Red Scale in Citrus

control affected by grove location and pest's post-treatment build-up

R. C. Dickson and D. L. Lindgren

THE COMMON California red scale is the most serious pest of citrus in southern California.

Apparently spreading from the original infested areas in Orange and Los Angeles counties, the red scale has reached all the citrus areas of California and Arizona. Quarantine and eradication programs have been important in limiting its spread and status as a serious pest in certain areas such as Arizona and in Ventura County, California. Climatic conditions have appeared as limiting factors in the past and the yellow scale has outranked the red in such interior counties as Tulare and Butte. More recently, however, the red scale has been noted in the warmer sections including the Coachella Valley.

Red scale occurs over a good portion of California, being found on ornamentals where there is no citrus. In recent years this insect has shown a marked tendency to increase in the interior districts. It has become of considerable importance in the Redlands area and has appeared in commercial groves in Tulare County and in the Coachella Valley. This may indicate that natural selection is producing a strain of red scale tolerant to high temperature and low humidity.

Yellow scale is similar to red scale but can ordinarily be distinguished from it in the field by the paler color and flatter shape and by the fact that yellow scale seldom infests the wood and twigs. It is commonly found in the interior districts and at the present time is of little commercial importance except in the San Joaquin Valley.

Generations of Red Scale

Experiments were conducted for two years to determine the number of generations per year of the red scale at various locations throughout southern California.

Red scale females produce young over an average period of 64 days in the summer and 154 days in the winter.

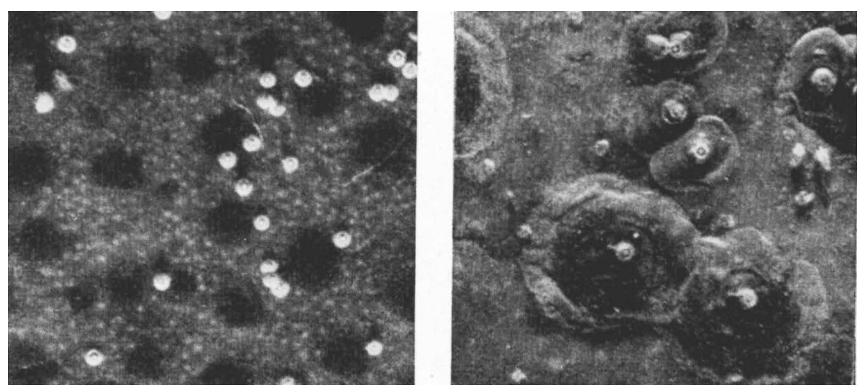
The shortest period recorded from settling to maturity was 58 days for one lot of insects at Riverside from July 7 to September 3, 1940. The longest period recorded was 262 days at Rincon Creek, Santa Barbara County, from September 11, 1940, to May 31, 1941.

In most locations it took six to seven months in the winter for a red scale to complete its development. In the summer it took a little over two months in the interior and about three months along the coast.

The number of generations per year was found to vary from 3½ at Elsinore and Corona to two at Carpinteria.

A red scale population is never all in one stage of the life cycle at the same time. The nearest approach to this comes in the spring when the per cent of adults is considerably higher than at other seasons.

The long period of young production by each female creates a condition of overlapping generations and explains the presence of scale of all ages as is commonly found.



California red scale, *Aonidiella aurantii* (Mask.). Left, whitecap; right, adult.

Resistance to HCN Fumigation

All reports of early HCN—hydrogen cyanide—fumigation against the red scale indicate that the results were very good. The kills obtained were so high that it was necessary to fumigate only at two- to four-year intervals. Unsatisfactory results appeared first in a limited area near Corona a few years before 1914.

Experimental work showed that the poor kills obtained in this area were due to the presence of a race of red scale that was definitely resistant to HCN fumigation.

The resistant race of red scale has become scattered throughout the citrus-growing areas of California. It is possible to find resistant red scale in any citrus-growing county and in practically any district.

Resistance to HCN fumigation in red scale is inherited so that the continued use of fumigation in a grove in which both resistant and nonresistant scale occur kills out the nonresistant race, leaving only the resistant individuals to reproduce themselves.

If a grove is infested with nonresistant scale only, repeated fumigations will not increase resistance.

The spread of resistant scale and continued fumigation have resulted in a gradual increase and extension of the resistant race so that now when red scale is introduced into a new locality there is a good chance that it will be resistant.

At the present time there is no indication that the nonresistant race is able to reëstablish itself in groves which are sprayed rather than fumigated.

