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A REPORT OF THE COCCIDS INFESTING AVOCADOS IN CALIFORNIA

With Special Reference to *Chrysomphalus Dictyospermi* (Morgan)

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IN THE FOLLOWING report are presented results of a survey of the commercial acreage devoted to avocado culture to determine the relative numerical abundance of this and other Coccids attacking avocados in San Diego, Orange, Los Angeles, Ventura, Santa Barbara, San Bernardino and Riverside counties, an area comprising practically all commercial avocado plantings in the State. It also deals generally with:

1. The questions leading up to the survey
2. Activities of the Department of Agriculture and other agencies in this field prior to the inauguration of this project
3. Organization and findings of the survey
4. A host index of *C. dictyospermi* based on the world record of plants on which they are found
5. The Latania scale and its economy
6. A discussion of the status of other species of particular economic significance with pertinent data on their hosts and distribution
7. Questions involved in control
8. Summary
9. Conclusion

QUESTIONS LEADING UP TO THE SURVEY

In 1924, Florida grown avocados infested with Dictyospermum scale were found on sale in the markets of Santa Barbara by the agricultural commissioner. This incident received considerable publicity in the avocado industry which at that time had just begun to expand its acreage. As a result there was engendered in the minds of many avocado and citrus growers, an -idea that this scale was a menace to both industries, particularly the former, and should be made an object of regulatory action by the State.

That this feeling was not merely a transitory fear is evidenced by subsequent action taken by different grower organizations and committees.

The question of the status of the scale again flared up and received added impetus the latter part of 1926 when a large shipment of Florida grown *Coccus plumosa* palms landed in Los Angeles. This species was known to be a host of the scale, though it must be admitted none were found. Sentiment, which heretofore had been local, became general and spread to parts of the citrus industry, finding expression at meetings of growers and committees. An idea as to how this scale was viewed by growers can perhaps better be understood by quoting from the minutes of a meeting of the pest control committee of the Fruit Growers Exchange, December, 1927, reported by E. S. Woglum, from whose report the following excerpts are taken:

> During the discussion it was shown that the Dictyospermum scale, otherwise known as the red scale of the Mediterranean, is the primary citrus pest of the Mediterranean countries, where its destructiveness to citrus is comparable with that of the California red scale. It infests the fruit, leaves and wood and in bad infestations has killed the trees outright. The conditions under which it exists in the Mediterranean are practically identical with California conditions. In Florida it is reported as the worst pest of avocado and its establishment in California might prove a serious drawback to profitable production. The form that occurs on palm and avocado has been pronounced by the University of California as identical with that on citrus in the Mediterranean.
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> The opinion was expressed that to obtain full protection it would pay the citrus industry to buy up these Florida palms and destroy them, provided future importations could be stopped. As it is, the palms are likely to be sold individually or in small lots and

distributed all over the State.

The consensus of opinion of citrus growers was that the Dictyospermum scale constituted a threat to the citrus industry through possible importation from Florida, and since inspection is inadequate it was believed host plants should be kept out by restrictive measures.

Motion was made by Mr. Myers, seconded by Griffith, that the California Fruit Growers Exchange provide sufficient funds for the expenses of an entomologist to investigate the Dictyospermum scale situation in Florida, and that the Director of Agriculture be asked to send a competent entomologist to Florida at once. Furthermore, that the Avocado Growers Exchange be asked to cooperate in the matter.

It requires no great stretch of the imagination to get a proper idea of the growers' viewpoint as expressed above. "Whether such attitude is justified by circumstances is not to the point. The fact is the idea that this scale constituted a standing menace was firmly implanted in the minds of representative growers and officials in both industries and neither individual nor collective sentiment was going to be changed until something was done to convince them otherwise.

Other meetings were held, but the problem of the Medfly, which was found in Florida in 1929, completely overshadowed the issue, and it was not revived again until 1930, when the aforementioned action was taken.

ACTION TAKEN PRIOR TO THE SURVEY

In 1924, immediately after the finding of this scale in Santa Barbara, the State Department of Agriculture, through its nursery service, undertook investigation, seeking advice from both State and Federal authorities in regard to its status and the hazards to be anticipated relative to its introduction on various commodities, particularly avocados from Florida. It was found that the insect was now present on five species of plants in Los Angeles County, the San Francisco bay region and parts of Sacramento and San Joaquin valleys, and that it was not known to exist except in greenhouses or under lath. At that time, through the nursery service, a survey and cleanup campaign was started which is still in operation.

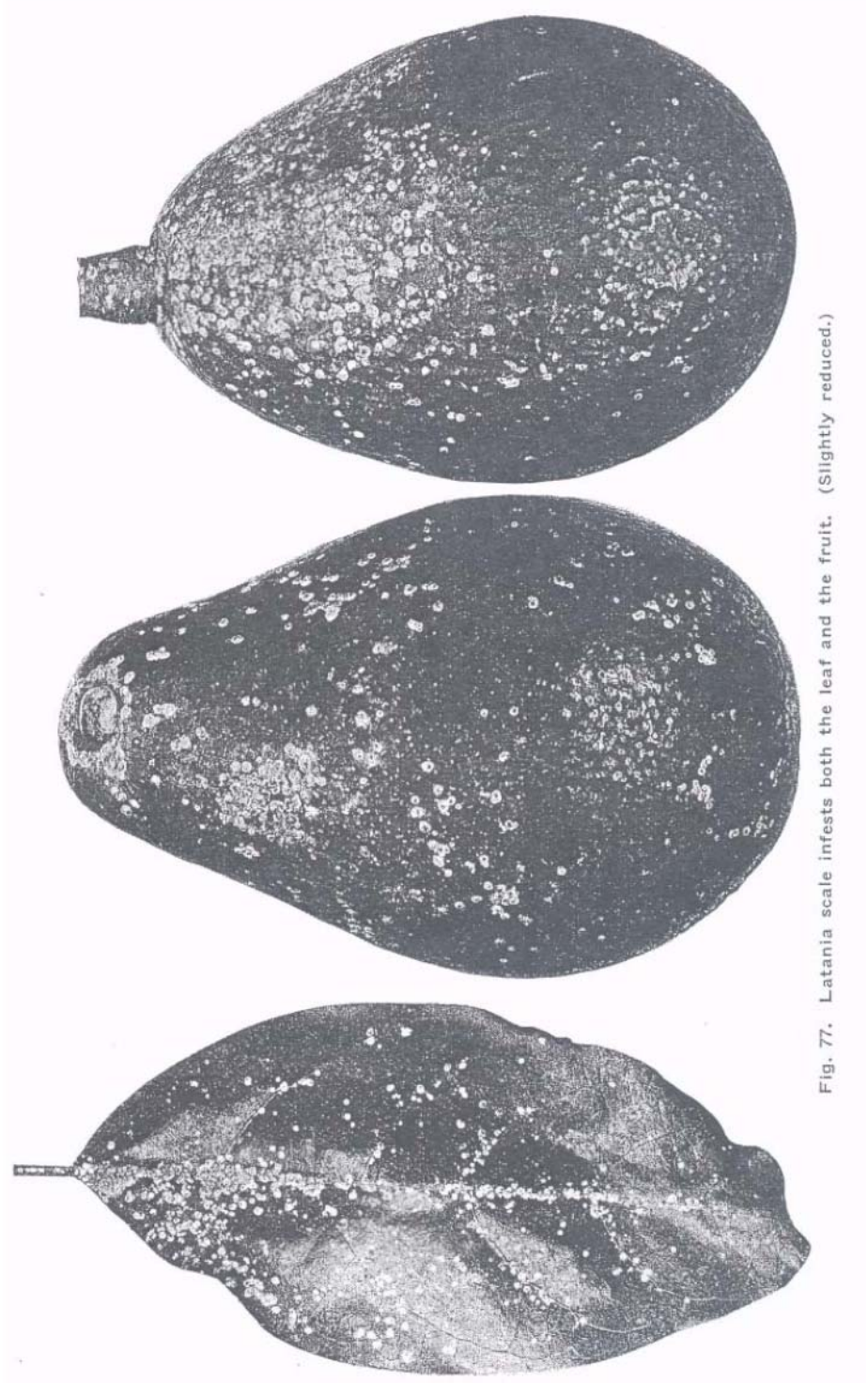

Fig. 77. Latania scale infests both the leaf and the fruit. (Slightly reduced.)

