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OBSERVATIONS ON PEEL INJURY TO POPE SUMMER ORANGES IN THE VERO BEACH AREA [1]

J. T. GRIFFITHS [2]
Florida Citrus Experiment Station, Lake Alfred

In 1948 Pope Summer oranges in one group of groves in the Vero Beach area showed essentially the same type of damage that has always been described and recognized as katydid injury (Watson and Berger, 1937). However, owners of the groves believed that grasshoppers were doing the damage, and it was so severe that investigations concerning it were initiated. The problem was particularly important since Pope Summer oranges are picked in late June or July and demand an exceptionally good price in fresh fruit markets. Down grading had been as much as thirty to forty percent in some instances, which represented a sizeable economic loss to the grower.

Observations have been made during the course of approximately three years, 1949-1951, and while positive conclusions cannot be drawn at present, certain definite facts have been

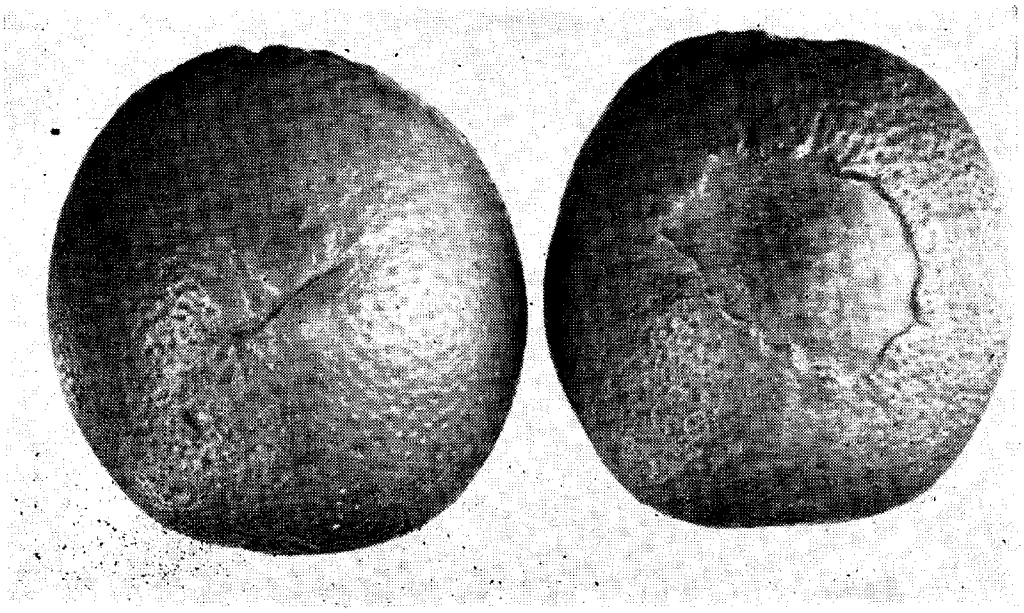

Figure 1. Two oranges which had been damaged just after setting. The one on the left was apparently damaged by one gouge of the insect's mandibles. The one to the right was more severely injured.

[1] Presented at the 1951 annual meeting of the Florida Entomological Society in Winter Haven. Florida Agricultural Experiment Station Journal Series, No. 83.

[2] Resigned in 1951; present address, Lyons Fertilizer Company, Winter Haven, Florida.

ascertained and recommendations for control may be made. This paper will discuss the findings made during this period.

The injury on mature fruit is a blemish that may cover as much as half of the fruit (figure 1). In the particular groves investigated the injury was found almost exclusively on Pope Summer oranges, while Marsh Seedless grapefruit, Temple oranges, and Pineapples had very little if any injury at any time. According to reports from some other growers along the Indian River, this same type of injury has been observed in other Pope Summer orange groves on previous occasions. Occasionally the damage has been extremely severe, but it has never seemed to persist from one year to the next. In the groves where these observations were made the injury was first noted on the crop set in the spring of 1948. Since that time injury occurred in 1949 and again in 1950, but in 1951 very little injury was found.

The fruit is injured before it reaches the size of a pea. Injury may take place any time after the petals have fallen and before the fruit has attained a diameter of about ½ inch. Apparently by that time the peel has taken on such characteristics that it is not considered edible by the insects involved.

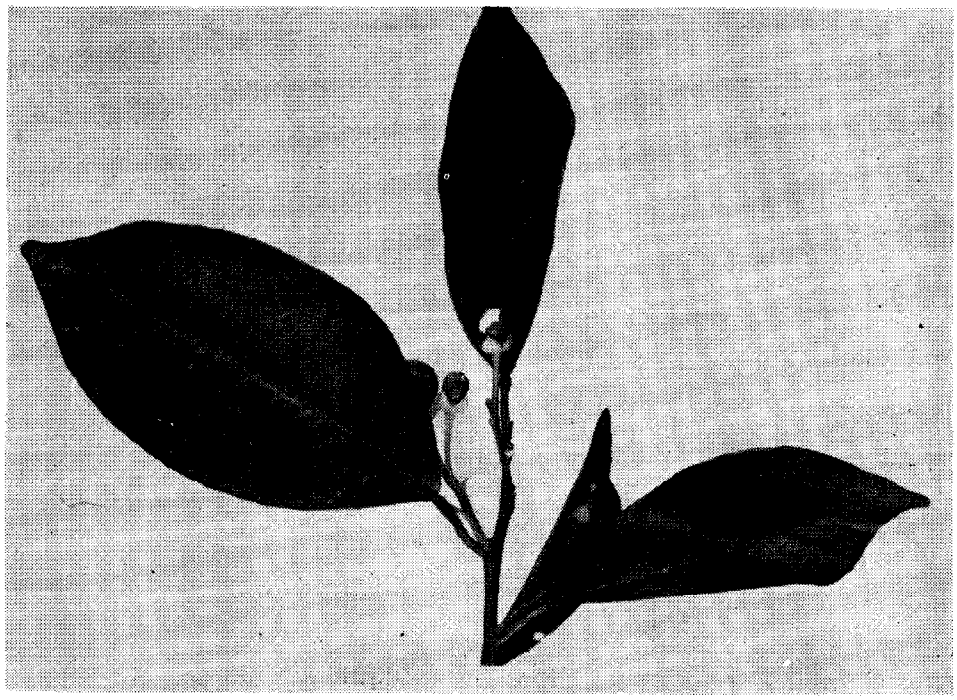

Figure 2. Fruit shortly after injury. All four fruits in the picture had been injured (⅔ natural size).

Figure 2 shows typical fruit injured shortly after the petals had fallen. The extent of the blemish at maturity will depend upon the amount of injury which occurs on small fruit. If injury is sufficiently severe, the fruit will drop. If less severe, it may cause the fruit to grow lopsided, or the fruit may attain a relatively normal appearance with only a small blemish on one side. Larger fruits are uninjured during the course of the summer months, except that occasionally the peel is chewed at the margin of an old scar.

