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SOME IMPORTANT ENTOMOLOGICAL FEATURES IN THE CITRUS GROWING REGIONS OF THE UNITED STATES

By W. W. Yothers

(Read with comments before the Florida Entomological Society, Gainesville, Florida, February 12th, 1926.)

FLORIDA.

It is generally known that the entomogenous or beneficial fungi are the most characteristic entomological feature in Florida. For many years a large part of the citrus growers have depended wholly upon them for controlling the pests attacking citrus trees and the rest of the growers so plan their spraying as to supplement the work of these fungi. In fact it can scarcely be conceived how citrus culture in Florida could continue without these natural and inexpensive aids. There is not an important pest attacking citrus trees that does not have some fungus attacking it.

It looks as if Florida is the only large commercial citrus growing region that has these natural advantages and this is due no doubt to the similarity in climate to that in Southeastern Asia, the original home of citrus trees.

SOUTHERN ALABAMA.

Owing to the similarity in climate to that of Florida about the same insect pests are present and these are attacked by entomogenous fungi. The purple mite (T. citri) one of the red spiders on citrus in Florida causes considerable damage to satsumas in winter and late spring. No doubt this is partially due to the satsuma being a favorite or preferred host plant.

LOUISIANA.

The climate with reference to the distribution of rainfall is quite similar to that of Florida and the same insect pests and beneficial fungi are present. The growers rely almost entirely on the entomogenous fungi to keep down the white flies and scale insects.

TEXAS.

The citrus growing region of Texas extends along the Rio Grande Valley from Mission to Brownsville, a distance of over 75 miles. It is a semi-arid region requiring irrigation only about 2 or 3 months in the summer time. Even then rains might occur at any time. In winter the rains are quite frequent. Owing to this lack of heavy and regular rainfall during summer the entomogenous fungi do not thrive. These have been introduced on nursery stock from Florida thousands of times but have never become established. Such diseases as scab and melanose do not thrive there either. Scale insects have been introduced from both California and Florida and in some instances cause much damage. As a whole these do not cause the injury that one would expect since the beneficial fungi are not present.

In one grove near Brownsville owned by Mr. H. H. Banker no spraying or fumigation has ever been done since the trees were planted, about 15 years ago. The insects and mites are present in only very limited numbers and no commercial damage is caused by them. The grove is uncultivated except a little hoeing or cutting of weeds. Irrigation is practised and the ditches in the grove are permanent—not rebuilt after each application of water. No explanation can be given for the lack of insects in this grove and this should be made the object of special study.

ARIZONA.

There are two sections where citrus is being cultivated viz., in the Salt River Valley near Phoenix and on the Mesa near Yuma. The first trees in the Phoenix district originated from seedlings planted many years ago—perhaps 50. These now are over 35 feet high. The recent plantings were mostly from home grown trees but some trees were planted from Florida and California nurseries.

The most outstanding entomological feature in Arizona, if not in the entire citrus growing sections of the United States, is the total absence of scale insects, white flies and mites on the trees and fruit. During three days search not a scale insect, white fly or rust mite was found. There were only a few specimens of *Tenuipalpis californicus* present. The rust mite has been recorded as being present in Arizona but I did not see one specimen. If present at all it is indeed very scarce. Some years the citrus thrips appear but only rarely does this occur.

The factors which prevent the multiplication of insects and

mites may be attributed to the heat and lack of humidity. The maximum temperature sometimes reaches 120°F. and frequently from 100 to 108°F. The humidity is very low. It is the opinion of some people that scale insects and white flies have never been permitted to enter the state. The quarantine measures may have interrupted thousands of cases but I dare say some of the insects were introduced prior to 1909 when the regulations were set up. In regard to the rust mite it is invariably introduced from place to place on young trees in Florida in spite of washing with various remedies to kill scales etc. For one from Florida to see citrus trees without pests is certainly a most astounding sight.

CALIFORNIA.

Aphis:

From a Florida standpoint the presence of the citrus aphis *(A. spiraecola)* in California for many years is of great interest. This is mainly because it has not killed trees nor to any appreciable degree affected adversely the citrus industry as a whole. It is confined to the section along the coast on low, cold locations and some years with cold springs it invades some of the groves on the higher lands and does much damage for short periods of time.