Control Variable

The length of time that a treatment will control the scale in a grove is determined by the density of the scale population before treatment, the per cent kill obtained, and the rapidity of the build-up following treatment.

Along the coast where the build-up is slow a comparatively poor kill will serve to hold down the scale as well as a good kill will in the interior.

Growers near the coast who practice fumigation may not be aware of the fact that they have resistant red scale in their groves since the treatment may hold the scale well anyway.

In the interior the more rapid build-up accentuates any poor kill and it soon becomes evident to the grower. This explains the rather common belief among citrus growers that resistant red scales are confined to the interior districts of California.

While resistant red scales are more common in the interior than along the coast they do occur in all areas, and now constitute an important part of our red scale population.

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FORAGE PLANTS

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to set seed on stems only two inches in height. It will probably replace or supplement much of the domestic ryegrass currently being so widely used on the range.

Prairie Brome

This strain was first grown in California at the Meloland Experiment Station of the University of California in the Imperial Valley with seed obtained from New Zealand.

Prairie brome is a strong winter grower. It has performed particularly well on coastal ranges. Elsewhere, without irrigation, its use is limited to good soils. There are indications that it is a good irrigated pasture plant. It is definitely distinct and superior to any of the "rescue grasses" of the southwestern United States.

Ryegrass 12

Ryegrass 12 is an increase from a packet of seed obtained in November, 1943, from the Plant Research Bureau, Grassland Division, New Zealand.

It is presumably a sister strain of their short rotation ryegrass. Both are selections from an artificial hybrid between annual and perennial ryegrass made in New Zealand.

Ryegrass 12 is morphologically about intermediate between the parents. It produces early fall growth, recovers more rapidly after pasturing than either annual or perennial ryegrass, and remains green much longer than annual ryegrass. It will undoubtedly find a place in California's irrigated pastures and good soil on dryland ranges.

Rose Clover

A winter annual, the foundation seed of rose clover is derived from F. C. 23014. The original seed was obtained from the U. S. Department of Agriculture at Beltsville, Md.

It appears to be less sensitive to low temperatures and short daylength than either bur clover or subclover, and therefore grows more rapidly than either of them in cool weather.

Rose clover is a true clover. It has no valuable burs and there is no intention of its eliminating bur clover. Rather, rose clover will supplement bur clover where it is difficult to obtain satisfactory stands or growth of the latter. It remains green one to two weeks longer than midseason subclover. It is especially useful on poor soils that are slightly acid as found in zones 1, 4, and 5.

All foundation seed of these forage plants is in the hands of capable seed growers. Under the direct supervision of the California Crop Improvement Association, the seed fields of those growers will be given every care, in order that the livestock industry may have better plants with which to revegetate their ranges and irrigated pastures.

R. Merton Love is Associate Professor of Agronomy, and Associate Agronomist in the Experiment Station, Davis.

Further information about forage plants is contained in the California Experiment Station Circular 371, "Improving California Brush Ranges," which is available without cost at the office of your local Farm Advisor or from the College of Agriculture, Berkeley 4, California.

HOUSING

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Certain features are required by the State Labor Housing and Sanitation Act—for example, the 75-foot distance from privies to kitchen or mess hall.

The workers' camp and individual units should be well placed with regard to compass directions. Where strong winds occur, buildings should be sheltered behind trees or hedges. Privies should be downwind from dining and sleeping quarters.

If rains usually come from a certain direction, buildings should be protected by natural land features, and placed to secure the best weather resistance.

Where summer heat is severe, bunkhouses should be shaded on the south and west by large deciduous trees.

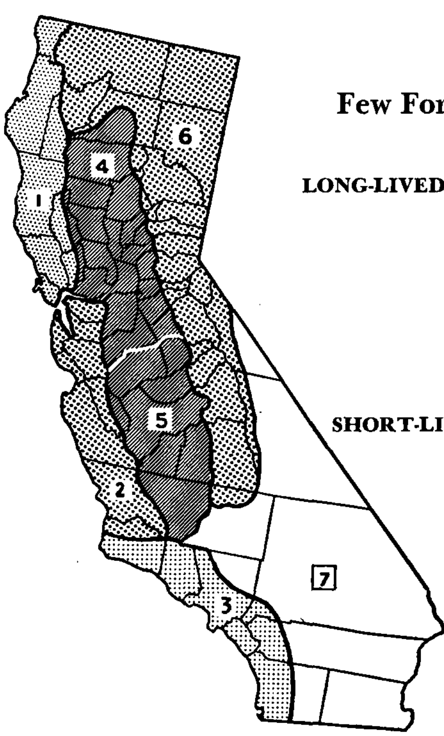
L. W. Newbauer is Assistant Professor of Agricultural Engineering and Associate Agricultural Engineer in the Experiment Station, Davis.