It was noted that late bloom fruit which appeared in the grove following a bloom in late June or in July suffered severe injury in the summers of 1949, 1950, and 1951. There was a relatively heavy late bloom crop set in 1949. In the two following years there was little late bloom fruit, but where it was present, injury was common. However, fruit which had already sized was not being injured at that same time. It is apparent from this observation that the insect involved is present not only in the spring but throughout the summer months. However, injury occurs only to very small fruits.

In 1949 and again in 1950 the injury was accompanied by severe foliage damage throughout the grove. Foliage injury was characterized by holes eaten in the center of leaves as well as along the margins. In 1951, however, foliage injury was not present, although there was some injury to the fruit that spring. Fruit injury appears to be only superficial, with only the external layers of the peel being affected. Whether or not the insect which is injuring the fruit was causing the foliage injury has not been satisfactorily determined.

THEORIES CONCERNING CAUSE

Numerous possibilities concerning the cause of this injury have been examined and, in almost all cases, found wanting. Each of these possibilities will be discussed separately below.

The citrus root weevil, *Pachnaeus litus* (Germar), was considered a possibility. This beetle has been reported often in the Homestead-Miami area and it is known to injure fruit and foliage in Cuba. Although, according to Florida State Plant Board records, it has been reported as far north as the Vero Beach area, it has not been common there. Never, during the course of the three years' observations, were beetles of this species encountered in the grove nor was the injury which has

been pictured by Wolfenbarger (in press) exactly the same as that found at Vero Beach. It is, therefore, not believed that this insect is involved in the present injury.

Since the injury was identical with that caused by the broad-winged katydid, *Microcentrum rhombifolium* (Sauss.), particularly close attention was paid to this insect. Very few katydids were noticed in the springs of 1949 and 1950, and in 1951 very careful observation for this insect was made. It was not seen in the grove in the spring of 1951. When this insect is present, observation has shown that foliage injury may be severe. There can be no question that they will chew on fruit and will cause injury identical to that under discussion here. The fact remains that this insect was apparently rare in these groves and, under the conditions discussed here, was not a problem on Pope Summer oranges. The type of injury which it normally causes on foliage is shown in figure 3. In 1951 this katydid produced a hatch which was approximately simultaneous with the set of fruit and thus its life cycle during that year was most satisfactory for an insect which would injure young fruit. However, it can be stated positively that the injury caused in the spring of 1951 in the particular groves involved was not caused by the broad-winged katydid.

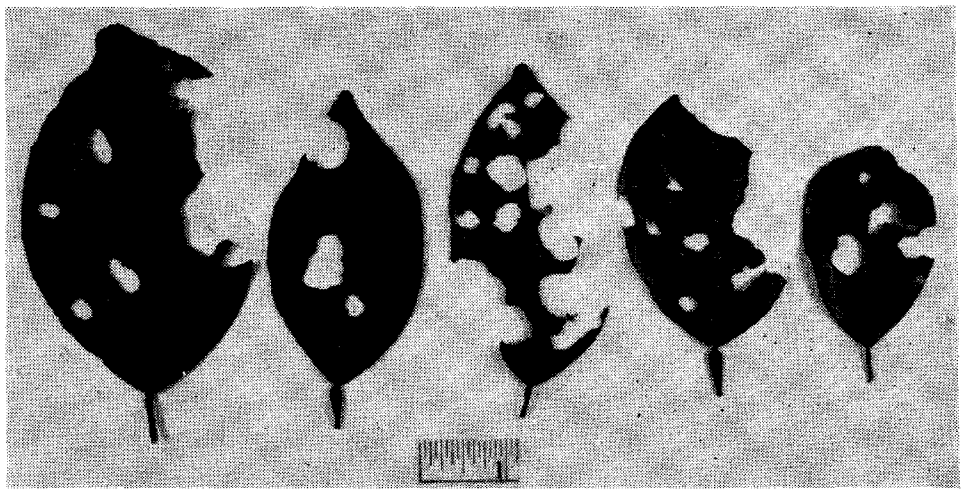

Figure 3. Leaves with holes chewed in centers and at margins by the broad-winged katydid. In the laboratory the restless bush cricket caused similar feeding patterns.

The owners of the grove originally believed that the injury was caused by some species of grasshopper. During the three years, numerous collections of grasshoppers were made to deter-

mine what species were present and which were most abundant. The most common grasshopper found in the grove in the spring of the year was the Eastern lubber, *Romalea microptera* (Beauvais). This species hatches in the spring of the year (Griffiths and Thompson, in press), usually by mid-February, and it was present in the grove in 1949 and again in 1950 in considerable numbers. Nymphs were found commonly during the spring of of the year on trees in areas where fruit was injured. In 1951 this species was almost nonexistent at the time fruit was set but, nevertheless, some injury occurred on the fruit. In 1949 no correlation could be made between the relative intensity of lubber infestation and the amount of fruit injured. In fact, the areas where lubbers were scarcest were the areas where most injury occurred. In the laboratory it was extremely difficult to get this insect to feed upon young fruits. While they would occasionally chew on the side of a small fruit, it was obviously not a desirable food source.

The second most common grasshopper found in the grove was *Melanoplus femur-rubrum propinquus* Scudder, the red-legged grasshopper. Griffiths and Thompson (in press) found that this insect hatches in mid- to late-February in most years and nymphs were present at the time the fruit was set. In the laboratory this insect failed to feed readily upon young fruits. It was uncommon also in the spring of 1951, although some individuals were present.

In addition to the above-named species *Schistocerca obscura* (Fabr.), *Schistocerca americana americana* (Drury), *Paroxya atlantica atlantica* (Scudder), *Paroxya clavuliger* (Serville), and *Dicromorpha viridis* (Scudder) also were found. None of these species was ever in sufficient abundance to be considered of any importance.

Individuals from three genera of Tettigoniiae, *Odontoxiphidium, Orchelium,* and *Conocephlus,* were collected, but these appeared to bear no relationship to the fruit injury.

The common field cricket, *Acheta assimulis* Fab., was always present in considerable numbers in the trash at the base of the tree. However, these crickets were never collected on the tree itself and in the laboratory they showed a marked aversion to fruits, although on one occasion one fruit was nibbled by a caged specimen.

The restless bush cricket, *Hapithus agitator* Uhler, was found on several occasions in the grove and there is definite

reason for believing that this very probably is the major cause of the fruit injury. This cricket is pictured in figure 4. In the summer of 1949 it was collected on trees in the vicinity of late bloom fruit which had been injured. One nymph was collected in sweepings of the cover crop. Specimens brought in to the laboratory readily chewed on fruit and foliage. The injury on foliage was similar to that made by katydids. Only the angular-winged katydid was found to eat fruit as readily as did the restless bush cricket. In the laboratory it appeared that small fruits were a preferred part of the cricket's diet. After the first collection, observations on the prevalence of this cricket were attempted, however the author was uniformly unsuccessful in finding specimens of this insect. During the blooming period in 1951 a careful search was made under the trees. Both nymphs and adults of the restless bush cricket were found among trash under the trees. These were found at a time when injury was occurring and at a time when most of the injury was confined to that part of the tree which was in intimate contact with some of the cover crop. In other words, injury was primarily on the lower limbs and usually only in those areas where tree and cover crop were touching. In such areas, insects without wings would be capable of climbing onto the tree and injuring fruit. Such would be the case if nymphs of this species were implicated. Due to the readiness with which the restless bush cricket will feed on young fruit in the laboratory as well as its occurrence, both under the trees and on the trees on several occasions, and the fact that this insect is apparently present throughout the spring and summer months when injury regularly occurred to young fruits, it would appear quite possible that this is the culprit that produced most of the injury to Pope Summer oranges. It is believed that until definite proof is found to the contrary, this insect should be considered the major insect involved. It is, of course, possible that some injury is caused by other insects, but in all probability the majority of the damage was performed by this one species.