As a result of the resolution proposed in the aforementioned meeting, George Wilson, entomologist of the Department, visited Florida, spending a month investigating the various nurseries which shipped

palms into California, as well as avocado groves in many sections of peninsular Florida. In all of hiss investigations lie was accompanied by the State Nursery Inspector of Florida and a representative of the Plant Board, who made every effort to develop information which would be of interest to him. A report of his findings has been made public and is of considerable interest. In it he stated that while this scale is found on the *Coccus plumosa,* where present in numbers it is easy to locate; only under conditions of heavy infestations is it found under the base of the petiole, where due to its great numbers, it is readily distinguishable. It was also noted upon avocados near Lake Okeechobee, though under conditions which could hardly be called representative, as the orchards had been defoliated by the October hurricane and neglected since that time. He also was able to demonstrate that it could be readily controlled by a 2 per cent oil spray and was amenable to treatment by either atmospheric or vacuum fumigation. In this connection the fact should not be lost sight of that in Florida plantings of avocados are 90 per cent or more of the West Indian variety, thin skinned and smooth.

In 1928, the inspection of this species was carried out by both the county agricultural commissioners and the State. Investigations conducted by Commissioners Ryan and Brock also brought out the fact that the scale occurred outside in residential properties in both Los Angeles and Orange counties and also on other species beside the Kentias and avocados. During this year and in the year following, 57 nurseries and florists' establishments in which it was found were made the subject of eradication operations, which by the end of 1929, had been successful in 46 of these. The results accomplished were brought about by the drastic procedure of burning or by destruction or vacuum fumigation of infested material. The majority of the plants destroyed were palms of the genus Kentia. Next in order of abundance were Pandanus, Ficus (India rubber and Morton Bay fig), Canary Island date and Dracena, respectively. Through continued inspections new infestations have since been added.

Work by members of the staff of Agricultural Commissioner Ryan of Los Angeles County developed Dictyospermum scale on Canary Island date (old trees) in 26 different widely separated properties in the metropolitan district of Los Angeles. They also found it in residential properties on camphor, rubber and .avocados. The same inspectors found it on 16 properties in Whittier, also in Beverly Hills and at Montebello.

Commissioner Brock's investigations revealed its presence on seven hosts including avocado in the vicinity of Santa Ana in Orange County. These investigations point conclusively toward its existence out of doors for a number of years.

The above is in brief a summary of activities of the department and other regulatory officials in connection with this species in the State. In order to round out our knowledge of its possible status, it may be well to look into its past history.

ORGANIZATION OF THE SURVEY

Immediately following the appropriation, the writer was charged with the responsibility of organizing and carrying out a survey to develop data on the economic significance of this and other species of insect life, particularly Coccids, attacking avocados. Cyril Gammon, Assistant Entomologist of the department, was placed in charge of the field forces and field operations. To secure data that would be most representative and enable an accurate interpretation of the status and economy of each species, a system of range finding was initiated, also a rigid system of uniformity as to methods of taking, preparation and identification of specimens.

To obtain a sectional view of the nonbearing industry, scouting was first inaugurated in the recently planted and nonbearing areas of San Diego County, the object being to ascertain the relative abundance on the younger, nonbearing trees compared to the older trees. As a result of this preliminary scouting it was early evident that younger trees had either been planted from cleaner stock or infestation was relatively slow in developing, as the scale was either absent or most difficult to find. For this reason, the survey was confined to bearing trees in commercial stands, as they offered

the added advantage of furnishing data on infestation of fruit, branch and foliage; likewise opportunity had been afforded the scale to become established and attain equilibrium.

All identifications were made by the department's taxonomist, H. H. Keifer, except in special cases where specimens were forwarded to specialists for final decision. In the collecting of specimens, every inspector, to the best of his ability segregated the species taken in each orchard, placing each collection in preserving fluid and sending same to Sacramento. The identification procedure consisted of developing series of authenticated specimens of each species on slides, the identifications being made by Harold Morrison of the U. S. Bureau of Entomology. As the specimens were received at the Sacramento laboratory they were examined under the microscope and a representative series selected for - critical study. This, after boiling and staining, was placed upon a single slide and the material determined by microscopic inspection and compared with authenticated specimens. During the course of the survey, 1155 lot determinations were made. Of these, 800 had to be mounted on slides, each slide averaging six specimens. A larger number was prepared in order to reduce the factor of error to the minimum. In order that it may be subject to recheck in the event of seeming necessity, all material has been placed on file and is immediately available.

In order to convey an idea of the comparative degree of infestation present, the terms, *light, moderate* or *moderately heavy* and *heavy* are used to report scale insects of major importance and are defined as follows:

(Type A) LIGHT—Infestation consisting of few scattered scales.
Infestation localized to less than 5 per cent over tree.
Limited to patches of scale in areas susceptible to infestation.

(Type B) MODERATE—Infestation generally distributed over tree, less than five scales per square inch over area susceptible to infestation.
Infestation localized on less than 25 per cent of tree, but with 20 or more scales per square inch over area susceptible to infestation.

(Type 0) HEAVY—Infestation generally distributed over tree; 5 or more scales per square inch over area susceptible to infestation.
Infestation localized on 25 per cent or a greater fraction of tree, but with 20 or more scales per square inch over area susceptible to infestation.

Summary of Infestation Data. Total for Survey Area

Host, Avocado

Number properties inspected	1,448	
Area represented	1,586¾ acres	
Number trees inspected	27,868	
Number trees found infested (one or more species)	12,245	(43.94% of trees inspected)

Trees infested with—

Aspidiotus lataniae	10,521	(85.92% of infested trees)
		Light— 7,766 (73.81%)
		Mod.— 2,188 (20.8 %)
		Heavy— 567 (5.39%)
Aspidiotus hederae	2,151	(17.57% of infested trees)
		Light— 2,058 (95.68%)
		Mod.— 93 (4.32%)
		Heavy— 0
Chrysomphalus dictyospermi	1,136	(9.28% of infested trees)
		Light— 647 (56.95%)
		Mod.— 312 (27.46%)
		Heavy— 177 (15.58%)
Aspidiotus camilliae	755	(6.17% of infested trees)
		Light— 682 (90.33%)
		Mod.— 73 (9.67%)
		Heavy— 0
Chrysomphalus aurantii	626	(5.11% of infested trees)
		Light— 316 (50.48%)
		Mod.— 173 (27.64%)
		Heavy— 137 (21.88%)

Record of—

Saissetia oleae	41 groves
Coccus hesperidum	30 groves
Saissetia hemisphaerica	5 groves
Lecanium corni	3 groves
Ceroplastes cirripediformis	1 grove (one individual)
Pseudococcus gahani	7 groves
Pseudococcus longispinus	5 groves
Pseudococcus maritimus	4 groves
Mealybug unidentified	5 groves
Thrips	8 groves
Red spider	20 groves

San Diego County

Host, Avocado

Number properties inspected	106	
Area represented	323¾ acres	
Number trees inspected	3,057	
Number trees found infested (one or more species)	283	(9.26% of trees inspected)

Trees infested with—

Aspidiotus lataniae	169	(59.72% of infested trees)
		Light— 136 (80.47%)
		Mod.— 28 (16.57%)
		Heavy— 5 (2.96%)
Aspidiotus hederae	105	(37.1 % of infested trees)
		Light— 55 (52.38%)
		Mod.— 50 (47.62%)
		Heavy— 0
Aspidiotus camilliae	84	(29.68% of infested trees)
		Light— 34 (40.48%)
		Mod.— 50 (59.52%)
		Heavy— 0
Chrysomphalus aurantii	27	(9.54% of infested trees)
		Light— 14 (51.85%)
		Mod.— 11 (40.74%)
		Heavy— 2 (4.41%)

Record of—

Saissetia oleae	11 groves
Coccus hesperidum	9 groves
Saissetia hemisphaerica	1 grove
Pseudococcus maritimus	1 grove
Pseudococcus longispinus	1 grove
Thrips	3 groves
Red spider	9 groves