The University has prepared a series of leaflets on farm labor housing structures and arrangement. The structures meet the requirements of the State Labor Housing and Sanitation Act. They have been approved by the Division of Immigration and Housing.

The leaflets listed below, by number and title, may be secured without cost by addressing the College of Agriculture, Berkeley 4, California.

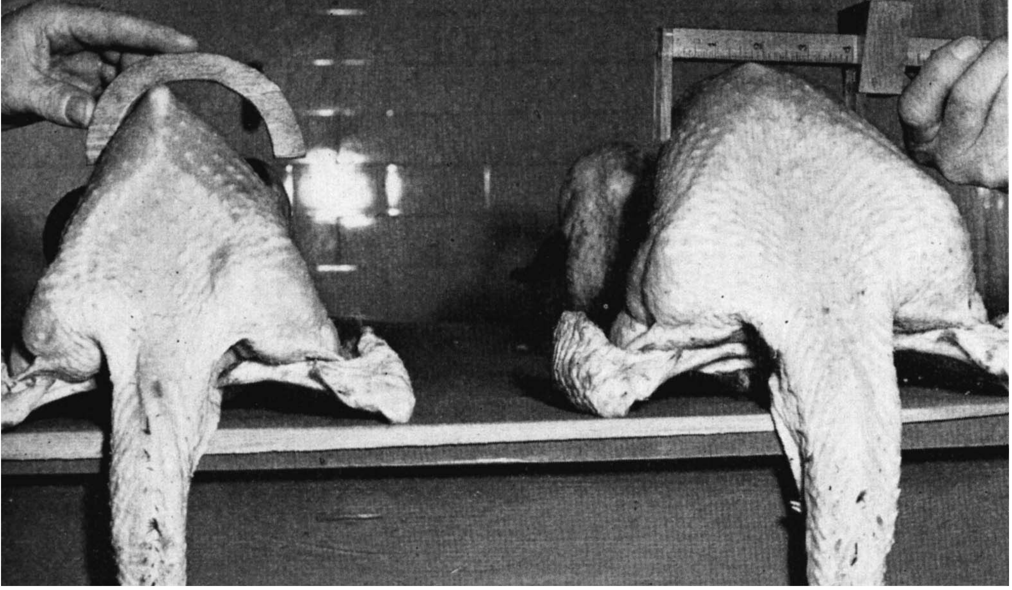
B-HD. Details (usually included with plans)
B-H1. A Four-Man Canvas-Roof Cabin
B-H2. A Two-Man Bunkhouse
B-H3. A Six-Man Bunkhouse
B-H4. A Two-Room Family Unit with Bath
B-H5. Two-Room Bathhouse, Men and Women
B-H6. A Farm-Labor Mess Hall with Kitchen
B-H7. Camp and Field Privies
B-H8. Labor-Camp Equipment
B-H9. A Twelve-Man Bunkhouse
B-H10. Bunkhouse with Separate Rooms
B-H11. Arrangement of Camp Structures

The California Experiment Station Bulletin No. 472, "Adobe Construction," also is available.



Few Forage Plants for California

Plant	Origin	Use	Adaptation	Zone
LONG-LIVED PERENNIAL BUNCHGRASSES				
Purple stipa	Native	Dry range	Brushlands; woodland—grass areas	1, 2, 3, 4, 5
Nodding stipa	Native	Dry range	Brushlands; drier areas beyond tree line	1, 2, 3, 4, 5
Smilo	Mediterranean	Dry range	Brushlands; light soils	1, 2, 3, 4, 5
Perennial veldt	South Africa	Dry range	Brushlands; sandy soils	2, 3, 4, 5
SHORT-LIVED PERENNIAL BUNCHGRASSES				
Harlan brome	Chile	Dry range	Brushlands; poor soils	1, 2, 3, 4, 5, 6
Prairie brome	South America	Dry range	Brushlands; good soils	1, 2, 3
		Irrigated Pasture		1, 2, 3, 4, 5
Ryegrass 12	New Zealand	Dry range	Brushlands; good soils	1, 2, 3
		Irrigated Pasture		1, 2, 3, 4, 5
WINTER ANNUAL LEGUME				
Rose clover	Europe	Dry range	Brushlands; poor soils, slightly acid	1, 2, 3, 4, 5



Measuring width of breast on dressed birds.