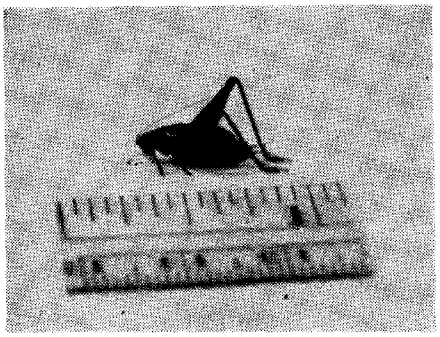

Figure 4. Restless Bush Cricket. The insect is light brown to tan with a light line along the wing margin.

CONTROL MEASURES

During the springs of 1949, 1950, and 1951 several insecticides were applied to determine if the damage could be successfully prevented. In these tests toxaphene, chlordane, lindane, dieldrin, and aldrin were tested. All of these are good insecticides for the control of grasshoppers and related Orthopteran species. Toxaphene was used on a commercial scale in each of two years. It was found that the application of these materials at the time petal fall was about half completed prevented the injury relatively well. Sprays applied before bloom were not generally successful. It is believed that insecticides should be used at dosages comparable to those for grasshopper control (Better Fruit Program, 1952; Griffiths and Thompson, in press) and applied to cover the foliage, young fruit, cover crop and ground under the tree.

SUMMARY AND CONCLUSIONS

In 1948 peel injury to Pope Summer oranges was first reported on the crop of fruit set in 1947. This injury in some instances involved as much as 30 to 40 percent of the crop. Observations during the succeeding three years indicated that the injury was not caused by the common broad-winged katydid, *Microcentrum rhombifolium* (Sauss.), or by grasshoppers which were present in the grove. It appeared that the injury was probably caused by the restless bush cricket, *Hapithus agitator* Uhler. Chemical control was attempted and it is probable that the application of either toxaphene, chlordane, lindane, or aldrin at the time of petal fall at dosages comparable to those used for grasshoppers in citrus groves would yield relatively satisfactory control.