Resistant scale:

In the district around Ontario the black scale appears to have developed a resistance to cyanide fumigation. There is considerable evidence to support this contention and practically all citrus growers and entomologists believe that such is the case. There is also a belief that the red scale in certain localities has likewise become resistant to fumigation. If these two pests have really become resistant to fumigation after 30 or 35 years it opens up an entirely new field not only in insect control but in the entire biological field. It indicates that artificial control of insects may be comparatively short lived. It also indicates that species may change their structure, habits or reactions in a short time.

Pest free section:

In East Highlands there is a section that is almost as free of insects as the Salt River Valley. Scales are either entirely absent or so scarce as to be of no economic importance. In fact no insects or diseases attack the trees or fruit. This condition is well known to the citrus growers and entomologists but no one has suggested any factor that would prevent insects from infesting citrus trees in this section.

MEETINGS OF THE SOCIETY

Feb. 12, 1926. The meeting was held in Science Hall at 4:30 P.M. with President Gray in the chair, and the following members present: Bratley, Berger, Goodwin, Gray, Hubbell, Inman, Merrill, Montgomery, Stone, Tissot, Watson and Yothers, and a Mr. Foster as visitor.

Mr. Watson called to the attention of the society of the vacancy of one place on the executive committee. He moved that the retiring president automatically become a member of the committee. Carried.

The paper of the evening, "Some Important Entomological Problems and Features in The Citrus Growing Sections of the United States", was given by W. W. Yothers. The paper was interesting and called forth some good discussion from various members.

March 1, 1926. At a joint meeting of the Florida Entomological Society and Sigma Xi Club, held March 1st, Professor Herbert Osborn, Director of Entomological Research, Ohio State University, was introduced by Dr. Leigh. Professor Osborn gave an illustrated talk on noted American Entomologists, showing the picture and giving a brief sketch of each worker's contribution to the nation's entomological progress. Among a large number of entomologists mentioned were Thomas Say, who is commonly called the "Father of American Entomologists;" T. W. Harris, who is considered the first economic entomologist of the country; Asa Fitch, the first State Entomologist; C. N. Riley to whom the establishment of the Bureau of Entomology, U. S. D. A., is largely credited; and Cooke, one of the first teachers of entomology.

March 12, 1926. The regular meeting of the Society was held in Science Hall with President Gray in the chair and the following members present: Bratley, Gray, Grossman, Hubbell, Rogers, Tissot, and Watson, also visitors: Goode and Web.

Mr. Tissot made a statement as to the dues and finance of the Society. Stating that there were several in arrears and some for several years.

The paper of the evening was given by Mr. Grossman, his subject was "Insect Chemotaxis", and several points of interest were brought out and quite a bit of discussion followed.

H. E. BRATLEY, *Secretary.*

SOME NOTES ON THE FEEDING HABITS OF ADULT CRANE-FLIES

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There are few recorded observations of adult crane-flies taking food. Knab[1] quotes the few, scattered and casual records that he was able to find, some of which he questions, and gives a quite detailed account of his observations on the feeding habits of *Geranomyia canadensis* and *rostrata,* made in the vicinity of Washington, D. C. He states that on several occasions he found these two species feeding on the nectar of composite flowers, and that Mr. W. L. McAtee also had taken *Geranomyia diversa,* from the flower of a composite. Alexander[2] states that *Geranomyia, Toxorhina, Elephantomyia* and other forms with elongate rostra feed on the nectar of tubular flowers and that it is probable that many other species feed in the adult state. Cuthbertson[3] is of the opinion that few British species, outside of *Geranomyia,* take food in the adult condition.

Knab's observation that *Geranomyiae* were to be seen feeding only at twilight or on cloudy days and were absent from the flowers in full daylight gives a hint, as to one reason, so few adult crane-flies are known to feed. I have found that by visiting flowers at night with a "jack light" one can find crane-flies feeding far more freely than daytime or even twilight observations would suggest.

