

gard as trials by which mistakes may be discovered as well as the possible reasons for them.

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L. B. Skinner, Dunedin: I would like to ask one question. I would like to ask if any observations have ever been made as to cold spells as related to the moon, when it seems to rise and set so far in the North. I have heard men say that whenever the moon rose and set a good long ways to the North, look out for cold weather.

Dr. M. R. Ensign: That whole question has not been thoroughly worked out. We realize that there is a period of approximately eighteen and six-tenths years which is the cycle for the moon shifting North and South, and this is one variable which may have to be considered, and may have an important bearing.

Member: You don't mention any connection with hurricanes?

Dr. M. R. Ensign: The time we have had to spend on this has made it impossible to get to the hurricanes any. I feel positive, from a preliminary survey that we will be able to get some information relative to their occurrence.

L. B. Skinner: Is there any way of determining whether the moon will be far north in any certain year?

Dr. M. R. Ensign: Yes sir, it follows the

eighteen and six-tenths year cycle, and that is very definitely known. It is related to the eclipse of the moon. When that time occurs the path of the moon and sun are practically on the ecliptic, and we have a few days either north or south of that particular track.

#### ANNOUNCEMENT

Mrs. E. L. Lord: Your Chairman has kindly given me permission to bring before you the activities of the Florida State Rose Society. Perhaps you didn't know such an organization existed, but some five years ago we organized under the wing of your society, and since then have been holding yearly meetings, with a rose show as an attraction. This year the Rose Show is being held in the lounge of this hotel, and we hope you will find it worth seeing. Tomorrow afternoon we are holding our sixth annual meeting, and have secured H. Harold Hume to be the chief speaker.

Your own Mr. Coe is telling us something about using roses in Landscape, making pictures of them, and there will be speakers from the various sections of the State; one person from each district will tell you something of how roses are grown in that section. We want to cordially invite you to attend our meeting and find out how your step-child is coming along.

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## INSECTS AND MITES ATTACKING CITRUS TREES IN HAWAII

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In October, 1929, the senior writer was detailed by the United States Department of Agriculture to carry on special research work on the Mediterranean Fruit Fly, in the Hawaiian Islands. The following notes and observations were made incidental to the main problems. Our interest, extending over many years, in pests attacking citrus trees in Florida and elsewhere, furnished the inspiration to observe the pests on citrus trees in

Hawaii. Some subsequent observations and notes have been added by the junior writer.

#### LOCATION OF THE HAWAIIAN ISLANDS

The Hawaiian Islands are approximately 2,100 miles southwest of San Francisco, or about one-third of the distance across the Pacific. They are in the same latitude as Cuba, Porto Rico, Jamaica

and the Dominican Republic, and extend from 19° to 22° North Latitude. This is considerable south of either Florida or California.

#### CLIMATE

Owing to the latitude of the Islands, the climate may be said to be quite tropical. It is much more so than that of either Florida or California, where large citrus acreages occur. Only very general statements regarding the rainfall and temperature can be made since these are very variable, depending upon elevation and location in reference to the rain-bearing winds. At sea level the annual temperatures usually range between 60° and 80°, with extremes of 53° and 87°. Daily ranges are usually about 10°. While snow falls and frosts may occur at the summits of the highest mountains, these climatic conditions never occur at lower elevations. In the greatest part of the entire group frost never takes place. The rainfall is heaviest on the leeward slopes of the mountains and near their summits. In one place the rainfall is over 600 inches; in another, at 5,000 feet elevation, the rainfall is 300 inches, while five miles distant leeward on the seashore, it is only fifteen inches. In several other localities the rainfall is only about six inches on the average, and in dry years practically nothing. Such localities are practically desert. In the greater portion of the Islands the climate is warm, humid, and exceedingly agreeable.

#### EXTENT OF THE CITRUS INDUSTRY

From the standpoint of production in California or Florida, there is no citrus industry in the Hawaiian Islands. In fact, practically all the citrus fruit used in the Islands is shipped from California. There are, however, numbers of dooryard trees for home use and a few small groves. The largest planting is the Ackerman Grove at Kealahou, on the Kona Coast of the Island of Hawaii. This consists of about 350 large sweet seedling trees. As near as could be determined, the trees in this grove are about a hundred years old. It is a matter of record that Vancouver brought citrus trees from Tahiti over 135 years ago, and it may be that since this grove is not far

from the place where Vancouver landed, these trees are some of the identical trees, or, at any rate, direct descendants of those introduced by him. The general appearance of the trees is very similar to the large seedlings in Florida. The flavor of the fruit is somewhat flat, but otherwise is quite similar to that of the Florida seedlings. If ample fertilizer and care were given, no doubt the fruit from the two distant localities would be almost identical.