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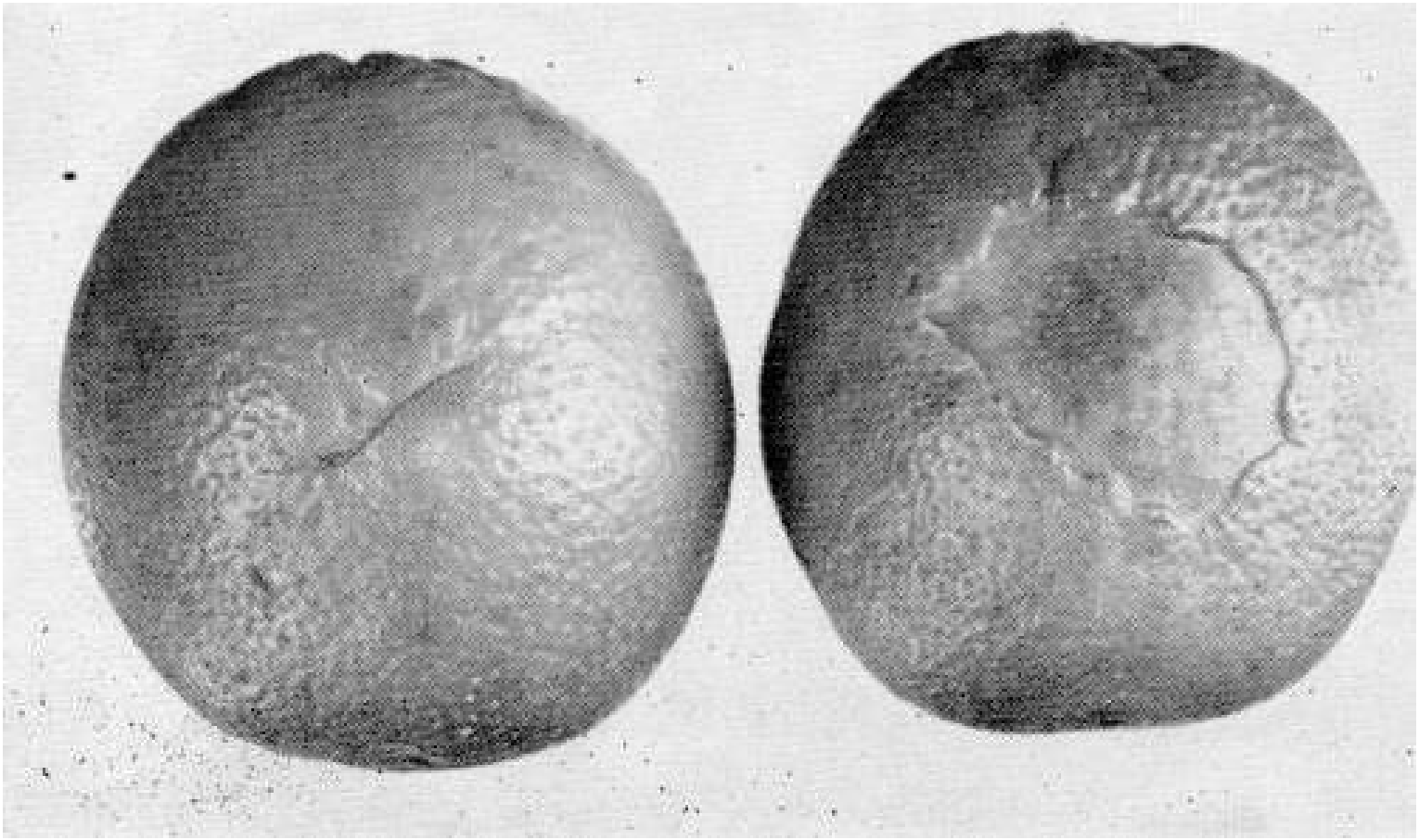
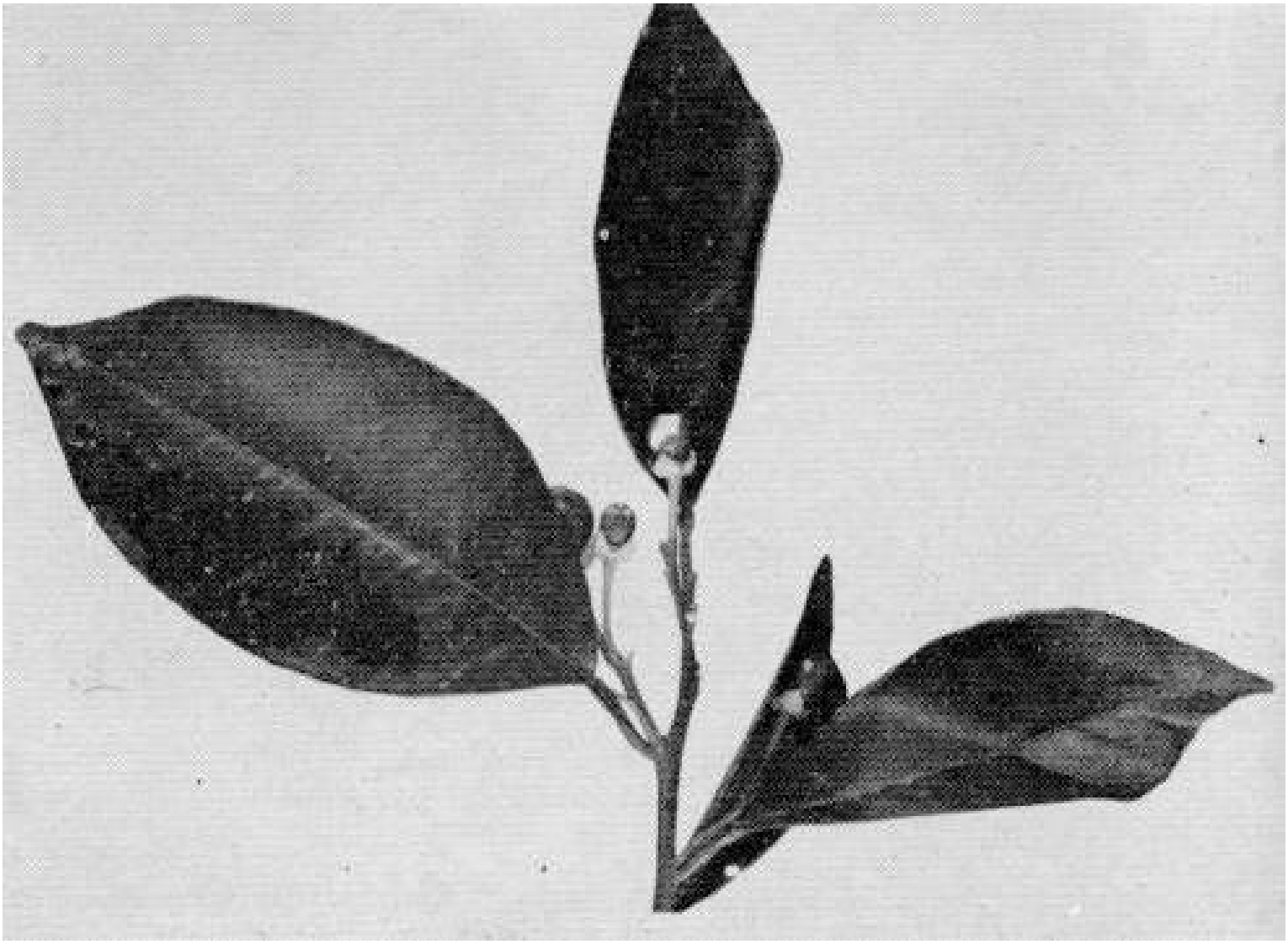
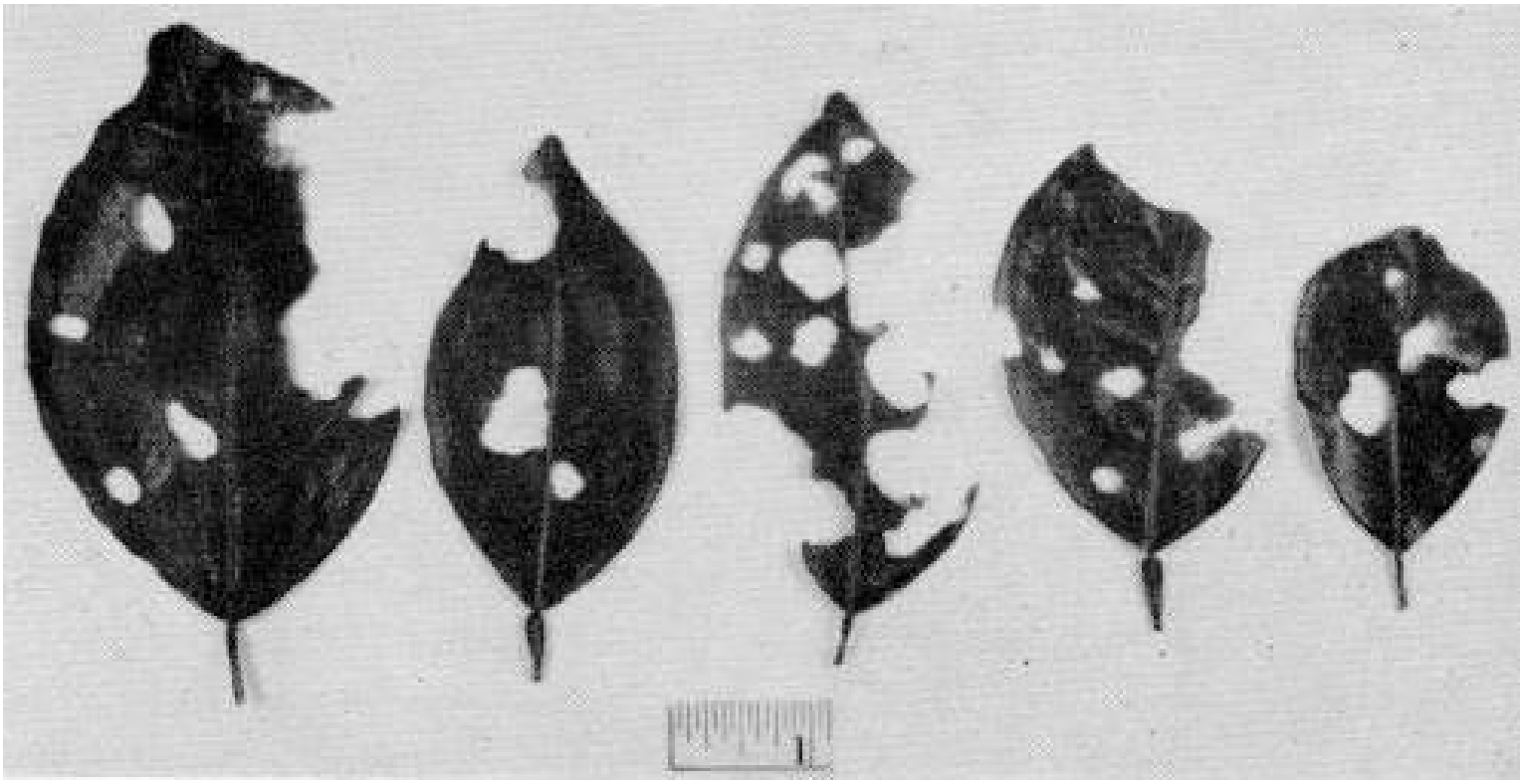
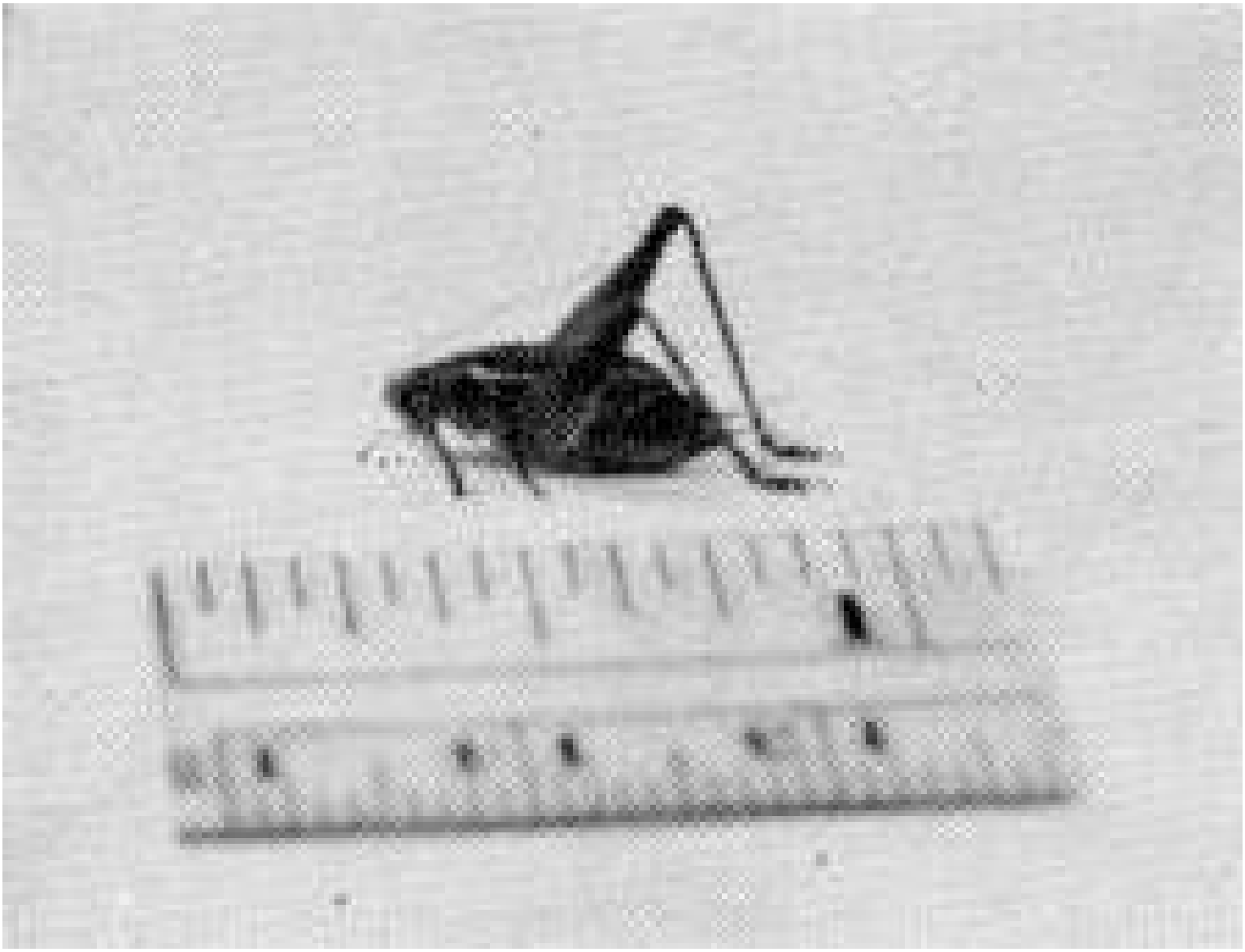








