Control of Cyclamen Mite

stocking test plots in new fields with natural enemies has given biological control on strawberries in first crop year

C. B. Huffaker and C. E. Kennett

The predatory mites, *Typhlodromus cucumeris* and *T. reticulatus*, are effective in controlling cyclamen mites—*Tarsonemus pallidus*—on field strawberries when they gain a fairly early general distribution in new fields, and if chemicals detrimental to them are not applied.

Two factors have hindered the use of this inexpensive method of control: *1*, predator mites do not—on their own—always enter new fields soon enough to assure control during the important first crop year; and *2*, complications arising from chemical control of two-spotted mite, or red spider mite, and aphid.

Trials during 1953, 1954, and 1955 tested predator-stocking of plots—by simply transferring prunings from fields with adequate predator populations—in conjunction with a chemical control of red spider mites. Aramite is most satisfactory because it did not seriously interfere with the predator populations.

Early spring applications of TEPP—prior to predator stocking—can be used to good advantage for both aphid and red spider, where required. Several treatments may be needed with this chemical to obtain adequate control of red spider. Use of TEPP subsequent to predator stocking in the second year—the first crop year—and any time in following years, will prove a serious deterrent to predator control of cyclamen mite if two or more consecutive treatments are made. After a field is stocked and the predators are established, a single treatment with TEPP—although destroying a high percentage of predators—does not eradicate them. They can again increase in numbers sufficient to control the cyclamen mite. This has been the case in some field plots where TEPP treatments were applied not later than April. Single dust applications with either parathion or malathion are ruinous to predator control.

During the three-year period, a total of 19 comparison blocks, involving strawberries of eight different growers and fields in Santa Clara and Monterey counties, was studied. Each comparison, as shown in the accompanying table, shows the cyclamen mite infestations which resulted under three different methods of treatment or handling: *1*, the condition resulting when predators were introduced or stocked in the planting early during its growth; *2*, the natural condition with no severe chemical interference with the predators which were normally present; and *3*, the condition resulting when all naturally occurring predators were destroyed and excluded from later entry—with no stocking done.

The very striking difference in grand totals—4,563 for the predator-stocked condition, compared to 94,399 for the predator-free condition—shows conclusively the severity of infestation that could be expected in this area if no predators at all were present in the fields and no means of chemical control were available as a substitute.

Statistical analysis of the results of the stocking trials showed that there is a highly significant difference between the infestations occurring under the predator-excluded and the predator-stocked condition. In every block where predators were established, the control was adequate. The infestations of cyclamen mites in the comparable predator-free plots of the same blocks were very high some years and constituted a level characteristic of severe loss to the grower. On the other hand, particularly during 1955, the seasonal development of cyclamen mite infestations was retarded throughout the counties where the studies were made. Much lower infestations occurred even where no predators were present. This variation in cyclamen mite potentials—during different seasons—accounts for the fact that in some years the infestation in the absence of predators may be 130 times that occurring in the comparable predator-stocked plot as shown by Block 10 in the table, while, during other seasons and in low-infestation berries, the ratio may be reduced to as low as 11-1 as in Block 18. The predators achieved a characteristic control and infestations were not correspondingly higher or lower as a result of greater or less favorability of weather and cultural conditions. Control of this pest by use of chemicals would be aggravated by increased favorability of these factors.

Total Cyclamen Mites on 120 Leaflets* in Predator-Stocked, Natural Predator-Occurring and Predator-Excluded Blocks of Second-Year Berries in 1953, 1954, and 1955

Year	Block no.	Predator stocked	Natural predator occurrence	Predator excluded
1953	1	294	520	9,160
	2	488	711	7,346
	3	229	1,366	9,024
	4	347	653	7,678
	5	46	36	1,882
	6	64	24	1,399
	7	612	345	4,820
	8	245	118	4,295
	Mean	291	472	5,700
1954	9	231	234	7,667
	10	79	381	10,469
	11	440	1,312	5,890
	Mean	250	642	8,008
1955	12	434	441	5,305
	13	587	438	4,695
	14	84	149	1,915
	15	221	1,194	2,074
	16	31	9	3,952
	17	25	263	4,636
	18	88	140	999
	19	18	67	1,193
	Mean	186	338	3,096
Grand totals		4,563	8,401	94,399

* 30 leaflets taken on each of four different sample dates during the period of highest infestation.

In cool coastal areas—where cyclamen mites are very slow in becoming established—stocking early during the second year of a planting has sometimes failed to accomplish establishment of predators and control has failed. Some of the reasons have been indicated, but further tests in these areas are needed.

The level of population density of cyclamen mites characteristic of predatory control is so low that loss in yield or quality of berries is negligible or nonexistent. The predators can not accomplish, and there is no need for, more effective control. The operation of this biological control mechanism is dependent upon survival of small numbers of cyclamen mites and/or related tarsonemid mites—*Tarsonemus setifer*—a harmless fungous-feeding mite which is abundant on old leaves and dead plant material during the wet season of the year. Otherwise, there would be no food present for reproduction and perpetuation of the predators, and the control would break down. This has never been observed in a strawberry field that has not been treated with, or received drift of, detrimental chemicals, once control is achieved by predators.

The differences in infestations from year to year are pronounced in the absence of predators, but this variation has not been enough to confuse the very clear position of predators as being capable of accomplishing entirely adequate

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control of the cyclamen mite. The table shows that in the predator-stocked blocks infestations were always very low—during 1953 or 1954 which were favorable to high infestations, as well as in 1955 which was less favorable. In some fields, and only early in the season, just subsequent to stocking, were cyclamen mites found to be abundant, even on individual plants of a stocked block. Once the development of the predator population reached a level to achieve general distribution on all plants, these minor areas of abundant cyclamen mites—the hot-spots—disappeared and did not reappear.