There is another small grove, consisting of about forty trees, a few miles distant near Capt. Cook on the main road leading down the mountain. On the Island of Oahu, near Honolulu, is a satsuma grove of about three acres. Then the experimental grove at the Hawaii Experiment Station in Honolulu contains a miscellaneous collection of about 200 trees. Other than these properties the citrus plantings consist of a few trees around homes, and along streets and highways.

#### PESTS PRESENT

Citrus Rust Mite, *Phyllocoptes oleivorus* Ashm.—This mite may be found on almost every citrus tree in the Islands. It was quite abundant in the Ackerman Grove, where about thirty per cent of the fruits were russet. The blemish was identical to that following rust mite attack in Florida. This leads us to believe that since these trees, or their immediate ancestors, came from Tahiti, the rust mite may be there also. The injury on rough lemon and limes is also similar to that found in Florida. On a rough lemon tree just below the Paris Hotel at Capt. Cook, the rust mites were so abundant in November, 1929, that the limbs had become a purplish blue and even the leaves were rusty. There were literally thousands of adult mites, nymphs and eggs present. On limes in Honolulu the mites had caused the characteristic injury called "silver scurf" or "shark skin." In the small grove of forty trees near Capt. Cook the fruit on some of the trees was 100 per cent russet, while other trees had scarcely any russetting. Rust mites were numerous on the citrus trees growing in the grounds of the Central Union Church, Honolulu, some of the oranges being almost blue. All the varieties of citrus at the Experiment Station are attacked by

them. The mite would no doubt prove as serious a pest here as in Florida if there was commercial planting of citrus present.

**Purple Mite, (*Tetranychus citri*, McG.)**—This red spider no doubt is present on citrus trees in every part of the territory at different seasons. It was observed in November on sweet seedling oranges on the road from Capt. Cook to Napoopoo, where females, males, nymphs, and eggs were found. The injury was, of course, identical with that in Florida. In August the mites were found on practically every tree examined around Honolulu.

**Six-Spotted Red Spider, *T. sexmaculatus*.**—Although extensive search was made for this red spider, none was found. In Florida this species is present on citrus trees only in the Spring, and it is most difficult to locate any at other seasons of the year. It may be that in Hawaii the same conditions exist. Search should be made for it in early spring instead of during fall and winter.

***Tenuipalpus irritans*.**—This species of red spider was abundant on sweet seedling trees near Capt. Cook in the same little grove where the purple mite was so plentiful. It also occurs on citrus trees around Honolulu. Only two or three instances of injury from the species have ever been observed in Florida. The same may be said of it in Hawaii where it can usually be found in small numbers.

**Purple Scale, *Lepidosaphes beekii*.**—This scale is everywhere present on citrus trees but usually not abundant. In the Ackerman Grove at Kona they were so scarce that little importance could be attributed to their injury. These trees have never been given any treatment such as spraying or fumigation. Neither was it evident that the entomogenous fungi had been active, only three pustules of the red fungus *Sphaeristilbe coccophila* Tul., being seen. In the Experiment Station grove and the satsuma grove in Kalihi Valley, the scales were much more numerous on the trees. At the latter place both the red fungi and the gray fungi *Ophionectra coccicola* E. & E., was quite abundant on infested limbs growing on the inside of trees or other shaded places. The scales are preyed upon by several species of lady beetles, most common of which is *Curinus coeruleus*. Other coccinellids observed were *Cryptolaemus*

*montroziere*, *Orcus chalybeus*, *Lindorus lopanthae* and *Chilocorus circumdatus*. No doubt these predators and the scale fungi are largely responsible for holding the insects in check. Internal parasites also contribute to their destruction.

**Long Scale *Lepidosaphes gloverii*.**—This scale insect was found in small numbers on the trees in the Experiment Station grove. Very little injury should be attributed to it.

**Florida Red Scale, *Chrysomphalus aonidum*.**—Although not numerous the red scale has been observed on a number of trees about Honolulu, and is present in the groves at the Experiment Station and Kalihi Valley. It was not seen on citrus trees at Kona.

**California Red Scale, *C. aurantii*.**—This red scale also occurs in the two groves mentioned above, and is more numerous than the Florida Red Scale. Both species of red scale are heavily preyed upon by the coccinellids listed above.