SOME BIOLOGICAL NOTES ON KATYDIDS IN FLORIDA CITRUS GROVES [1]

J. T. GRIFFITHS [2]
Florida Citrus Experiment Station, Lake Alfred

During the course of observations on injury to Pope Summer oranges in the Vero Beach area, interest in the broad-winged katydid, *Microcentrum rhombifolium* (Sauss.), on citrus in Florida led to observations on the biology of this insect. This katydid has been known for many years to occasionally damage citrus fruits by chewing on the peel as described by Griffiths.[3] This paper presents observations on the life history of this katydid and illustrations of the instars.

In 1951 eggs hatched early in the spring and the hatching coincided with the onset of the spring flush of growth on citrus trees. Figure 1 shows eggs which are just about to hatch. These eggs have swelled and hatching would normally occur within a relatively short time. Katydids were first observed to hatch on February 16.

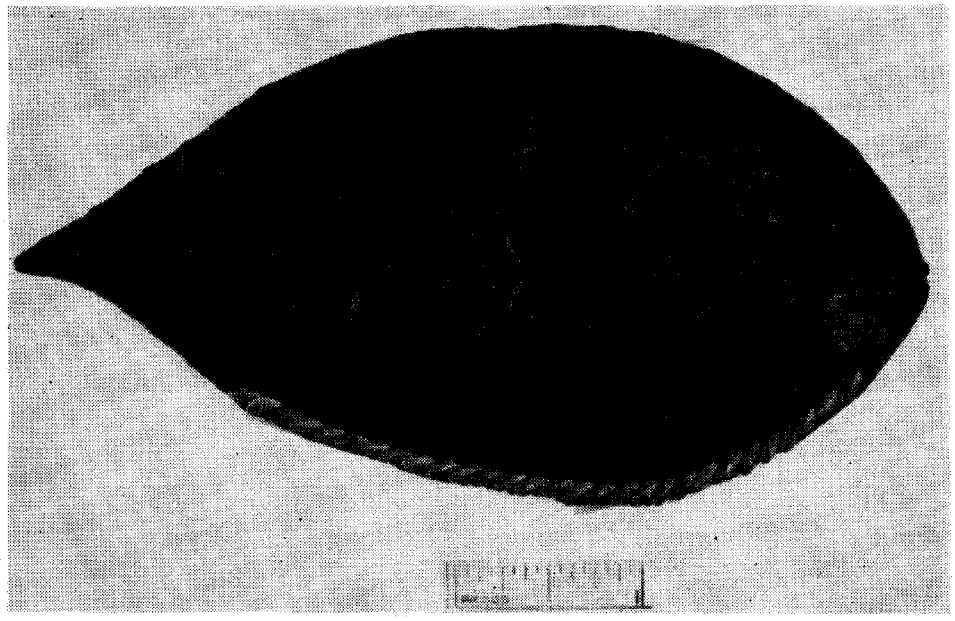


Figure 1. Katydid eggs which are about to hatch. These appear raised and swollen.

[1] Florida Agricultural Experiment Station Journal Series, No. 84.