Orange County

Host, Avocado

Number properties inspected	86	commercial
	69	residential
Area represented	302¾	acres
Number trees inspected	3,689	
Number trees found infested (one or more species)	1,120	(30.36% of trees inspected)
Trees infested with—		
Aspidiotus lataniae	750	(66.96% of infested trees)
Light—	599	(79.87%)
Mod.—	144	(19.2 %)
Heavy—	7	(0.93%)
Aspidiotus hederae	115	(10.27% of infested trees)
Light—	110	(95.65%)
Mod.—	5	(4.35%)
Heavy—	0	
Chrysomphalus aurantii	106	(9.46% of infested trees)
Light—	40	(37.74%)
Mod.—	30	(28.3 %)
Heavy—	36	(33.96%)
Aspidiotus camilliae	55	(4.91% of infested trees)
Light—	49	(89.09%)
Mod.—	6	(10.91%)
Heavy—	0	
Chrysomphalus dictyospermi	43	(3.84% of infested trees)
Light—	24	(55.81%)
Mod.—	18	(41.86%)
Heavy—	1	(2.33%)
Coccus hesperidum	8	groves; 122 trees (10.89% of infested trees)
Saissetia oleae	11	groves; 35 trees (3.13% of infested trees)
Red spider	9	groves

Los Angeles County

(Including City of Whittier)

Host, Avocado

Number properties inspected	210	commercial
	865	residential
Areas represented	731¾	acres, commercial
	12,284	trees, residential
Number trees inspected	16,876	
Number trees found infested (one or more species)	10,366	(61.42% of trees inspected)
Trees infested with—		
Aspidiotus lataniae	9,555	(92.18% of infested trees)
Light—	6,986	(73.11%)
Mod.—	2,014	(21.08%)
Heavy—	555	(5.81%)
Aspidiotus hederae	1,678	(19.19% of infested trees)
Light—	1,650	(98.33%)
Mod.—	28	(1.67%)
Heavy—	0	
Chrysomphalus dictyospermi	1,093	(10.54% of infested trees)
Light—	623	(57. %)
Mod.—	294	(26.9 %)
Heavy—	176	(16.1 %)
Chrysomphalus aurantii	475	(4.58% of infested trees)
Light—	262	(55.16%)
Mod.—	114	(24. %)
Heavy—	99	(20.84%)
Aspidiotus camilliae	466	(4.5 % of infested trees)
Light—	453	(97.21%)
Mod.—	13	(2.79%)
Heavy—	0	
Record of—		
Saissetia oleae	10	groves; 25 trees
Coccus hesperidum	2	groves; 2 trees
Saissetia hemisphaerica	1	grove
Lecanium corni	1	grove
Pseudococcus gahani	2	groves
Pseudococcus maritimus	1	grove
Pseudococcus longispinus	1	grove
Thrips	1	grove
Red spider	2	groves

Los Angeles County

(Not including City of Whittier)

Host, Avocado

Number properties inspected	210	
Area represented	731¾	acres
Number trees inspected	10,218	
Number trees found infested (one or more species)	4,601	(45.03% of trees inspected)

Trees infested with—

Aspidiotus lataniae	4,173	(90.7 % of infested trees)
		Light— 2,838 (68.01%)
		Mod.— 1,168 (27.99%)
		Heavy— 167 (4. %)
Aspidiotus hederae	1,017	(22.1 % of infested trees)
		Light— 993 (97.64%)
		Mod.— 24 (2.36%)
		Heavy— 0
Aspidiotus camilliae	287	(6.24% of infested trees)
		Light— 276 (96.17%)
		Mod.— 11 (3.83%)
		Heavy— 0
Chrysomphalus aurantii	158	(3.43% of infested trees)
		Light— 67 (42.41%)
		Mod.— 45 (28.48%)
		Heavy— 46 (29.11%)
Chrysomphalus dictyospermi	56	(1.22% of infested trees)
		Light— 18 (32.14%)
		Mod.— 31 (55.36%)
		Heavy— 7 (12.5 %)
Saissetia oleae	10	groves; 25 trees
Coccus hesperidum	2	groves; 2 trees
Saissetia hemisphaerica	1	grove
Lecanium corni	1	grove
Pseudococcus gahani	2	groves
Pseudococcus maritimus	1	grove
Pseudococcus longispinus	1	grove
Thrips	1	grove
Red spider	2	groves

Whittier

Host, Avocado

Number properties inspected	865	
Estimated number of trees in city	12,248	
Number trees inspected	6,658	
Number trees found infested (one or more species)	5,765	(86.59 % of trees inspected)

Trees infested with—

Aspidiotus lataniae	5,382	(93.36% of infested trees)
		Light— 4,148 (77.07%)
		Mod.— 846 (15.72%)
		Heavy— 388 (7.21%)
Chrysomphalus dictyospermi	1,037	(17.99% of infested trees)
		Light— 605 (58.34%)
		Mod.— 263 (25.36%)
		Heavy— 169 (16.3 %)
Aspidiotus hederae	661	(11.47% of infested trees)
		Light— 657 (99.39%)
		Mod.— 4 (0.61%)
		Heavy— 0
Chrysomphalus aurantii	317	(5.5 % of infested trees)
		Light— 195 (61.51%)
		Mod.— 69 (21.77%)
		Heavy— 53 (16.72%)
Aspidiotus camilliae	170	(3.1 % of infested trees)
		Light— 177 (98.88%)
		Mod.— 2 (1.12%)
		Heavy— 0

Ventura County

Host, Avocado

Number properties inspected	45	
Area represented	73¾ acres	
	5,346 trees	
Number trees inspected	1,855	
Number trees found infested (one or more species)	187	(10.08 % of trees inspected)

Trees infested with—

Aspidiotus hederae	84	(44.92% of infested trees)
		Light— 83 (98.81%)
		Mod.— 1 (1.19%)
		Heavy— 0
Aspidiotus camilliae	63	(33.69% of infested trees)
		Light— 59 (93.65%)
		Mod.— 4 (6.35%)
		Heavy— 0
Aspidiotus lataniae	45	(24.06% of infested trees)
		Light— 43 (95.56%)
		Mod.— 2 (4.44%)
		Heavy— 0
Coccus hesperidum	32	(17.11% of infested trees) (4 groves)
Saissetia oleae	19	(10.16% of infested trees) (4 groves)

Record of—

Ceroplastes cirripediformis	1 grove; (1 individual)
Pseudococcus gahani	2 groves
Mealybug unidentified	2 groves

Santa Barbara County

Host, Avocado

Number properties inspected	39
Area represented	84¾ acres
	5,519 trees
Number trees inspected	1,328
Number trees found infested (one or more species)	173 (13.02% of trees inspected)

Trees infested with—

Aspidiotus hederae	141 (81.50% of infested trees)
	Light— 132 (93.62%)
	Mod.— 9 (6.38%)
	Heavy— 0
Aspidiotus camilliae	53 (30.64% of infested trees)
	Light— 53 (100%)
Coccus hesperidum	26 (15.03% of infested trees)
	(7 groves)
Saissetia oleae	18 (10.4 % of infested trees)
	(4 groves)
Saissetia hemisphaerica	3 groves
Lecanium corni	2 groves
Aspidiotus lataniae	1 grove (1 tree)
Pseudococcus gahani	3 groves
Pseudococcus longispinus	3 groves
Pseudococcus maritimus	2 groves
Mealybug unidentified	3 groves
Thrips	4 groves
Fuller's rose beetle	3 groves

San Bernardino County

Host, Avocado

Number properties inspected	21
Area represented	54¾ acres
	4,848 trees
Number trees inspected	790
Number trees found infested (one or more species)	29 (3.67% of trees inspected)

Trees infested with—

Aspidiotus hederae	28 (96.55% of infested trees)
	Light— 28
Aspidiotus camilliae	28 (96.55% of infested trees)
	Light— 28
Saissetia oleae	1 (3.45% of infested trees)

Riverside County

Host, Avocado

Number properties inspected	7
Area represented	15½ acres
	725 trees
Number trees inspected	273
Number trees found infested (one or more species)	87 (31.87% of trees inspected)

Trees infested with—

Chrysomphalus aurantii	80 (91.95% of infested trees)
	Light— 0
	Mod.— 18 (22.5 %)
	Heavy— 62 (77.5 %)
Aspidiotus camilliae	6 (6.9 % of infested trees)
	Light— 6
Aspidiotus lataniae	1 (1.15% of infested trees)
	Light— 1

It will readily be seen from a study of the foregoing that— (1) *C. dictyospermi* is not the most abundant of the different Coccids found on avocados. Neither is it most widely distributed.