On the nights of December 31, 1924 and January 1, 1925, I visited a mango tree, growing near the banks of the Manatee River, Manatee Co., Florida. The tree bore hundreds of panicles, the florets varying from tightly closed buds at the tip of the panicle to fully opened blossoms near the base. The air for a considerable distance away from the tree was scented by the blossoms and a variety of insects were present. Besides crane-flies there were several species of moths and beetles, some abundant: two species of mosquitoes; and a number of lace-winged flies. Crane-flies were more abundant than any other feeding insects. The species present and feeding were: *Geranomyia canadensis* (?), few; *G. rostrata,* numerous; *G. virescens,* abundant; *G. vanduzeei,* few; *Rhipidia domestica,* abundant; *R. Schwarzi,* few; *Gonomyia pleuralis,* few; *G. puer,* few; *Erioptera caloptera,* two females. Both males and females of *G. virescens, G. rostrata,* and *R. domestica* were observed feeding, the females

the more numerous. In the other species, only females were seen. In all cases of the species listed above, specimens were taken from the flowers with forceps while feeding, were killed and later pinned and their identity made certain.

The *Geranomyiae* went thru their characteristic bobbing motion over each blossom they visited. The rostrum, moved up and down by this motion, probed about each flower in what seemed a "trial and error" stabbing. When the insect suddenly ceased bobbing the rostrum could be seen to be inserted in the flower. One or two slight tremors, that might be called very faint bobbing followed this insertion of the rostrum and then the fly quietly fed for a brief time. Slightly opened buds seemed to yield the most nectar, for on these the *Geranomyiae* remained feeding much longer than on the more fully opened blossoms and more *Geranomyiae* were found about the tips of the panicles than about the bases.

All the species of other genera were found on the fully opened blossoms, only. In each species the procedure was very much the same, the mouth parts were closely applied to the inside of the base of the petals and the body was crouched down on the flower or its pedicel. In the latter case the head was inserted into the flower between two petals. The short mouthed forms remained at a single floret much longer than did any Geranomyia and were so intent on feeding that usually when their bodies were lightly touched with the forceps they slightly shifted their position without removing the mouth parts from the flower. All the *Geranomyiae* were much more easily disturbed.

Apparently the feeding goes on all night, but whether the same flies remain about the blossoms or their places are taken by new-comers I did not ascertain. On the second night I remained at the tree from 9:30 until after midnight and the number of crane-flies about a panicle did not appreciably change, and this in spite of a cool, drifting fog that settled in tiny droplets on their wings and bodies.

All of these species come rather freely to light but altho my light was quite bright, none of the feeding flies left their blossoms or were in any way affected that I could detect. When a branch was beaten with a net handle the dislodged flies came about the light or my illuminated net bag, but most of them soon returned to the flowers.

Spiders and tree frogs were numerous about the tree. Both jumping spiders and small spider webs were common on and among the panicles and twigs, but no crane-flies were observed to have been captured by either. Many *G. virescens* were noted resting on strands of spider web, hanging from their prothoracic legs. Here they seemed particularly wary and difficult of approach. The tree frogs were all *Hyla cinerea,* both adults and juveniles, and were numerous and alert. They were usually perched near the base of a panicle and probably took a good many feeding insects but I failed to examine any stomachs.

At Gainesville, Florida, I have noted several other crane-fly species either feeding or presumably feeding, at night. *Pseudolimnophila luteipennis* has been taken from the flower spikes of lizard's tail *(Saururus cernuusd.)* but it is not certain that they were feeding. *Rhipidia shannoni,* I have, on two occasions, taken from the flowers of a wild honey suckle. In both cases the insect was within the mouth of the flower. Sweeping these flowers at night very frequently yields this species altho it is not common in this region.

I have never observed any *Tipulinae* on flowers but have taken two species, *Nephrotoma okefenoke* and *Tipula longipes,* both females, from sugar and molasses baits, at night, about Gainesville.

In Jefferson Co., Indiana, *Brachypremna dispellans* was observed on one occasion drinking dew from the surface of a pebble. This was in the daytime, in quite deep shade. The top of a small pebble was covered with dew and the fly applied its mouthparts to the surface of the pebble for well over a minute. The head was slightly moved about the surface of the pebble without losing contact with it but the feet were not moved. The amount of moisture on the pebble was appreciably diminished.