[2] Resigned in 1951; present address, Lyons Fertilizer Company, Winter Haven, Florida.

[3] Griffiths, J. T. 1952. Observations on peel injury to Pope Summer Oranges in the Vero Beach area. Fla. Ent. (in press).

Individuals hatched on February 16, 1951 were reared to adults in the laboratory. It is probable that their life cycle was longer than would normally have occurred in citrus groves, inasmuch as the katydids were confined in small containers and their diet was probably not as satisfactory as would have been found in nature.

On March 11 the first katydids molted from first to second instar (figure 2). This represented a period of 23 days for the first instar. The first individuals to reach third instar did so on April 2 or after another 23 days. The last nymph to reach third instar did so on April 10.

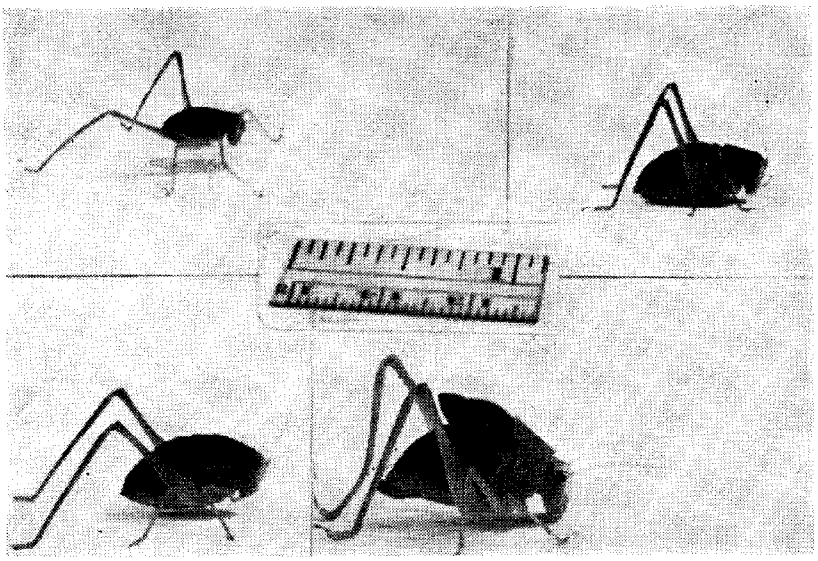


Figure 2. The four instars of the broad-winged katydid, *Microcentrum rhombofolium* (Sauss.). Upper left, 1st instar; upper right, 2nd instar; lower left, 3rd instar; and lower right, 4th instar.

In the third instar (figure 2) a distinctive line appears on the dorsal side of the abdomen. This is usually light yellow and extends along the mid-dorsal line of the thorax. As it emerges behind the small wing pads it separates and forms two distinct lines down the lateral margin of the dorsal abdominal area. This is a distinctive marking which readily places the individual in third instar. It is not present as a pronounced line in second instar.

The first individuals to reach fourth instar did so on April 13 and the last one on April 28. Wing pads appeared in the third and were pronounced in the last instar. The first adult (figure 3) emerged on May 1 and the last two on May 8. The

life cycle from hatching to adulthood extended over a period of almost three months. Observations in the field showed that katydids in similar stages to those in the laboratory were found at approximately the same times. Adults were first observed during the latter part of April.

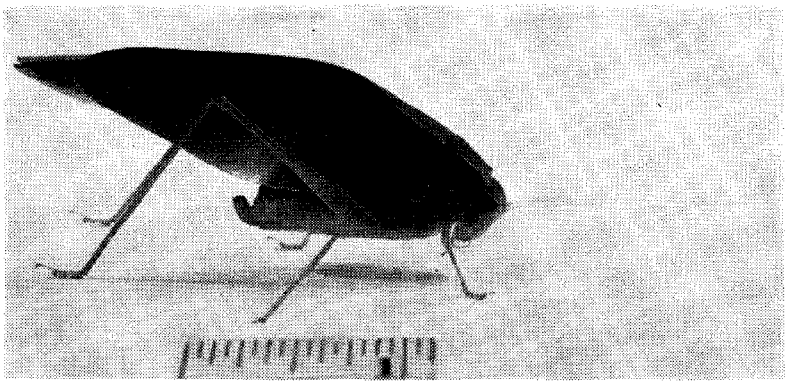


Figure 3. Adult female of the broad-winged katydid.

A second hatch occurred in the summer of 1951. Another hatch was observed about September 1 and on January 1, 1952 second and third instar nymphs were seen in the field. It is apparent from this that the life cycle is probably continuous throughout the year with, perhaps, three or more generations occurring annually. Whether hatching and nymphal development is normal in most winters is unknown, but in the period of rather mild temperature during November and December of 1951 it was apparent that hatching had occurred in a number of groves and that nymphs were present in January of 1952.

This katydid is seldom of major economic importance to citrus. It has been definitely established that it can injure fruit and does so on occasion although fruit injury amounting to economic loss is probably rare. Foliage injury, particularly to young trees, can be extremely severe. In the fall of 1951 observations in a young grove indicated that katydid injury was the major factor in partial defoliation of numerous trees. This injury was widespread over a 60 acre block and chlordane sprays were applied to control the insect. Since a number of eggs are laid on a single leaf, if these eggs hatch, a fairly large population of katydids will be present with a limited leaf area for food. The damage by these rapidly growing nymphs can on occasion be most severe.

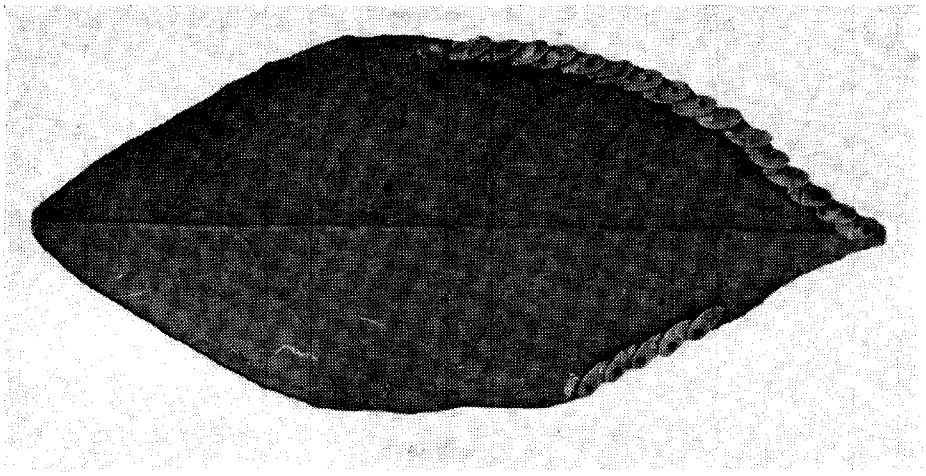


Figure 4. Emergence holes in parasitized katydid eggs made by *Anastatus mirabilis* (Walsh). Note the flattened appearance of these eggs as contrasted with those in Figure 1.