Though in the general summary it ranks third with 9 per cent infestation of trees examined carrying scale, this position is conceded only by inclusion of the heavily infested Whittier residential area. Its position in numerical abundance, figured against the commercial acreage only, shows it to be present on 99 trees out of 27,868, or slightly over 8/10 of 1 per cent, a consideration which would reduce it to the same status as the black and hemispherical form of scale.

(2) This scale is restricted to two counties, Los Angeles and Orange, with about 90 per cent of the infestation in the city of Whittier and the metropolitan district of Los Angeles, with infestation heaviest in the residential properties of Whittier.

(3) That each county has its predominant species, which in only two counties is the same.

The outstanding feature of the survey is the predominance of the Latania scale over all others in the area between the mountains and the sea from Beverly Hills to the Mexican border. This scale is present in varying ratio, exceeding its nearest competitor among other scales taken in the ratio 6.5 to 1. Such a condition is, to say the least, surprising, as the

species is without an economic record in the State, or for that matter in the country. Just why it has been overlooked is perhaps due to its close relationship and general resemblance to the other con- ' generic species, *Aspidiotus hederae,* and *A. camilliae,* the greedy scale. Both of these scales have been recognized as pests, though largely as affecting ornamentals. In view of its possible status in the economy of the avocado industry, it is desirable to give it more than casual reference.

Lack of available fruit due to seasonal conditions made it impossible to develop comparative data as to preference of *C. dictyospermi* for fruit of the different types, Mexican or Guatemalan. However, if branch and leaf furnish any index, the following data obtained in the heaviest infested section of the State, the residential section of Whittier, comprising approximately 80 blocks, may be considered representative.

Notes were made to determine the comparative susceptibility of avocados of Guatemalan type, Mexican type and the hybrid Fuerte variety to Dictyospermum scale.

Number of trees of Guatemalan type inspected	503	
Number of trees of Guatemalan type infested with Chrysomphalus dictyospermi	133 (26.4 %)	
	Light—	144 (85.71%)
	Mod.—	14 (10.53%)
	Heavy—	5 (3.76%)
Number of trees of Mexican type inspected	910	
Number of trees of Mexican type infested with Chrysomphalus dictyospermi	404 (44.4 %)	
	Light—	175 (43.32%)
	Mod.—	142 (35.15%)
	Heavy—	87 (21.53%)
Number of trees of Fuerte variety inspected	195	
Number of trees of Fuerte variety infested with Chrysomphalus dictyospermi	31 (15.9 %)	
	Light—	16 (51.61%)
	Mod.—	14 (45.15%)
	Heavy—	1 (3.23%)

For purposes of comparison, the Mexican varieties seem to be more favored. However, comparisons in this regard should not be drawn too hastily, as the position of the infested tree in residential properties is often such that ideal conditions for scale propagation may be of extremely local nature, and the environment of trees, even across the street, may be so entirely different, as vitally to affect the wellbeing of any insect such as members of the Coccidae that during their life attach themselves to their host and are not again free moving.

Due to lack of seasonal consideration, plus the limited distribution of the scale, no comparison of susceptibility to infestation of the different varieties was available. It was taken on both the Mexican and Guatemalan varieties.

The most that may be said at present in this connection is that it is believed that the possibility of fruit infestation is predicated largely on numerical abundance of the scale on other parts of the tree, and the seasonal ripening may possibly enter the equation in each particular variety.

BIOGRAPHICAL SKETCH

This scale was first described by Morgan from specimens taken on the palm, *Dictyosperma alba,* at Demerara (British Guiana) in 1889. It is of interest to record that the host, a popular ornamental palm, is of oriental origin, being native of southeastern Asia. It is of further interest that Bodkin, a successor of Morgan in British Guiana, reports inability to find the scale in that colony. Though originally described from Demerara, the fact that the subsequent investigators were unable even to find it there casts reasonable doubt as to its place of origin. The home of its host genus is southeastern Asia where the genus Chrysomphalus is also well represented by endemic species. The species has been reported by investigators from a wide range of hosts in this area leading to a natural presumption of oriental origin.

Until late years considerable confusion has existed as to the true identity of the material identified as *C. dictyospermi* and various so-called varieties.

In 1923 B. E. Green, the eminent British entomologist, established distinguishing characters which enabled the separation of *C. dictyospermi* (Morgan) from *C. pinnulifera* (Mask) with which it had until this time been confused and fixed the specific status of the latter species.

In 1927 J. C. Chamberlain of the Citrus Experiment Station at Riverside established the identity of the California scale as the true *C. dictyospermi.*

During the survey no attempt has been made to find new hosts, nor to develop a complete host list for California. It is a fact, however, that several have been added to the list both by agricultural commissioners and by the inspectors employed in the survey. Such species as have been added were secured during the house to house canvass of the residential area of Whittier and the metropolitan districts of Los Angeles.

Dictyosperma alba is a popular ornamental palm which is even now world-wide in distribution because of its popularity as an ornamental. There is perhaps no better means of distributing a scale insect than a popular ornamental and many of our new introductions are traceable to this group.

Its economic significance is perhaps greatest in parts of the Mediterranean basin. .In Spain it is called the "Poll Roig," and is the object of intensive control in most of the citrus growing districts. Prof. H. J. Quayle states, however, that if it were as abundant in the citrus districts in the vicinity of Valencia as in some other parts of Spain undoubtedly it would severely curtail production.

Dictyospermum scale is reported both on citrus and certain ornamentals in Algeria by Paul Marchal, the eminent French entomologist, and is the species to control which Woglum introduced hydrocyanic acid fumigation to Spain, which is the present means of control.

In so far as can be ascertained the first record of this scale taken in California was made by C. F. Baker and E. O. Essig on finding it in 1909 on orchid, *Coelogene cristata,* a popular commercial species native of southeastern Asia. Examination of the records of the quarantine office show that what was identified as this species was taken in 1913 on orchids in Philadelphia. During the same year it was taken on orchids from Belgium and on mangos (fruit) from Tahiti. In. the same year it was taken from orchids of widely separated families in the Conservatory at Golden Gate Park, San Francisco. A. A. Brock, then County Horticultural Commissioner of Ventura County, reported it from Kentia in 1915; while E. 0. Essig, University of California, reported it from Marysville and San Diego the same year.

Little interest seemed to attach to the species in California until the finding previously noted in 1924 at Santa Barbara. Examination of the records shows that it had been reported as injurious to palms under glass and had a fairly large host index; however, the idea that it could not exist outside in California does not seem to be justified.

In June, 1930, a committee of avocado and citrus growers, together with the Director of Agriculture, made representation to the Governor, as a result of which $8,400 was set aside from the emergency fund to make a survey of the avocado plantings to determine the economic significance of this scale with particular reference to the California avocado industry.

"Watson, University of Florida, reported Dictyospermum scale outside in that state from Pensacola to Key West, giving it an indeterminate status. That it was also established outside in the Gulf States is reported by evidence of the great freeze of January, 1920, upon its numerical abundance in New Orleans.

In order to furnish a basis against which to check in the event future work is contemplated, the following world host index has been compiled.

