

California Red Scale

study of prospects for biological control of pest in orange and lemon groves of San Diego County

Paul DeBach

Citrus growers in San Diego County have a very good chance—possibly the best chance of any citrus area—of obtaining biological control of the California red scale, *Aonidiella aurantii* (Mask.).

The conditions are particularly favorable for orange growers in the Escondido area.

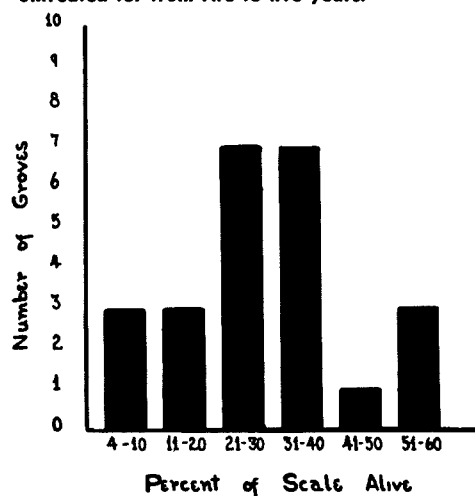
Continuing studies since 1948 in orange and lemon plots at Escondido, Vista and El Cajon—listed in the table below—have confirmed that parasites were responsible for the satisfactory biological control of red scale in these untreated groves.

Elimination or reduction of parasite populations on certain trees proved that the red scale would have increased to the point of extensive damage—sometimes within a six-month period—had it not been for the work of the parasites.

Red scale parasites occur abundantly around Escondido. *Aphytis chrysomphali*, the golden chalcid, is by far the dominant parasite, although *Comperiella bifasciata* plays an important supporting role. In samples from 22 groves untreated for two years or longer, a total of 829 *Aphytis* and 381 *Comperiella* were found. *Comperiella* attacks mature scale which *Aphytis* can not do.

Approximately 50 groves in the Escondido area have been left untreated during the last two to five years without receiving any aid in the form of colonization of insectary-reared parasites. Three sur-

Per cent of California red scale alive in 24 Escondido citrus groves. These groves had been untreated for from two to five years.



veys showed good parasite populations in all groves and no sufficiently heavy red scale populations to cause alarm, except where ants or dust were adversely affecting the parasites.

Natural mortality of red scale caused by these parasites occurs throughout the year. In areas where red scale parasites and predators are scarce, 50% to 80% of the scale are alive at any given time. Laboratory counts of field samples were taken from 24 groves in the Escondido area. In three groves less than 8% of the scale were alive; the average grove

only had 29% alive; the range was from 4% to 53% alive. In 20 out of 24 groves over 60% of the scale were dead at the time of sample.

The commercial status of the red scale infestation was investigated in 30 citrus groves which had been untreated for two to five years. Of the 30 groves, 23 were found commercially clean, three were lightly infested, and four were not commercially clean. Of the 23 clean groves none was ant-infested while all four of the noncommercially clean groves were ant-infested.

Favored Area

The principal reasons why the Escondido area is particularly suitable for biological control of the red scale appear to lie in: 1, a mild climate seldom exhibiting extremes of temperature and humidity which might reduce parasite populations, and 2, a scarcity of pests which have become established without adequate natural enemies. The relative lack of air-borne dust on the trees in most groves is also a favorable condition.

In most other areas various factors act adversely to the parasites. In the interior, combinations of very high temperatures with very low humidities caused by desert winds destroy many red scale parasites. Very low temperatures are also detrimental. And air-borne dust on trees may hamper delicate parasites.

In coastal areas the climate is mild and favorable for red scale enemies, but the purple scale, having no effective enemies, necessitates the use of chemicals about as drastic as those used against the red scale.

Honeydew-seeking ants constitute a stumbling block for natural enemies in all areas, and must be controlled, if abundant.

The possibilities for complete biological control on lemons in the Escondido area are not as good as on oranges, because of the citrus bud mite's preference for lemons. The rust mite may also complicate matters on occasion. Tests are underway to determine if bud mite can be controlled chemically without upsetting the natural balance of the other insects and mites. The possibility for natural control of the bud mite is also under study.

Continued on page 12

Red Scale Studies in Orange and Lemon Plots at Escondido, Vista, and El Cajon

Grove and locality		Last treated	Red scale infestation and notes	
			When first observed—1951	
Lemons	Vista	Never (13 yrs. old)	1948 heavy ant induced infestation	Light-ants controlled
Oranges	Escondido	1940	1948 generally very light-medium to heavy where ants and dust present	All very light. Ants controlled
Lemons	Escondido	1947	1949 heavy where ants present, otherwise very light	Very light except few trees on which ants not controlled
Oranges	Escondido	1949	1950 light-medium where ants present	All very light. Ants controlled
Oranges	El Cajon	1947	1948 medium (<i>Aphytis</i> colonized) ants present	Commercially clean 1950. Fair ant control



Lemon tree in the Escondido area defoliated by California red scale. The injury occurred when natural enemies were virtually eliminated for an eleven-month period by light monthly sprays of DDT, designed to be ineffective against scale.