Eggs of this katydid are commonly parasitized and parasitism is a major factor in the normal control of this insect pest. The eggs have a flat appearance (figure 4) and round emergence holes of the parasite are very evident. The most common parasite is *Anastatus mirabilis* (Walsh),[4] a member of the family Eupelmidae. Usually when parasitism occurs, all eggs of a group on a single leaf will be parasitized.

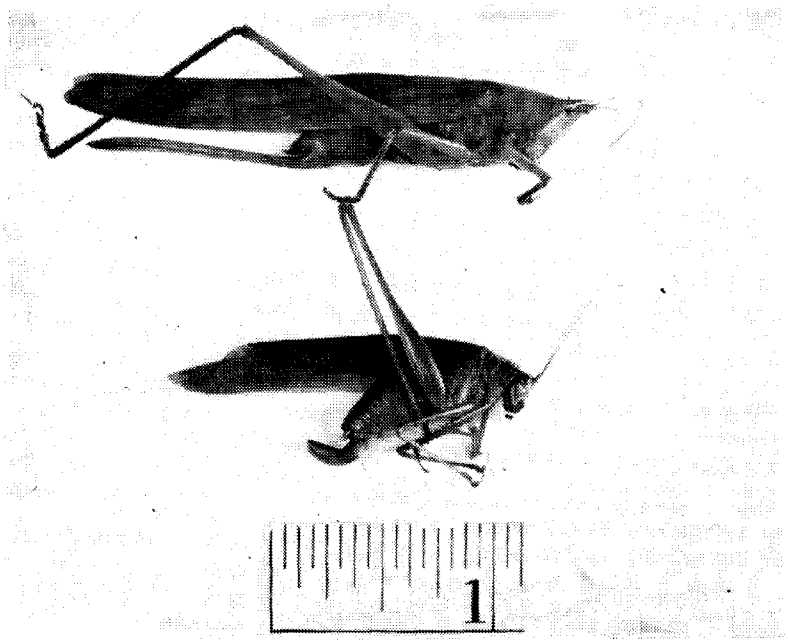


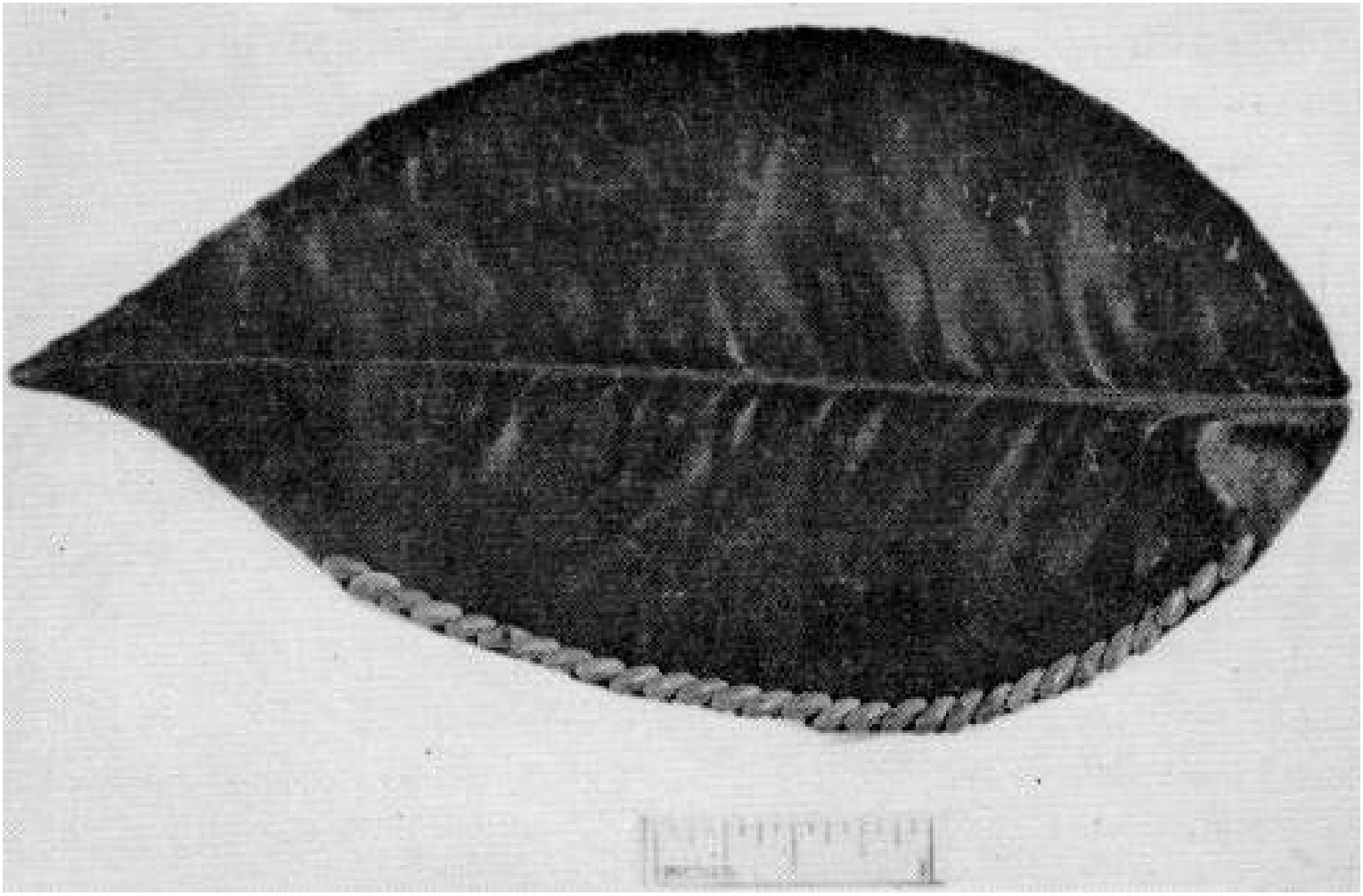
Figure 5. Two katydids which are sometimes found in citrus groves, *Neoconocephalus triops*, above, and *Scudderia* sp. below.