The index has been prepared and arranged by family 'alphabetically, the species following in the same sequence in each division, as this species, it being sometimes confused with its congener *C. pinnulifer.*

HOST LIST OF CHRYSOMPHALUS DICTYOSPERMI

Technical name	Common	Locality reported, country
ACANTHACEAE—		
Thunbergia sp.	Thunbergia	
AMARYLLIDACEAE—		
Agave neglecta	Agave	Florida
ANACARDIACEAE—		
Mangifera indica	Mango	China, Florida, Cuba, India
Pistacia lentiscus	Pistacia	North Africa
APOCYNACEAE—		
Allamanda sp.	Allamanda	Florida
Carissa sp.	Carissa	Florida
Nerium oleander	Oleander	Florida, North Africa
AQUIFOLIACEAE—		
Ilex sp.	Holly	Florida
ARACEAE—		
Anthurium sp.	Anthurium	Florida
Colocasia sp.	Caladium	
ARALIACEAE—		
Aralia papyrifera	Rice paper plant	California
Hedera helix	English ivy	Florida, Kansas, Italy, Brazil, N. Africa, France
BIGNONIACEAE—		
Bignonia cherere	Bignonia	California
BROMELIACEAE—		
Billbergia sp.	Billbergia	

HOST LIST OF CHRYSOMPHALUS DICTYOSPERMI—Continued

Technical name	Common	Locality reported, country
BUXACEAE—		
Buxus balearica	Box	California
Buxus sempervirens	Box tree	
Cactaceae	Opuntia	Ceylon
CANNACEAE—		
Canna indica	Canna	Florida
CASUARINACEAE—		
Casuarina cunninghamiana	Australian pine	Florida
CELASTRACEAE—		
Euonymus japonica	Euonymus	Florida, California
Euonymus radicans	Euonymus	Florida, California
Euonymus microphylla	Euonymus	Florida, California
COMPOSITAE—		
Bahia fastigata	Bahia	Florida
CORNACEAE—		
Acuba sp.	Gold dust plant	
CYCADACEAE—		
Cycas	Sago	Egypt, Jamaica, Ceylon, U. S.
Cycas revoluta	Sago palm	Ceylon
Zamia floridana	Coontie	Florida
CYCLANTHACEAE—		
Carludovica palmata	Panama hat plant	Florida
EBENACEAE—		
Diospyros kaki	Persimmon	Florida
ELAEAGNACEAE—		
Elaegnus sp.	Russian olive	Florida
ERICACEAE—		
Arbutus sp.	Arbutus	
EUPHORBIACEAE—		
Codiaeum variegatum	Croton	Florida
Euphrobia pulcherrima	Poinsettia	Florida
GUTTIFERAE—		
Calophyllum sp.	Calophyllum	
Garcinia sp.	Garcinia	
Mammea americana	Mamey	Florida
Rheedia aristata	Rheedia	Florida
IRIDACEAE—		
Iris sp.	Iris	California
JUGLANDACEAE—		
Hicoria pecan	Pecan	Florida
LAURACEAE—		
Cinnamomum camphora	Camphor tree	Louisiana, Florida
Cinnamomum zeylanicum	Cinnamon	Florida
Laurus nobilis	Bay	Florida
Persea americana	Avocado, Guatemalan	Calif., Florida, Guatemala
Persea drymifolia	Avocado, Mexican	Mexico
LEGUMINOSIAE—		
Acacia sp.	Acacia	Florida
Albizzia	Albizzia	Florida
Bauhinia sp.	Mountain ebony	Florida
Ceratonia sp.	Ceratonia	North Africa
Cytisus scoparius	Canary Island broom	Madeira Island
Erythrina indica	Coral tree	
LILIACEAE—		
Aloe bainesi	Aloe	
Aloe zeyheri	Aloe	
Asparagus plumosus	Asparagus fern	
Cordyline australis	Dracena palm	California
Dracaena indivisa	Dracena palm	Kansas
Phormium tenax	New Zealand flax	
Pincenectitia	Pinectitia	Egypt
MAGNOLIACEAE—		
Magnolia grandiflora	Bull bay	Florida
MALPHIGHIACEAE—		
Malpighia glabra	Barbados cherry	Florida
MORACEAE—		
Ficus elastica	Rubber tree	North Africa, Kansas
Ficus macrophylla	Moreton bay fig	North Africa
Ficus pumila	Creeping fig	Florida
Ficus retusa	Apollo laurel	Florida
Ficus nitida	West Indian laurel	North Africa
Morus spp.	Mulberry	Florida
MUSACEAE—		
Musa cavendishi	Chinese dwarf banana	Madeira
Musa sapientum	Banana	
Ravenala madagascariensis	Travelers' tree	Florida
Strelitzia augusta	Bird-of-Paradise flower	North Africa
MYRTACEAE—		
Callistemon sp.	Bottlebrush	
Eucalyptus sp.	Eucalyptus	Florida
Eugenia jambos	Rose apple	Florida

HOST LIST OF CHRYSOMPHALUS DICTYOSPERMI—Continued

Technical name	Common	Locality reported, country
MYRTACEAE—*Continued.*		
Feijoa Sellowiana	Feijoa	California
Melaleuca sp.	Ironwood	
Metrosideros floribunda	Iron tree	
Myrtus communis	Myrtle	North Africa
Psidium guajava	Guava	Florida, Egypt
OLACEAE—		
Jasminum officinale	Jasmine	Florida
Ligustrum sp.	Privet	Florida
Olea sp.	Olive	North Africa
ORCHIDACEAE—		
Coelogyne sp.	Orchid	California
Cynibidium		British Columbia
Cypripedium sp.	Lady's slipper	British Columbia
Dendrobium sp.	Dendrobium	India
PALMACEAE—		
Areca triandra	Areca palm	California
Chamaerops sp.	Palm	Florida
Chamaerops nucifera	Coconut	Florida
Cocos plumosa	Cocos palm	Florida
Dictyosperma alba	Dictyosperma	British Guiana
Hyophorbe amaricaulis	Bottle palm	California
Kentia velmoriana	Kentia palm	California, Florida, Indiana, Tunis
Kentia forsteriana	Kentia palm	California
Livistonia chinensis	Chinese fan palm	Florida
Latania borbonica	Latania palm	New Jersey
Oreodoxa regia	Royal palm	Cuba
Phoenix canariensis	Phoenix palm	N. Africa, Madeira, California
Phoenix dactylifera	Phoenix palm	
Sabal	Sabal palm	South Carolina, Florida
PANDANACEAE—		
Pandanus		Florida, Mexico
Pandanus praminifolius	Screw pine	Florida
PINACEAE—		
Araucaria sp.	Araucaria	
Pinus	Pine	Mexico
Thuja sp.	Arbor vitae	
POLYGONACEAE—		
Muehlenbeckia complexa	Mattress vine	
ROSACEAE—		
Eriobotrya japonica	Loquat	Florida, Cuba
Prunus angustifolia	Mountain cherry	
Prunus communis	Almond	North Africa
Prunus persica	Peach	Florida, Mexico, S. Africa, etc.
Rosa sp.	Rose	Ecuador, Florida, Java, Madeira, Cuba, California
RUTACEAE—		
Citrus limonium	Lemon	China, Spain, Italy, Kansas
Citrus limetta	Lime	Tahiti, Mexico
Citrus aurantium	Orange	France, Canal Zone, Mexico, Italy, Nicaragua, Spain
Citrus grandis	Pomelo	China, Straits Settlements
Citrus nobilis	Tangerine	Italy
Citrus medica	Citron	North Africa
SALICACEAE—		
Salix sp.	Willow	Florida
SAPINDACEAE—		
Melicocca bijuga	Spanish lime	Cuba
SAPOTACEAE—		
Casimiroa edulis	White sapote	California, Cuba
Mimusops elengi	Mimusopa	India
TERNSTROEMIACEAE—		
Camellia japonica	Camellia	Florida
Camellia sasanqua	Camellia	Florida
Thea sinensis	Tea	Florida

LATANIA SCALE *(Aspiawtus latamae)*

In view of the preponderance of Latania scale over all others, a report dealing with Coccids infesting the avocado would be incomplete without giving some space to a discussion of this species.

The Latania scale furnishes a classical example of an insect that has been overlooked. Entomological publications and books in this State are largely free from any but casual reference to it. The reason for this is not difficult to ascribe. It is found often in company with two other common scales, *Aspidiotus camelliae* and *A. hederae,* and the resemblance is so close that probably a goodly part of the material that has considered either of these species contained specimens of *C. lataniae.*

While it may be construed as an eleventh hour statement it is nevertheless a fact that inspectors were adjured to pay special attention to this species, not because of any expectation of finding it common, but merely because of a belief that probably it would be found.