**Chaff Scale, *Parlatoria pergandi*.**—Slight infestations of this scale are found on the larger limbs and trunks of citrus trees in several places. About the heaviest infestation is on the citrus trees on the grounds of the Central Union Church. Some of the trees at the Experiment Station grove are also well infested. This is the same species that infests the trunks of the lime trees on the Florida Keys, and causes so much damage.

***Parlatoria ziziphi*.**—This scale also occurs in small numbers in several places about Honolulu, mainly on the leaves of citrus trees.

**Green Coffee Scale, *Coccus viridis*.**—This soft green scale at times becomes so numerous as to make the trees appear black due to sooty mold growing on the honey-dew excreted by it. The satsuma grove referred to is well infested with these insects. They have also been observed in other citrus trees, both around Honolulu, and in Kona. Parasites hold it in check, *Prococophagus orientalis* How., and *Encyrtus Sp.* being the ones most commonly found. This scale occasionally occurs in large numbers on coffee trees in the Kona district. A fungus disease as well as the parasites mentioned help to control it.

**Red Wax Scale, *Cerophastes rubens*.**—A single specimen of this native wax scale was taken on a

satsuma tree in Kalihi Valley. It occurs commonly on many other plants and trees.

Cottony Cushion Scale, *Icerya purchasi* Mask.—The cottony cushion scale occurs in small numbers wherever citrus trees can be found. It is always held well in control by the Australian lady beetle *Novius cardinalis*.

Mealy Bug, *Pseudococcus filamentosus*.—This mealy bug is also present on nearly all citrus planting examined. It is heavily parasitized and held in check by internal parasites, most important of which is *Aphycus terryi*.

*Pseudococcus citriculus*, Green.—A single infestation of this mealy bug is known on an orange tree in Manoa Valley, Honolulu.

Black Citrus Aphid, *Toxoptera aurantii*.—This aphid was found in the Ackerman Grove near Capt. Cook. It was not causing any appreciable injury to the trees. It also occurs in the Experiment Station grove in Honolulu. The species causes little or no damage in Florida, and is rarely seen on the trees.

Spirea Aphid, *Aphis spiraciola*.—In 1923, 1924, and 1925 *Aphis spiraciola* caused great damage to many citrus properties in Florida. In low sections in the river valleys the injury was alarming and many people believed the entire citrus industry would be destroyed. Spirea, or bridal wreath, is the primary host plant. This shrub was introduced into the various countries from China. Since the Hawaiian Islands are a sort of midway place between Asia and the United States, it was only logical to believe the spirea would be present and that the green citrus aphid would also occur there. After most extensive inquiries and search, we located one single plant growing in Nuuanu Valley. The aphids were not present on this plant. Further inquiries indicated that spirea is growing at elevations of 2,000 feet or over on

the Northeast Coast of the Island of Hawaii. Further search should be made for this insect in the Islands. It is our opinion that the green citrus aphid is present in Hawaii, and also in China, the original home of the primary host plant.

*Aleurodes giffardi* Kot.—This small sulphur yellow aleurodid occurs in small numbers on most all citrus trees. No appreciable damage is caused by it. The citrus whitefly is not present in Hawaii.

Beetles, Fuller's Rose Beetle, *Pantomorus godmani* is occasionally seen on citrus trees. The larvae feed on the root tips. The Japanese Rose Beetle, *Adoretus sinicus* at times causes some damage to citrus trees by feeding on the leaves.

Cypress Roach *Eleuthroda dytiscoides*, Sew.—The cypress roach often does considerable damage to citrus trees and fruits. They congregate in the fruit clusters while small and produce large irregular scars on the surface of the fruits. The greatest damage is caused by the roaches eating the bark on the limbs and trunks of young trees.

Grasshoppers and Katydid: The large katydid *Holoclora venosa*, and the long-horned grasshopper *Conocephalus saltator* occasionally are seen feeding on the leaves of citrus trees.

Mediterranean Fruit Fly, *Ceratitis capitata*, Wied.—The Mediterranean Fruit Fly infests citrus fruits of most kinds if they remain on the trees until well ripened. Oranges are little attacked until after January 1st. Lemons are immune to infestation, and lime and grapefruit are only rarely attacked. Satsumas and other thin-skinned varieties are usually severely attacked. Sour oranges are the most favored hosts among the citrus varieties, and are always heavily infested.

## SOME PLANT INTRODUCTION EXPERIENCES

Dr. David Fairchild, Coconut Grove

I want to confess to a degree of embarrassment in my preparation for presenting before you some experiences of Plant Introduction. I have tried three times to write what I would say to you this

evening, and I have these articles for Mr. Floyd if he wants to use them, in the drawer of my desk. They don't any of them appeal to me as likely to be of particular interest to you. I have