Commonly, predators enter new fields late in the first year and keep pace with incipient cyclamen mite infestations, or they may follow so quickly during the second year that they achieve, on their own, a condition nearly comparable with that in the predator-stocked berries. However, there is lack of uniformity when only natural migration is relied upon. There may be considerable numbers of rather large hot-spots. These may become a source of economic loss, even though the predators do usually clean up the infestations as they move through the fields in population waves. The average densities of cyclamen mites may thus be rather low in comparison with those in berries entirely free of predators, but economic loss often does result. This is more pronounced if the lag period is great and the plants have suffered serious loss in vigor from which they do not quickly recover even though the cyclamen mite infestations are no longer injurious. If new fields are very close to older berries which have been under biological control, the natural movement of predators into the new fields may give results just as good as does artificial stocking.

On the other hand, if fields are far removed from sources of predators there may be a very serious time lag and, consequently, prolonged and serious infestations of cyclamen mites. In such cases the resulting infestations may be as severe as are those observed under the predator-excluded condition. Early stocking with predators is a solution.

The material for stocking new fields is obtained from older fields having adequate populations of predators. Examination by a competent entomologist or acarologist is required to determine which fields are suitable sources of predators. Once this is established and a rate of application of prunings containing predators is determined, all subsequent work associated with this method of control could be done by the growers themselves.

February is the normal period for pruning berries in the central coastal area. Only hand-pruned material is satisfactory for stocking purposes. However, if an adequate source of predators were located, prunings from one acre could be used to stock from five to 20 acres of new plantings, depending upon the abundance of predators in the material.

New fields—to be stocked—should be pruned two to three weeks earlier than the fields which are to supply the stocking material. This is in order that the new plantings can begin foliage regrowth subsequent to pruning and prior to the stocking operation, if the stocking material is to be moved directly to the new fields. However, the prunings can be held in a cool, shaded and sheltered location in burlap bags for a period not exceeding one month prior to use in the new fields. This is usually adequate time to permit the new fields to obtain some growth after pruning, in case they are pruned at the same time as the source field. Storage also has the advantage that pests such as red spider mites and aphids die during storage and would not be introduced into the fields with the prunings.

Both old, dead leaves and the new growth contain predators so the prunings can be gathered and placed in burlap bags for storage until needed. A handful of leaf material is placed in the crowns of every fourth or fifth plant and natural spread to intervening plants is adequate.

Results obtained by small scale procedures have been transposed to give rough approximations of the labor required to stock 10 acres of new plantings. Approximately four man-days of labor are needed to prune a one-acre source planting and six man-days to bag the material—about 500 bags—transfer to storage, and later to the fields to be stocked. The amount of material obtained from the one acre, on the average, would be adequate to stock 10 acres of new plantings. At one man-day per acre, 10 man-days would be required to stock the 10 acres. This would be a total labor item of 20 man-days to obtain the material, handle and later stock 10 acres of plantings. Even three or four man-days per acre would be a small item of cost or effort in terms of the relief from cyclamen mite which the evidence indicates could be expected. Pruning of the source field—a normal requirement whether or not the material is to be used for stocking purposes—is included in the labor estimate.

It is hoped that commercial acreage tests can be conducted during 1956 with the co-operation of volunteer growers.

C. B. Huffaker is Associate Entomologist, University of California, Berkeley.

Charles E. Kennett is Principal Laboratory Technician, University of California, Berkeley.

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29 days with no supplement other than white block salt. There were no apparent toxic effects of even the most severely damaged hay, and all the calves remained healthy throughout the test. The calves fed light honeydew hay ate a little more feed and gained a little more than the clean hay lot; but the clean hay lot showed slightly more efficiency of gain. However, these small differences are not significant. The gain and the efficiency of both the clean hay and honeydew lots were significantly superior to the severely damaged hay lot.

Weight Gains in Feeding Trial

	Average daily gain in pounds	Prounds of hay to produce 100 lbs. of gain
Clean hay	1.93	835
Honeydew hay	2.21	844
Damaged hay	0.72	2054

Although this feeding trial was limited in duration and the number of animals fed, the results confirm earlier predictions based on appearance of the hays. It would appear that a slight amount of honeydew does not appreciably reduce the feeding value so long as the sooty mold has not invaded the honeydew or the alfalfa plant has not started losing leaves. There is even some evidence that hay with moderate amounts of honeydew is eaten more readily. On the other hand, hay which has lost leaves and has turned black from sooty mold fungus is lower in feed value and palatability as compared to undamaged hay. The extent of damage will usually depend upon the amount of leaf loss and mold. In this test, severely damaged hay was worth about 40% as much as undamaged hay when measured in pounds of hay fed to produce a hundred pounds of beef.

Unchecked, the spotted alfalfa aphid can hamper the production, reduce the yield, and impair the quality of alfalfa hay, but it can be controlled economically by careful use of the chemical treatments properly applied.

Until resistant alfalfa varieties become commercially available or until introduced parasites take over the control of the aphid, growers must depend on chemical controls—and best results are obtainable when all growers in an area cooperate in control treatments.

Roy V. Parker is Farm Advisor, Kern County, University of California.

Vernon E. Burton is Farm Advisor, Kern County, University of California.

Ray F. Smith is Associate Professor of Entomology, University of California, Berkeley.

The chemical analyses of the alfalfa hays were made by the Department of Agronomy, University of California, Davis.