Little seems to be known of the country of origin of Latania scale, though it has been known for a long time, being described by the French entomologist, Signoret, in 1869. The original description merely describes it as coming from the palm, *Latania borbonica* Jacq.

The species seems to have been defined by well distinguished

characters as it has stood for these 60 or more years. The main confusion has been with *A. cydoniae*, a species since declared a synonym.

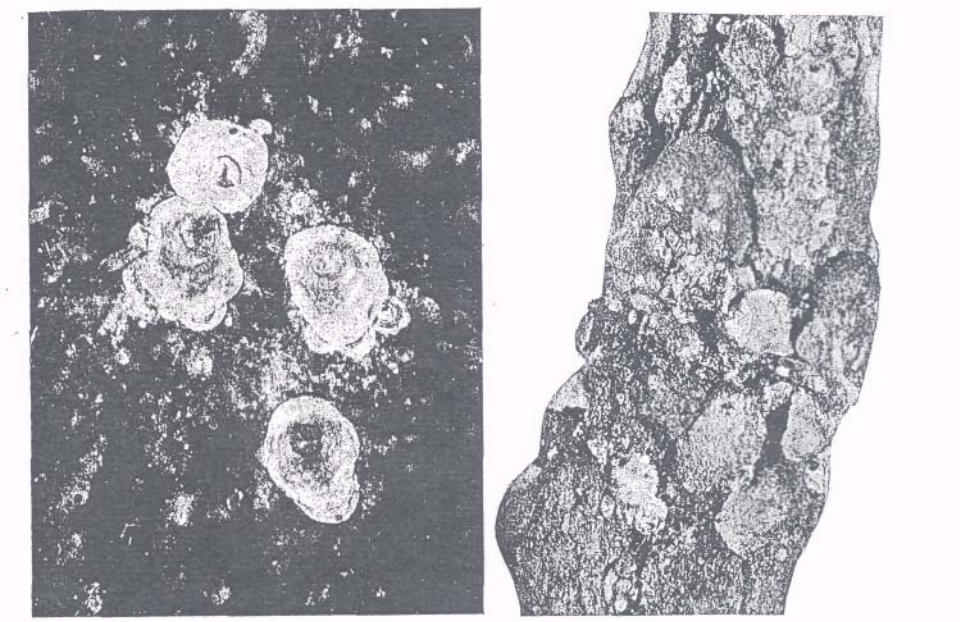

Fig. 78. Latania scale on fruit and branch of Fuerte avocado. (Enlarged 8 times.)

It is not definitely known where the home of this species is, though Signoret's original description leaves the reader to infer that the scale was taken from a plant in a French conservatory. While it is the host palm, a native of the Mascarine Islands, it was received in France in 1794 and described by the Botanist Nicolas Jos. Jacquin. The same account of its arrival states that it was carried by colonists to northeastern America, where is became popular as an ornamental.

In this connection, it may be noted that this was perhaps the most popular of the so-called ornamental glass-house fan palms, remaining as such until superseded by *Livistonia chinensis*, a species more easily propagated.

While it may be somewhat of a presumption, yet the record of Latania scale shows that both host and scale are recorded far from the type locality and in many countries.

As previously stated, a popular ornamental is perhaps the greatest vehicle for the distribution of a scale insect of the type and habits of the Latania scale.

As no general host index has ever been compiled for the species, for purposes of reference a list of its hosts and distribution has been prepared, also a bibliography of all available records pertaining to it and its economy.

HOST LIST OF ASPIDIOTUS LATANIAE

Technical name	Common	Locality reported, country
ACANTHACEAE—		
Thunbergia sp.	Clockvine	U. S.
AMARYLLIDACEAE—		
Agave sisalana	Sisal	India
Agave sp.	Agave	U. S.
Polianthes tuberosa	Tuberose	
ANACARDIACEAE—		
Mangifera indica	Mango	India, Philippines
ANNONACEAE—		
Annona muricata	Soursop	Mexico
APOCYNACEAE—		
Carissa edulis	Carissa	India, Egypt
Nerium oleander	Oleander	U. S.
Plumeria sp.	Frangipani	Rhodesia
Tabernaemontana sp.	Crape Jasmine	U. S.
Thevetia nerefolia	Tiger apple	Rhodesia
Vinca minor	Trailing Myrtle	U. S.
AQUIFOLIACEAE—		
Ilex cassine	Dahoon	U. S.
Ilex glabra	Gallberry	U. S.
Ilex opaca	Holly	U. S.
ARACEAE—		
Caladium sp.	Caladium	U. S.
ARALIACEAE—		
Aralia sp.	Aralia	China
Hedera helix	English ivy	U. S.
ARISTOLOCHIACEAE—		
Aristolochia sp.	Birthwort	
BEGONIACEAE—		
Begonia sp.	Begonia	U. S.
BIGNONIACEAE—		
Bignonia sp.	Bignonia	Egypt
Cresentia cujete	Calabash tree	U. S
BOMBACACEAE—		
Ceiba pentandra	Silk-cotton	U. S.
BORAGINACEAE—		
Cordia myxa	Cordia	Egypt
BUXACEAE—		
Buxus Japonica	Japanese Box	China
Buxus sempervirens	Box	South Africa
CACTACEAE—		
Mammillaria sp.	Mammillaria cactus	U. S.
CALYCANTHACEAE—		
Calycanthus sp.	Sweetshrub	U. S.
CANNACEAE—		
Canna sp.	Canna	Egypt
CAPRIFOLIACEAE—		
Lonicera sp.	Honeysuckle	U. S.
CARICACEAE—		
Carica papaya	Papaya	Mexico, U. S.
CASUARINACEAE—		
Casuarina cunninghamiana	Australian Pine	U. S.
CELASTRACEAE—		
Euonymus sp.	Euonymus	U. S.
CHENOPODIACEAE—		
Chenopodium album	Goosefoot	Egypt
COMPOSITAE—		
Aster sp.	Aster	Egypt
Chrysanthemum coronarium	Crowndaisy	Egypt
CYCADACEAE—		
Cycas revoluta	Cycad	U. S.
Cycas circinalis	Cycad	U. S., Egypt
CYPERACEAE—		
Cyperus sp.	Flat Rush	Egypt
EBENACEAE—		
Diospyros kaki	Japanese persimmon	Egypt
Royena pallens	Royena	Rhodesia
ELAEAGNACEAE—		
Elaeagnus sp.	Russian Olive	U. S.

