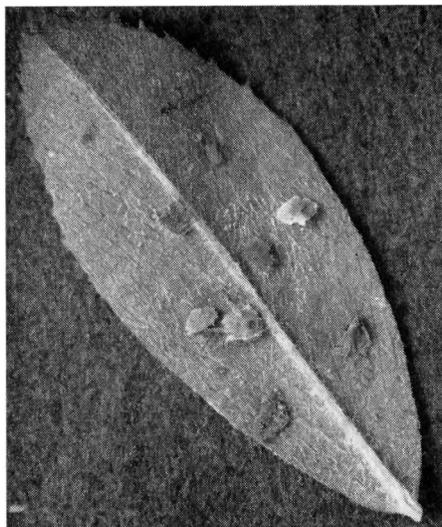
Two of the species display high pathogenicity for the aphid, and with favorable moisture conditions—natural or artificial—are capable of bringing about marked reductions in the aphid populations in fields where the fungi are evenly distributed. One species, particularly, appears to have spread rather quickly over much of southern California, where it has been responsible for disease outbreaks and control of aphid populations in widely scattered fields.

So far, the distribution of the pathogenic fungi throughout the state is far from uniform, although the spread by natural means—aided by an artificial distribution program in which almost 1,800 cultures were placed in infested fields in 12 counties during the summer of 1956—has been spectacular and has resulted, in a number of counties, in widespread control of the aphid by the fungi.

In San Diego County, the 1956 spring build-up of the aphid occurred only in certain areas. Aphid populations did not develop in a 150-acre plot under observation in the Del Mar Valley, but a nearby 200-acre field at Rancho Santa Fe had one isolated flare-up in February which was quickly controlled by disease. In March, heavy aphid populations developed in a 100-acre plot at the upper end of the San Luis Rey Valley but were destroyed—along with subsequent aphid populations developing throughout the summer—by naturally occurring fungi and lady beetles. The fall build-up of the spotted alfalfa aphid in the Del Mar and Rancho Santa Fe areas was followed by the reappearance of the fungi, and excellent control of the aphid by disease has been noted in a number of fields.

Little is known—because no plots are being followed—of any effective fungus control of the aphid in the coastal areas of other counties in southern California. There are indications, however, that fungi are present in Orange County and are capable of controlling aphids when conditions are favorable.

In the Santa Ynez Valley of Santa Barbara County, a heavy build-up of



Fungus-killed spotted alfalfa aphids.

aphids causing occasional severe damage in August was followed by an outbreak of disease. The occurrence of heavy morning dews enabled the fungi to become distributed quite rapidly throughout the fields and effectively control a heavy aphid population which was building up on the new growth following cutting.

On 600 acres of alfalfa being observed at Temecula in Riverside County, the 1956 spring build-up of the aphid was severe in only a few fields, and during a period of damp weather in April outbreaks of fungus disease quickly developed in both heavy and light density aphid populations. One 80-acre field was given an extra irrigation which greatly increased the activity of the fungi, and the aphid population was reduced to a subeconomic level. A large number of lady beetles which developed on aphids not killed by the fungi moved from field to field as cutting progressed and destroyed any aphids that were present. Similarly, in a 100-acre plot in the Perris Valley, a heavy aphid population at cutting time was cleaned up by the combined effects of the fungus and lady beetles.

Pathogenic fungi have made their appearance in many fields in western Riverside County where the diseases, aided by predator activity, have destroyed heavy aphid populations.

No diseases have been observed in the Coachella Valley. In the Imperial Valley,

however, fungi were found to be quite active against the spotted alfalfa aphid in many fields during January and February of 1956. In March, the humidity-lowering effect of spring winds plus widespread insecticidal treatments used to suppress exploding aphid populations all but made the fungi disappear, and in only a few of the plots under observation did the pathogens play an important role against the aphid. With the arrival of fall weather, the fungi became more active although not enough to cause widespread control.

Outstanding biological control of the spotted alfalfa aphid with pathogenic fungi is occurring in three fields of young alfalfa on the Colorado River flood plain at Bard. These fields—two of them are in their second year and the third is about one year old—have been subjected to heavy aphid attack since they were planted, but because of the build-up of pathogenic fungi and lady beetles, no insecticidal treatments have been required since April 1955. Changes in irrigation practices—to create more humid conditions in the fields for better growth of the fungi—were made possible by the excellent drainage that permitted extra irrigations without damaging the alfalfa. The blanket of humidity thus maintained allowed the fungi to continue to attack the aphid populations despite the effects of the almost continuous spring winds.

Although occasional fungus-killed winged aphids have been recently observed in fields in the Owens Valley near Bishop, no widespread outbreaks of disease have been noted in the high desert areas. In the Antelope Valley, an artificially induced outbreak did not result in establishment of the organisms when the fungi disappeared following the drying-out and cutting of the field.