SCALE

Continued from page 8

The orange grower in the Escondido area probably can quit treating and expect to achieve good biological control without suffering from severe pest damage if certain qualifications are understood.

Foremost, the grower should have constant advice from a field entomologist well versed in biological as well as chemical control. Since this entomologist would undoubtedly occasionally recommend colonization of natural enemies, the need for an insectary is indicated. A single grower or a few growers can not afford an insectary so some sort of group co-operation would be desirable. A similar program of supervised control is being successfully used by the University in co-operation with alfalfa and cotton growers who have organized into districts in northern California. If parasites or predators are doing a good job no treatment is made, otherwise insecticides are recommended.

Many factors would have to be considered and appropriate action taken to permit a citrus grower safely to quit and stay out of treatment.

Existing ants should be controlled. Pests should not be abundant initially, or damage might occur before natural enemies become numerous. The effect of past treatments in reducing natural enemy populations should be evaluated so that initial colonizations of insectary-reared parasites or predators can be made if necessary. The microclimate of the grove

should be considered for it will favor or inhibit parasites and predators. The necessity for future deficiency or fungicidal sprays must be evaluated because these materials, too, may inhibit natural enemies. The degree of contamination with field or road dust to which the trees are subjected must be considered. Finally, the emergency use of any insecticide to control a pest which may do damage if left untreated must be considered from the standpoint of its over-all effect against the pest and all natural enemies, not the pest alone.

Even after the grower has quit treatment and developed a satisfactory degree of natural control in his grove his problems are not solved for good. Unusually extreme climatic conditions may kill off natural enemy populations with the result that serious pest increases follow. This happened throughout southern California in the case of the black scale following the winters of 1948-49 and 1949-50. An insectary maintaining stocks of the more important natural enemies would be very valuable under those circumstances.

The lemon grower may reduce treatment under similar conditions but he will probably have to treat for citrus bud mite, perhaps for rust mite. If bud mite control can be obtained by the judicious use of a material which has relatively little adverse effect on natural enemies of other pests, no other treatments may be required. Colonization of insectary-reared red scale parasites may be more necessary on lemons than on oranges because the lemon is more preferred by the red scale. The lemon tree also may furnish a poorer microenvironment for red scale parasites.

Individual growers without help from entomologists and insectaries, may leave untreated some acreage—at least one acre—which would not seriously hurt them economically if pest damage should occur. The block chosen to go untreated should be kept free of ants at all times and it should be relatively dust free. If after two or three years the untreated trees are satisfactorily controlled biologically, more acreage can be added to the program.

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CLOVER

Continued from page 3

sult in: 1, a firm seedbed; 2, a light mulch of soil and organic matter to cover the seed; 3, a ready source of phosphate for the young plants which is necessary for maximum growth of clover; and 4, nitrogen-fixing bacteria will be present for nodulation of the roots.

From one to 10 pounds of seed per acre should be sufficient. An original seeding of one pound per acre will generally develop into a solid stand in four or five years. The higher rate should provide a solid stand the second year.

If the soil is extremely infertile and supporting practically no growth of native plants, rose clover may be used alone. If there is a fairly good cover of native weedy annual grasses and other types, a mixture of 50% rose clover, 25% sub-clover, and 25% crimson clover is recommended. Bur clover is not recommended in this original mixture because if it is not already present on a range, it is probably not adapted to that particular soil under existing conditions.

A mixture of winter annual legumes is desirable for two reasons: 1. Seasons vary tremendously in California, and rose clover may do better one year, and sub-clover another, on the same site. 2. Any field has some soil variation, and rose clover will occupy the poorer soil or better drained areas, subclover will do well on the better soil or moister sections.

Rose clover may be included in the seeding mixture for use after controlled brush burns. For seeding burns one half to one pound of seed per acre is usually adequate when included in a general seed mix, such as harding, smilo, burnet, and alfalfa. The seed should be inoculated with a Nitragin-type preparation just before mixing it with the other seeds.

The only evidence on the use of rose clover on grain land is a 50-acre planting near Farmington, San Joaquin County. It was seeded by plane December 1, 1950, in red oat stubble. No seedbed preparation was made because of wet weather. Single superphosphate was applied at the rate of 500 pounds per acre. Inoculated seed was used at the rate of eight pounds per acre.

The advantages of growing rose clover on grain land are: 1. It will do well on soil types that do not support a good growth of bur clover. 2. It will provide a good aftermath feed to supplement the cereal stubble. 3. It will volunteer in succeeding years and add nitrogen to the soil, thus aiding the grain crop.

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More detailed information on the subject of range improvement is presented in Circular 371, Improving California Brush Ranges, by R. Merton Love and Burle J. Jones, and Circular 407 Rose Clover, by R. Merton Love and Dorman C. Sumner. These circulars are available without charge at the local office of the Farm Advisor or by addressing a request to Agricultural Publications, 22 Giannini Hall, University of California, Berkeley 4, California.