HOST LIST OF ASPIDIOTUS LATANIAE—Continued

Technical name	Common	Locality reported, country
EUPHORBIACEAE—		
Aleurites fordi	Tung-oil tree	U. S.
Hura crepitans	Sandbox tree	U. S.
Phyllanthus sp.	Phyllanthus	U. S.
Xylophylla sp.	Xylophylla	
Graminae	Bamboo	India
GUTTIFERAE—		
Mammea sp.	Mamey-Apple	U. S.
HAMAMELIDACEAE—		
Hamamelis virginiana	Witch-Hazel	U. S.
Liquidambar styracifolia	Sweet Gum	U. S.
HYDROPHYLLACEAE—		
Wigandia sp.	Wigandia	
JUGLANDACEAE—		
Hicoria pecan	Pecan	U. S.
Juglans sp.	Walnut	U. S.
LABIATAE—		
Anisomeles sp.	Anisomeles	Egypt
LAURACEAE—		
Cinnamomum camphora	Camphor tree	U. S.
Cinnamomum zeylanicum	Cinnamon	U. S.
Laurus nobilis	Bay	U. S.
Persea americana	Avocado	Mexico, Guatemala, U. S.
Persea drymifolia	Avocado	U. S.
LEGUMINOSAE—		
Acacia decurrens	Green Wattle	Rhodesia
Acacia spp.	Acacia	China
Albizzia lebbek	Lebbek	Egypt
Andira mermis	Cabbage tree	U. S.
Ceratonia siliqua	Carob	Syria
Dalbergia chanionii	Sessoo	Ceylon
Delonix regia	*Poinciana*	India
Erythrina tomentosa	Coral-tree	Rhodesia
Parkinsonia sp.	Parkinsonia	Egypt, Rhodesia
Robinia pseudoacacia	Black Locust	Egypt
Samanea saman	Rain tree	India
Tamarindus indica	Tamarind	India
Trifolium	Trefoil	Egypt
LILIACEAE—		
Asparagus officinalis	Garden asparagus	Egypt
Asparagus plumosa	Ornamental asparagus	Germany, U. S.
Dracaena indifisa	Dracena	U. S.
Pincenectitia sp.	Pincenectitia	Egypt
Smilax sp.	Bamboo-brier	U. S.
Yucca sp.	Yucca	U. S., Egypt
LOGANIACEAE—		
Gelsemium sp.	Confederate Jessamine	U. S.
LORANTHACEAE—		
Loranthus	Loranthus	Ceylon
LYTHRACEAE—		
Lagerstroemia sp.	Crape-myrtle	Ceylon
Lawsonia sp.	Henna	Egypt
MALVACEAE—		
Althaea althea	Rose of Sharon	U. S.
Hibiscus rosa-sinensis	Chinese hibiscus	Egypt
Lagunaria sp.	Lagunaria	Egypt
Marantaceae	Maranta	
MELASTOMACEAE—		
Melastoma nesophila	Ladies' Favor	U. S.
MELIACEAE—		
Melia azedarach	Chinaberry	Rhodesia, Syria
MORACEAE—		
Artocarpus incisa	Breadfruit	India
Ficus benghalensis	Banyan tree	India, Syria
Ficus carica	Fig	Ceylon, U. S., Syria
Ficus indica	Banyan tree	U. S.
Morus sp.	Mulberry	U. S.
MORINGACEAE—		
Moringa oleifera	Horseradish tree	U. S.
MUSACEAE—		
Musa sapientum	Common Banana	Hawaii
Musa paradisiaca	Plantain	India
MYRTACEAE—		
Callistemon sp.	Bottlebrush	
Eucalyptus sp.	Eucalyptus	Egypt, U. S.
Eugenia jambos	Rose-apple	U. S.
Melaleuca nesophila	Pink Melaleuca	U. S.
Myrtus communis	Myrtle	Egypt
Psidium guajava	Guava	India, U. S.
OLEACEAE—		
Jasminum Sambac	Indian Jasmine	U. S.
Jasminum primulinum	Yellow Jasmine	U. S.

HOST LIST OF ASPIDIOTUS LATANIAE—Continued

Technical name	Common	Locality reported, country
OLEACEAE—*Continued.*		
Ligustrum sp.	Privet	U. S.
Osmanthus fragrans	Sweet Olive	U. S.
ORCHIDACEAE—		
Epidendrum sp.	Orchid	U. S., Brazil
PALMACEAE—		
Areca lutescens	Yellow palm	U. S.
Cocos nucifera	Cocoanut palm	U. S., Guam, Philippines, Central America
Hyophorbe amaricaulis	Bottle palm	U. S.
Kentia Belmoreana	Kentia palm	U. S., Australia, Belgium
Kentia Sellowiana	Kentia palm	Algeria
Latania commersoni	Latania palm	U. S.
Livistonia chinensus	Chinese Fan palm	Algeria
Latania borbonica	Fan palm	Ceylon
Phoenix dactylifera	Canary Island date	U. S.
Phoenix Roebeleni	Roebelens palm	U. S.
PANDANACEAE—		
Pandanus utilis	Screw-pine	U. S.
PINACEAE—		
Cupressus lusitanica	Portuguese Cypress	Rhodesia
Juniperus sp.	Juniper	U. S.
Thuja sp.	Arborvitae	U. S.
PLATANACEAE—		
Platanus orientalis	Plane tree	Egypt
Platanus occidentalis	Sycamore	U. S.
POLYGONACEAE—		
Antigonon leptopus	Rosa de Montana	U. S.
Coccolobis uvifera	Sea-grape	U. S.
Muehlenbeckia sp.	Mattress vine	U. S.
PRIMULACEAE—		
Cyclamen sp.	Cyclamen	U. S.
RHAMNACEAE—		
Zizyphus jujuba	Jujube	U. S.
ROSACEAE—		
Crataegus	Thorn bush	Egypt
Cydonia	Quince	India
Eriobotrya japonica	Loquat	U. S.
Malus sylvestris	Apple	India (South)
Prunus communis	Almond	U. S.
Prunus laurocerasus	Cherry Laurel	U. S.
Prunus persica	Peach	India
Prunus sp.	Plum	U. S.
Pyracantha coccinea	Firethorn	U. S.
Pyrus communis	Pear	Egypt
Photinia japonica	Photinia	U. S.
Rosa sp.	Rose	U. S., Rhodesia, Africa
Spirea sp.	Spirea	U. S.
RUTACEAE—		
Citrus medica	Citron	India, China
Citrus grandis	Pomelo	China
Citrus aurantium	Orange	U. S.
Calodendrum sp.	Calodendrum	U. S.
SALICACEAE—		
Populus sp.	Poplar	Egypt
Salix babylonica	Weeping Willow	Egypt
SAPINDACEAE—		
Malicocca bijuga	Spanish Lime	Cuba
SAPOTACEAE—		
Achras sapota	White Sapote	India, U. S., Tahiti
Chrysophyllum cainito	Star-apple	Mexico, U. S.
SAXIFRAGACEAE—		
Carpenteria sp.	Carpenteria	Egypt
Ribes sp.	Gooseberry or Currant	U. S.
SCROPHULARIACEAE—		
Veronica imperialis	Imperialis	U. S.
Veronica imperialis	Veronica	Channel Island
SOLANACEAE—		
Lycium halimifolium	Matrimony vine	U. S.
STERCULIACEAE—		
Abroma sp.	Abroma	Egypt
Dombeya sp.	Dombeya	U. S.
Sterculia sp.	Bottle-tree	U. S., Egypt
TERNSTROEMIACEAE—		
Camellia japonica	Camellia	South America
Thea sp.	Tea	India, Ceylon
VERBENACEAE—		
Verbena sp.	Verbena	U. S.
Lantana camara	Lantana	U. S.
VITACEAE—		
Vitis sp.	Grape	India, South Africa

From the records of this survey it is evident that this scale outranks all others on avocado in numerical abundance. It constitutes 85.92 per cent of all recorded infestation on trees examined, being found on 10,521 out of 27,868 trees inspected for scale insects. It feeds on branch, leaf and fruit. No attempt has been made to work out its life history, though it has been noted that young hatch from the yellow eggs in a few hours, the embryonic young being readily discernible in the newly laid eggs. The crawlers apparently in many cases do not travel far from the mother scale as the young scale have been noted as affixed to the bark still well under the scale of the mother, a fact also attested to in the finding of scale in heavy infestations arranged seemingly on edge due to crowding out by the developing scale underneath. Eggs and young were noted in March.

Fig. 79. Nodules caused by feeding punctures of Latania scale on Fuerte avocado. (Slightly reduced.)

What the future course of Latania scale will be is impossible at present to state, but it is sufficiently numerous to warrant investigation of control means.

The particular economy at present of Latania scale is in relation to its presence on fruit. Examination of infested fruit clearly shows (see illustration) that on the thinner skinned varieties the scale in feeding perforates the skin, seemingly causing an irritation in the flesh, as infested avocados develop nodules under the skin which adhere when it is removed, causing deep pockets in the flesh of the ripe fruit. Where there is a colony the separation of the skin from the ripe fruit is impossible. Thus far observations have been limited to the variety Fuerte,

Specimens of ripe avocados were received by the Department of Agriculture for observation, from a dealer in Pasadena, in which were indurated perforations accompanied by large hollow pockets which were seemingly identical with those caused by the scale, except that the perforations were noticeable on the surface of the fruit where the skin

had calloused around each. While no evidence of scale was present, the fruit had the appearance of having been infested and the scale seemingly removed by mechanical means. In order to check the mechanical cleaners employed in packing houses, observation was made at the house of the Calavo growers and it was readily demonstrated that the ordinary process of brushing the fruit does not remove scale. Furthermore, all scaly fruits are culled out, so that had the above-mentioned fruit been infested with scale they must have been treated by a more forceful manner than the ordinary cleaning process employed at the association packing house, evidently at the place of production, as they had come through and been sold through the association.