In early June of 1923, *Geranomyia rostrata* and *G. canadensis* were found feeding at dusk from the white flowers of a tall shrub along a brook in Bibb County, Georgia. The next morning no *Geranomyiae* were about the flowers. But bees and *Syrphidae* were numerous. About ten A. M. the sky became very cloudy and a light shower fell. During the shower a few *G. rostrata* were found feeding again. With the return of bright sunlight in about an hour not a specimen of *Geranomyia* could be found, even by sweeping the flowers and bushes. Much the same behavior was

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noted as has been described by Knab. When a fly approached a flower cluster it flew in a shuttle-like movement back and forth in front of the blossoms. Each movement toward the flower seemed to bring the extended feet into contact with a floret. with each movement away from the flower the legs were flexed. This flying dance takes about a minute when the flower is still but is prolonged if the flower is moved. Finally, on one of the movements toward the flower the fly alights and the wings are folded or partly folded. A rapid bobbing motion continues by the extension and flexing of the legs, a movement like the "deep-knee-bend" of setting up exercises. Soon the rostrum is jabbed into a floret on one of the down motions and the bobbing ceases. A floret was soon exhausted and the bobbing was resumed, without the feet changing their holds. A new floret is quickly found and the bobbing ceases. Most of the florets within reach were tried before the feet were moved from their position. The florets within reach were not systematically probed; the fly was just as apt to return to an already sampled floret as to a fresh one beside it. When most of the florets have been tried the Geranomyia flew to another flower or to a different area of the same cluster, there to repeat the whole behavior.

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(1)Knab, Frederick. The feeding habits of Geranomyia. Entomological Society of Washington. Proc. XII: 61-62. 1910.

(2)Alexander, Charles P. The Crane-Flies of New York. Part I. Memoir 25 of the Cornell University Agricultural Experiment Station.

(3)Cuthbertson, Alexander. Country Side VI. No. 8—Aug. 1925.

NEW THYSANOPTERA FROM FLORIDA—XIII

J. R. WATSON

(Continued from Vol. IX, p. 60)

Liothrips muscorum n. sp. (Continued)

Antennae about twice as long as the head. Segment 1, cylindrical, dark brown, concolorous with the head; 2, with a broad curved peduncle, yellowish brown; 3, long clavate, tapering uniformly to a rather broad base, a uniform yellow; 4, clavate, a little shorter and darker; 5, barrel-shaped, contracted abruptly to a broad peduncle, brownish yellow in basal two-thirds, heavily shaded with brown in apical third; 6, yellowish brown in basal half, dark brown in apical; 7, ovate, abruptly contracted to a narrow peduncle, margin deeply crenated in upper half; dark brown; 8, conical, margin deeply crenated, dark brown.

Mouth cone long and sharp pointed, reaching the mesosternum.

Prothorax trapezoidal in shape, sides (including coxae) almost straight and sharply diverging. The sides of the prothorax proper form sharp angles where they meet the coxae at about half their length, and from these angles extend straight and parallel to the posterior border. Posterior angles (of the coxae) well rounded, each provided with a single short but thick bristle and two minute ones. Each posterior angle of the prothorax bears a prominent stout blunt bristle, a short very thick, blunt bristle at each median angle mentioned above.

Mesothorax, quadrangular, anterior angles quite square; dorsum striated.

Metathorax, a trifle narrower, sides arched, converging posteriorly.

Middle and hind legs of medium length and very slender; fore femora considerably thickened; tarsi unarmed.

Wings, long, membrances reaching beyond the base of the tube; fore pair not constricted in the middle, colorless except for a small brownish yellow area at the extreme base, fringed with hairs except for about the basal third of the anterior border where they end abruptly. These hairs are unusually long near the tip of the wing. Eight inter-located ones on posterior margin. On the hairless base of the anterior border are three conspicuous, blunt bristles.

Abdomen rather short and thick, widest at about the middle. Posterior lateral angles of the posterior segments armed with rather long brown bristles, those on segment 9 as long as the tube. Tube about two-thirds as long as the head; widest at about the middle. Thence tapering with straight sides to both apex and base. Two pair of terminal bristles about as long as the tube.

Described from a single male taken from moss and lichens on the trunk of a tree in a magnolia hammock. Gainesville, December 1925. Type in author's collection.

Limocercyothrips gen. nov.