TURKEYS

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hatch well, whereas washed clean eggs hatched as well or almost as well as unwashed eggs.

These findings emphasize the importance of producing clean eggs; keeping them in a cool room on the farm, at the receiving plant, and in transit; frequent delivery to the receiving plant or hatchery—two or three times a week—and prompt shipment from the receiving plant to the hatchery. Of course, the hatchery operator should also set the eggs promptly after they are received.

Turkey Feeding

Hatchability of turkey eggs is determined primarily by the hatching quality of the egg when laid. Methods of handling and hatching the eggs can reduce the innate hatchability of the new laid egg but cannot do much, if anything, to improve it. This is determined by breeding and by nutrition. In practice nutritional deficiencies are probably more commonly responsible for hatching failures than are breeding effects, such as those resulting from close inbreeding.

Knowledge of the nutritional requirements of turkeys to ensure maximum hatchability is still incomplete. Work done some years ago showed the need for riboflavin and pyridoxine and this has been well established.

Since the needs for reproduction have not been fully established, it would be well to feed an adequate breeder ration starting about a month before eggs are expected. If lights are used, the change to a breeder mash might be made at the time the lights are started. Then as an added insurance measure fresh greens should be fed.

The turkey nutrition work has demonstrated that turkey poults require a slightly higher level of the water soluble vitamins, such as riboflavin, than chicks. Also that the higher protein requirements of turkey poults as compared with chicks are reflected in higher requirements for some of the indispensable amino acids—the building blocks of the proteins. Too low a level of lysine may or may not be the cause of the wide white bar sometimes seen on the wings of Bronze poults, but in any case the work done on protein requirements indicates that too little protein is the commonest cause of the white bar and the slow growth which often is associated with it.

While much work remains undone on the nutritional needs of young turkeys, it is expected that work can soon be started on the nutritional needs of breeding turkeys.

V. S. Asmundson is Professor of Poultry Husbandry, and Poultry Husbandman in the Experiment Station, Davis.

F. W. Lorenz, Assistant Professor of Poultry Husbandry, and Assistant Poultry Husbandman in the Experiment Station, Davis, and F. H. Kratzer, Assistant Professor of Poultry Husbandry, and Assistant Poultry Husbandman in the Experiment Station, Davis, participated in the studies reported above by Dr. Asmundson.

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HAROLD ELLIS.......................Director, Agricultural Information

W. G. WILDE..................................Editor

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HEALTH CONCEPTS

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Such widely prevalent conditions as anemias may be of varied origin involving iron, copper, cobalt, and members of the B complex.

In the human, macrocytic anemia may be due to improper diet lacking meat, milk, and eggs, resulting in an absence of the extrinsic factor, and be nutritional in origin. Folic acid may be involved. This is usually the case in sprue and other tropical macrocytic anemias.

No data on nutrition, as a factor in resistance of humans to infectious disease, have been obtained in any way comparable to known data on inherited resistance in poultry, where fowl typhoid has been reduced from 85% to 10% in five generations of selective breeding.

The situation with diseases caused by protozoa is quite comparable to infectious disease in that data are lacking, inconclusive, or in some cases, quite negative.

In the case of parasitic invasions the importance of nutrition has been more tangibly established. Thus in cecal coccidiosis of growing chickens caused by *Eimeria tenella* the feeding of a ration containing 40% dry skim milk has been demonstrated to be beneficial. Credit for this has been given to the milk sugar, to the nutritional value of milk and/or the laxative effect.

Nutrition, heredity, and disease are so closely interwoven in the development and environment of the individual that separation for even carefully controlled experiments is extremely difficult or impossible.

While great progress has been made, we now need to know the secrets that remain unknown.

George H. Hart is Professor of Animal Husbandry, and Animal Husbandman in the Experiment Station, Davis.

Factors involved in the yield of olive orchards are subjects of a special study undertaken by the Division of Pomology.

CALIFORNIA AGRICULTURE this month comes to you in new form, one that we hope will not only be more attractive but also will enable us to give you more information. The response to this publication has been gratifying; we believe it is serving a useful purpose in getting results of research in the College of Agriculture to you more quickly. We will welcome suggestions for its further improvement.

—THE EDITOR