Following the introduction—and rapid spread—of the spotted alfalfa aphid into the San Joaquin Valley in 1955, surveys of plots with heavy aphid populations revealed only occasional fungus-diseased aphids. In Kern County, in the fall of 1955, the introduction of fungi appeared to be successful in some fields. During the spring of 1956, up to 20% mortality caused by fungus diseases was observed in a number of fields, and heavy disease was noted—during the summer months—

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WEEDS

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At rates of 20 to 40 pounds per acre it controls bermudagrass and other perennial grasses. Annual grasses are controlled at rates below 10 pounds per acre. Dalapon is absorbed by the foliage and translocated throughout the plant, killing roots, rhizomes, and tops. After a treatment, dalapon residues may become leached into the soil in sufficient quantity to be toxic to the roots of trees and shrubs. Therefore, it should not be used over roots.

Amino triazole is another new weed killer that is effective on both grasses and broad-leaved weeds. It is absorbed by the foliage and translocated to underground plant parts. Preliminary experiments indicate that it can be safely used on weeds growing within the root zone of trees and shrubs.

Neburon, a new soil sterilant, is similar to monuron and because of its very low solubility does not leach readily to roots underlying treated areas. When this material is applied prior to seed germination, seedlings are killed at the time of emergence. Tests with neburon indicate that it may be safely used in the root areas of trees and shrubs. It is a herbicide of exceptional promise for a number of uses in landscape management.

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in the vicinity of Old River and Cawelo.

In Tulare County, when diseased aphids were placed in a field near Earlimart in October 1955, the fungi became established quite rapidly and soon spread to adjoining fields. Shortly thereafter, heavy mortality caused by fungus diseases was noted in other parts of the county. During the spring and early summer of 1956, the expected build-up of the aphid was suppressed by lady-beetle activity. When the predators began to disappear in July, fungus diseases began to play an important role in controlling the aphid throughout the county and since then little treatment has been required.

Recent reports from Kings County—where several hundred fungus cultures were placed in fields during the summer months—indicate that disease outbreaks in spotted alfalfa aphid populations are becoming rather commonplace over

much of the county. In Madera County—where a similar introduction program took place during the summer months—diseased aphids have been observed. Natural spread of the fungi has also been recently noted in Fresno County.

So far, the pathogenic fungi have not spread naturally into other counties in the San Joaquin Valley, and artificial distribution of about 500 fungus cultures into San Joaquin, Merced, and Amador counties has as yet given no indication of establishment.

In the Sacramento Valley, starting in June—when the aphid was beginning to build up and little or no disease was noted—a total of 870 cultures of the three species of pathogenic fungi were placed in infested alfalfa fields in Tehama, Sacramento, Solano, and Glenn counties. In September, after the culture distribution program was completed, the first signs of heavy disease in the aphid populations were noted in Tehama County. At about the same time the fungi began to appear in Glenn and Butte counties.

The spread of the fungi—whether by natural or artificial means—has been spectacular; so, also, has been their ability to become distributed throughout a field quite rapidly and reappear when an aphid build-up starts after a lengthy host-free period. As their distribution continues, the fungi should become widely recognized as an important part of the predator-parasite-disease complex in the biological control of the spotted alfalfa aphid.

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APHID RESISTANCE

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Hinkley, 85.5% of the aphids were dead in the parathion plots. The remaining 15% of the aphids were mainly full-grown adults which apparently are more difficult to kill than the small young. To prevent further damage to the alfalfa, the whole field was re-treated.

In addition to the field tests, adult aphids from Del Mar, Big Pine, and Hinkley were tested in the laboratory. The aphids from Hinkley were about four times as tolerant to parathion as those from Big Pine and Del Mar.

New Insecticides

Three new insecticides were used with parathion in the field tests. Two of the materials—Trithion and Phosdrin—have

been used on crops other than alfalfa in large-scale plots. In addition to being quite effective on other insect pests, they have given excellent results in field tests for the control of the spotted alfalfa aphid.

The third compound—8305—is still in the basic experimental stage. It gave satisfactory control of the aphids at Hinkley, but a considerable number of trials must be conducted in order to determine its value under varying climatic conditions.

In field tests, Phosdrin has given excellent control even when used as low as one-half ounce per acre. In one test in the Imperial Valley, one and three-ounce treatments were applied on large blocks of alfalfa, and the vapors eliminated the aphids in the large untreated plots. However, when Phosdrin is used at less than a half ounce per acre, the control is not satisfactory, and because it has little residual activity, it will not prevent a build-up from aphids migrating into the field. In the Big Pine test—where 0.6 ounce per acre was used—the control dropped from 99.8% to 89.9% 72 hours after treatment. The population was almost 100% newly born aphids from migrating winged forms.

Since Trithion was used at different dosages at Hinkley and Big Pine, it is difficult to compare the effect of the material on the two aphid populations. In tests conducted during the summer months, Trithion gave satisfactory control of the aphid when used at four ounces per acre. Additional tests with Trithion are in progress to further determine its value in controlling resistant aphids.

If these new insecticides are able to pass the rigid requirements for registration, they might be of great assistance—in the event the insecticides now used continue to lose their effectiveness—in controlling the aphid. Trithion would appear to have an advantage over Phosdrin in that it has greater residual toxicity. However, the short residual life of Phosdrin may prove advantageous under certain conditions.

Since the resistance to parathion is still in the early stage of development, it is not possible to predict whether parathion will become totally useless as an aphid control measure or whether the aphid resistance will eventually extend to other organic phosphate insecticides. Therefore, nonphosphate insecticides are being evaluated for their effect on the spotted alfalfa aphid.

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