Head about as long as wide, produced anteriorly in front of the eyes into a triangular projection which bears the antennae and projects slightly over their bases; cheeks slightly converging posteriorly. Antennae

8-segmented; maxillary palpi 3-segmented. Ocelli and wings present in female, ocelli absent in males and wings rudimentary. Prothorax about as long as the head; posterior angles provided with two strong bristles. Abdomen rather long and slender in female but short and thick in male. Segment 9 of female much the longest and provided (as is also segment 10) with long bristles, a short stout spine on each side of segment 10 above.

Type *Limocercyothrips bicolor* sp. nov.

This genus has characters intermediate between *Limothrips* Haliday and *Cercyothrips* Morgan. It differs from the former in the converging cheeks, the character of the antennae and the terminal segment of the abdomen of the female. It agrees with Cercyothrips in the elongated ninth segment of the female. But the antennae are not inserted far apart and close to the eyes nor directed somewhat laterally. It differs from that genus also in the presence of two stout spines on each posterior angle of the prothorax.

The following key will aid in separating the genera of the family:

a. Head very small, noticeable smaller than the prothorax. —*Chirothrips* Haliday.

aa. Head larger, as long as prothorax or longer.

b. Cheeks swollen posteriorly; terminal segment of abdomen of female approaching a tubular form; segment 9 not especially long. .....*Limothrips* Haliday.

bb. Cheeks converging posteriorly; terminal segment of abdomen of female conical; segment 9 elongated, much the longest of the abdomen.

c. Antennae inserted close together; two stout bristles on each posterior angle of the prothorax....*Limocercyothrips* gen. nov.

cc. Antennae inserted far apart and close to eyes; no stout bristles on posterior angles of prothorax..*Cercyothrips* Morgan

95. Limocercyothrips bicolor sp. nov.

General color brown but very variable in shade, pterothorax usually much lighter in color than head and abdomen. Head dark brown, prothorax varies from raw umber (Ridgeway's color standards), almost as dark as the head, to yellow brown, almost as light as pterothorax; pterothorax varies from light grayish yellow to yellow brown; abdomen mostly dark brown but all but the posterior margins of the segments, and sometimes the entire basal half, often yellowish brown, as light as pterothorax.

Head a trifle longer than broad, widest across the eyes, cheeks slightly convex and converging posteriorly. Dorsum faintly striated. Two pairs of bristles, the postocular and one laterad to the anterior ocellus, nearly as long as the eyes; smaller ones near the anterior angles of the eyes and two near their posterior border and a pair near center of dorsum. Head prolonged in front of the eyes into a triangular projection upon which the antennae are carried. The lateral margins of this projection are straight, about two-thirds as long as the width of the first antennal segments, and extend inward and forward from the inner corners of the

eyes at an angle of about 45 degrees. The apex of the projection is rounded and usually covers the bases of the antennae. The space between the bases of the antennae not nearly as wide as the bases.

Eyes, large and much protruding; inner margins almost staight and sharply converging posteriorly. Eyes much wider posteriorly, pilose, black, facets large and widely separated. *Ocelli* large, yellow, flecked with orange and bordered with dark orange crescents; sub-approximate, situated far back, the posterior pair near, but not touching, the inner posterior angles of the eyes. *Mouth cone* large and long, reaching about three-fourths across the prosternum, rounded at the tip, maxillary palpus 3-jointed.

Antennae 1.5 times as long as the head, segments 1, 2, distal half to two-thirds of 6, 7, and 8 chestnut brown, concolorous with the head in lighter specimens; 3, 4, 5, base of 6, and often tip of 2, uniform pale straw yellow (naphthalene yellow—Ridgeway) 1 short-cylindrical; 2 cup-shaped with a very broad short peduncle; 3 oval, abruptly contracted to a thin peduncle; 4 oval with a short, thick peduncle; 5 oblong ovate with a short broad peduncle; 6 oval-ovlanceolate with a broad peduncle; 7 and 8 cylindrical, 7 a little broader and shorter than 8. Bristles pale and inconspicuous.