The degree of necessity in any program of this nature will, of course, be governed by degree of infestation in the grove. At present, examination of the results shows that only a low per cent of infested trees are heavily infested, the ratio being light 73.80 per cent, medium 20.8 per cent, heavy 5.39 per cent. However, the need exists of considering future action. Whether it will extend to the hard-shelled varieties has not been determined.

QUESTIONS INVOLVED IN CONTROL

What the ultimate control program will be it is at present impossible to state. Research in this connection falls within the province of agencies outside of the State Department of Agriculture, which is a regulatory body. However, it may not be amiss to point out certain factors to show what action will tend to diminish the possibility of future losses from this source.

Neither the Dictyospermum nor Latania scale exists on wild growth in the vicinity.

It will be seen from the tabulation that 10 different scale insects

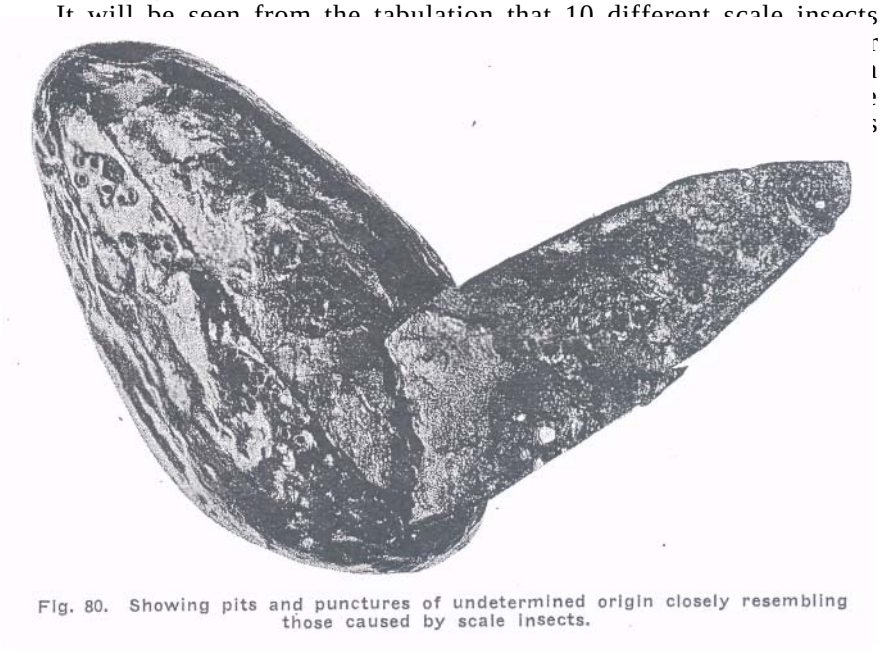

Fig. 80. Showing pits and punctures of undetermined origin closely resembling those caused by scale insects.

question of the seasonal and developmental factors, particularly of the large fruited varieties that hang on the tree for about a year. Plantings in many cases are located on terraced hillsides where special spraying or fumigation programs will have to be worked out. How ever, nothing in the above should be construed to mean that any pest affecting avocados can not be brought under control, as the difficulties present are far from being insurmountable.

A consultation with the best informed horticulturists will perhaps bring the problems of fertilization and pest control together on a more compatible basis. There are two courses that will do much to forestall future loss.

Plant clean trees. Trees free from scale can be assured by treating

them with hydrocyanic acid immediately prior to planting by the standard vacuum fumigation procedure, However, they should be allowed to cure until new growth is hardened in order to prevent injury. Likewise, there are numbers of groves, perhaps some slightly infested, from which the scale can be successfully eradicated by spraying or fumigating before they come into bearing, thus obviating the hazard of future loss.

SUMMABY

An examination of 27,868 trees involving practically all the bearing avocado properties of the State, shows that 43 per cent are infested with scale insects of which *A. lataniae,* a species heretofore practically unknown in the State, is dominant. The Dictyospermum scale occurs largely in a district extending from "Whittier to Beverly-Hilts with slight local infestation in Santa Ana and Fullerton. In the residential properties in the "Whittier area it reaches its greatest "numerical abundance. Infestations of lighter degree occur in Montebello and the metropolitan district of Los Angeles. All outside infestations, insofar as survey findings show, are confined to Los Angeles and Orange counties.

An examination of world literature on the two major scales shows a host index upwards of 150 species of economic and ornamental plants. One of these is of considerable economic significance in portions of the Mediterranean basin, in certain parts of which it is the most destructive species affecting citrus.

Since 1924, one species, *C. dictyospermi,* has been the object of a program looking to its eradication in nurseries. Of those formerly infested, 93 are now reported clean. Twenty-four remain on the infested list in that they have not been 'reported as cleaned, though in only 11 have infested plants been found on the premises.

Little is known as to distribution in the State of the Latania scale other than what is revealed by the survey. In 1928, it was recorded from seven hosts in Los Angeles, and has been taken at quarantine since 1913. It has a world host index of over 140 species and is of cosmopolitan distribution. A strange circumstance is that despite its wide distribution and extensive host index, economic record is confined to reports of its presence in glass houses. It has been reported on avocados in Florida, Guatemala and California, but not recorded as a pest.

CONCLUSION

From the information developed by this survey and from observations made by the writer and others in Florida, it is not believed that evidence at hand points to the species *G. dictyospermi* or any other scale as constituting the menace to avocados that growers in California have been led to believe.

In California the species is found 011 a comparatively wide range of hosts, frequently on palms of the genus Kentia, but it has never been reported as causing specific losses.

In its distribution outside of conservatories and lath houses the evidence indicates that it will be found over a considerable range of ornamentals, and in favored locations, may cause local injury.

It is believed that such a program of eradication of this species would present insurmountable difficulties. The evidence supporting this viewpoint is*:

That *C. dictyospermi* exists in an area over 200 square miles, and in practically every case is associated with other scales from which, to the casual observer, it is inseparable, making it practically impossible to find the last scale. Its presence largely in residential properties further complicates the situation, as there is no incentive to control it there. Due to the peculiar habits of growth of certain hosts, it is most difficult, if not impossible, to say with any degree of certainty that a plant is or is not infested. In this same connection, certain types of hosts do not lend themselves to treatment. Last, but not least, there are legal obstacles involving the question of penalizing one group of individuals without due

compensation for the benefit of another group. A superior court judge has indicated that a presumption of infestation is not tenable from a legal standpoint.

However, it is believed that a control program would not present insurmountable difficulties for either *C. dictyospermi* or *A. lataniae.*

As a result of this survey the status of the different scales from the standpoint of numerical abundance has been tabulated, a part of the departmental program anticipating notification to every grower of the condition of his planting.

County agricultural commissioners will be furnished with lists of all plantings in their respective counties. In the event of seeming necessity the legal machinery to effect a cleanup of any property that may constitute a nuisance is already on the statutes. Either species can be reduced by a fumigation or by a spraying program.

Evidence exists that varietal tree schedules can be worked out that will be compatible to the tree and yet give the measure of control that will keep either species reduced below injurious abundance through the use of an oil spray or by fumigation with hydrocyanic acid.

From first hand observation made in Florida during 1929, it is believed that *C, dictyospermi* is not the general pest of avocado in that state that California growers have been led to believe. "While it is true that operations are conducted against it in parts of the State, action is dictated by circumstances in the individual properties. In no district have I been able to find where a general seasonal program is in effect.

In considering the question as a whole, the fact should be borne in mind that the avocado industry of California is just emerging from its infancy and may be expected to undergo the regular pains attendant to normal growth. It has already had to standardize on certain approved varieties *due* to marketing difficulties. It may yet have to standardize again from a standpoint of compatibility in pest control.

It may be said that no evidence has been adduced to warrant the assumption that this industry is menaced by any particular species that can not be reduced below the point of injurious abundance by known control measures.