Prothorax, about as long as the head and (including coxae) 1.5 times as broad as long. Two strong bristles at each posterior angle of which the anterior is about a third as long as the width of the prothorax, the posterior is often considerably shorter. A third minute, curved bristle at each posterior angle and also anterior angle. Pronotum with a few striations along the anterior margin. *Mesothorax* considerably wider than the prothorax, sides rounded. *Metathorax* with nearly straight and parallel sides; posterior angles rounded.

Wings weak and narrow; membranes of anterior pair clear except for the brownish extreme bases of the costal margins. Both margins sparsely fringed; the hairs on the posterior margin rather long and wavy; about 5 rather heavy spines on the anterior vein, four near the base and one near the apex, and 9 evenly distributed ones (except the extreme basal portion) on the posterior vein. Three on the scale. *Legs* of medium length, femora (except base, and often basal half of middle and hind tibiae) yellowish brown, nearly concolorous with the pterothorax, bases of femora, tibiae, and tarsi (except dark spot near the base) light brownish yellow to sulphur yellow.

Abdomen rather slender, widest at about segment 6, thence tapering gradually to tip. Segment 9 very long, much the longest of all, provided with three pairs of very long bristles, a pair of short but heavy, black, curved bristles near posterior angles. Segment 10 conical, not at all tubular, split open above, also with three pairs of long dark bristles, and a pair of short, thick, dark spines near the tip.

Measurements: Total body length 1.2 mm. Head, length 0.17 mm., width 0.16 mm.; prothorax, length 0.13 mm., width 0.22 mm.; mesothorax, width 0.26 mm.; metathorax, width 0.23 mm.; abdomen, greatest width 0.27 mm. Antennae total length 0.26 mm.

Segment	1	2	3	4	5	6	7	8
length	25	38	45	37	40	62	14	18
width	28	33	21	20	19	22	10	6 microns.

Male. Similar to the female but much smaller and ocelli absent and wings mere rudiments which barely reach the base of the abdomen. Head about as wide as long. In color the pterothorax and the legs are a more vivid yellow than in the female and the head and abdomen darker; the color contrasts are more sharp. Antennal segment 6 is sometimes entirely yellow and 7 and 8 a light yellowish brown. The abdomen is rounded at the tip but carries long bristles similar to those of the female.

Measurements: Total body length 0.85 mm. Head, length 0.15 mm., width 0.15 mm.; prothorax, length 0.16 mm., width 0.21 mm.; mesothorax, width 0.24 mm.; metathorax, width 0.22 mm.; abdomen, greatest width 0.25 mm. Antennae, total length 0.23 mm. Segment 1, 25; 2, 34; 3, 39; 4, 33; 5, 33; 6, 54; 7, 13; 8, 16.5 microns.

Described from six females and five males collected from under the leaf sheaths of Japanese cane and Napier grass at Gainesville. Jan. and Oct. 1925. Type in the author's collection.

PROF. OSBORN VISITS FLORIDA

Professor Herbert Osborn spent the last week in February and the first few days in March in Gainesville as the guest of Dr. E. W. Berger of the State Plant Board. He looked over the jassids in the collection of the State Plant Board and the Experiment Station and the Department of Biology of the University. Professor Osborn is a frequent visitor to Florida where a number of his former students are at work on various projects. Professor Osborn, the editor of the Annals of the American Entomological Society, is nationally known as a teacher and leader of a large number of America's economic entomologists.

FUMIGATION OF SATSUMAS

Mr. Carl B. James, Horticulturist of the L. & N. Railroad, in cooperation with the American Cyanamid Company, has been conducting some very interesting and successful experiments in fumigating satsuma trees for the camphor and other scales.

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CORRECTION OF RECORDS OF CEUTHOPHILUS (ORTH., TETTIGONIIDAE)

In 1922 I recorded *Ceuthophilus nigricans* Sc. from Berrien County, Michigan (Occ. Pap. Mus. Zool. Univ. Mich., **116**, 69). Examination of the Scudder types in the Museum of Comparative Zoology show that these specimens represent instead *C. divergens* Sc. I have this species also from Ann Arbor, Washtenaw, Co., Mich., and Reelfoot Lake, Obion Co., Tenn.

The first of the undetermined species of Ceuthophilus mentioned on p. 52 of my North Dakota paper (1922-l.c., **113**), from Bottineau, has been determined by comparison with the types to be *C. pallescens* Sc.

T. H. HUBBELL.