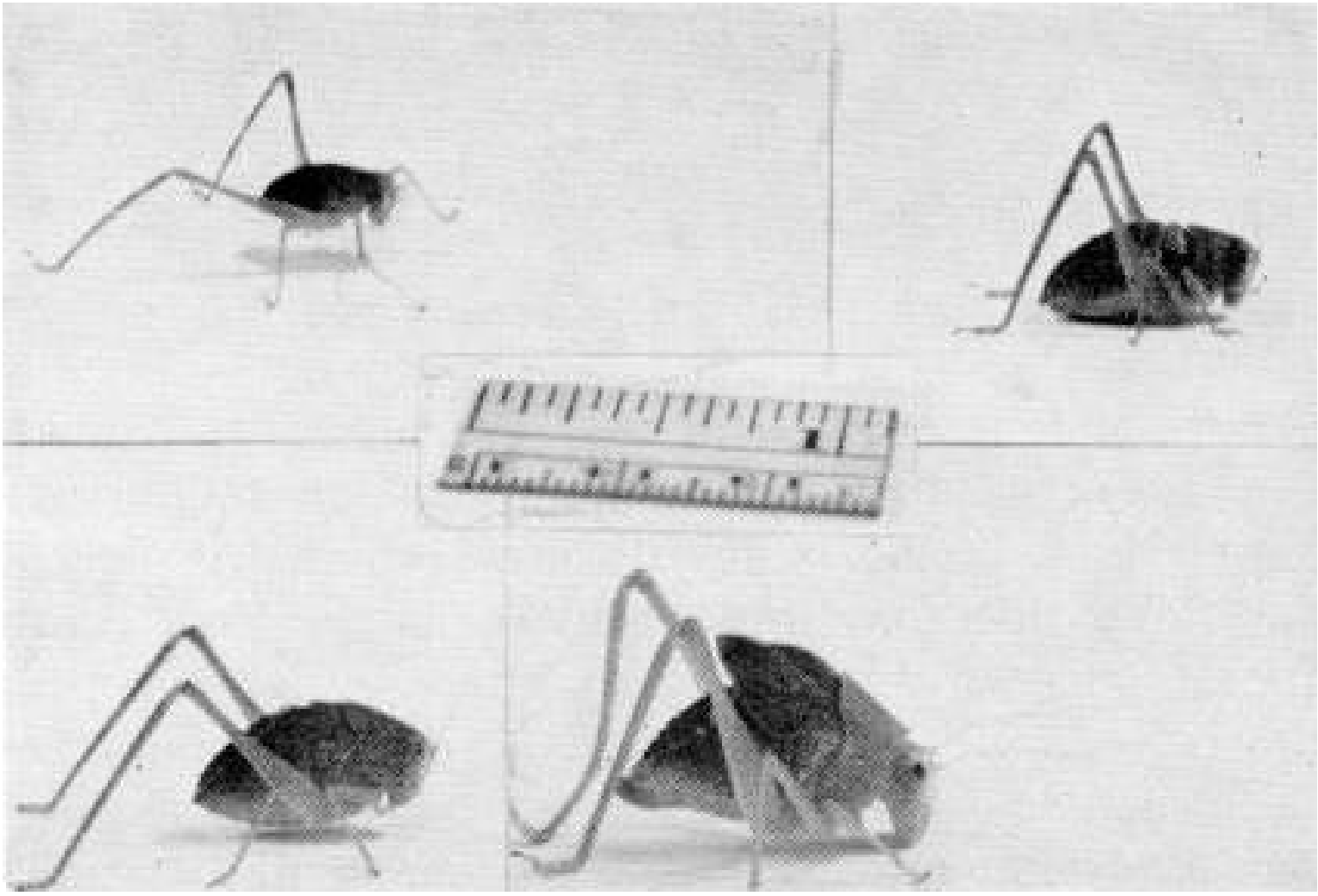
[4] Identification by Mr. A. D. Gahan of the Bureau of Entomology and Plant Quarantine.

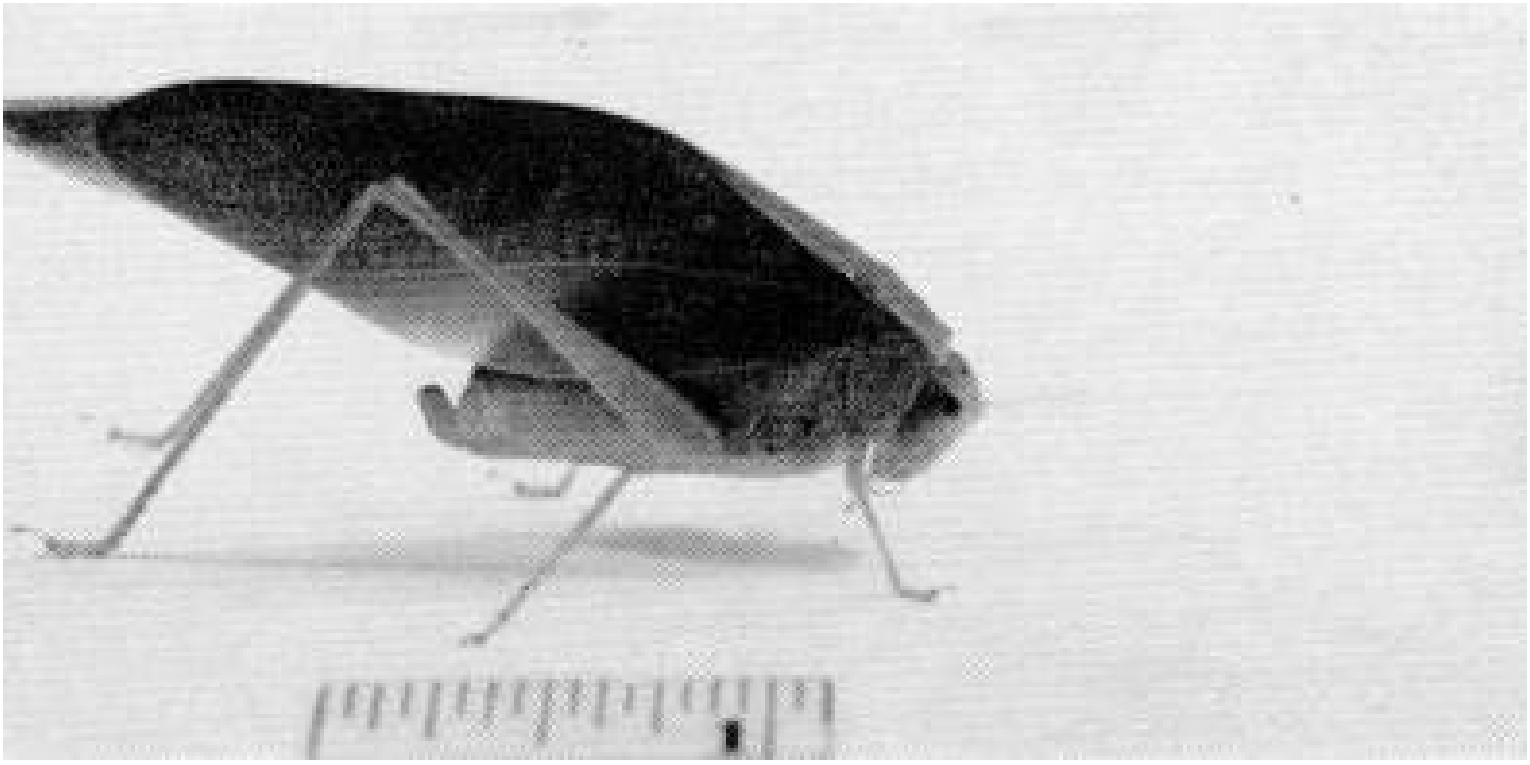
The broad-winged katydid is the most common species found on citrus in Florida, however, two other species regularly encountered are pictured in figure 5. One is the species *Neoconocephalus triops* (L.) and the other belongs to the genus *Scudderia*. Positive identification of this specimen was not made. No information on the life cycles of these two species is available.

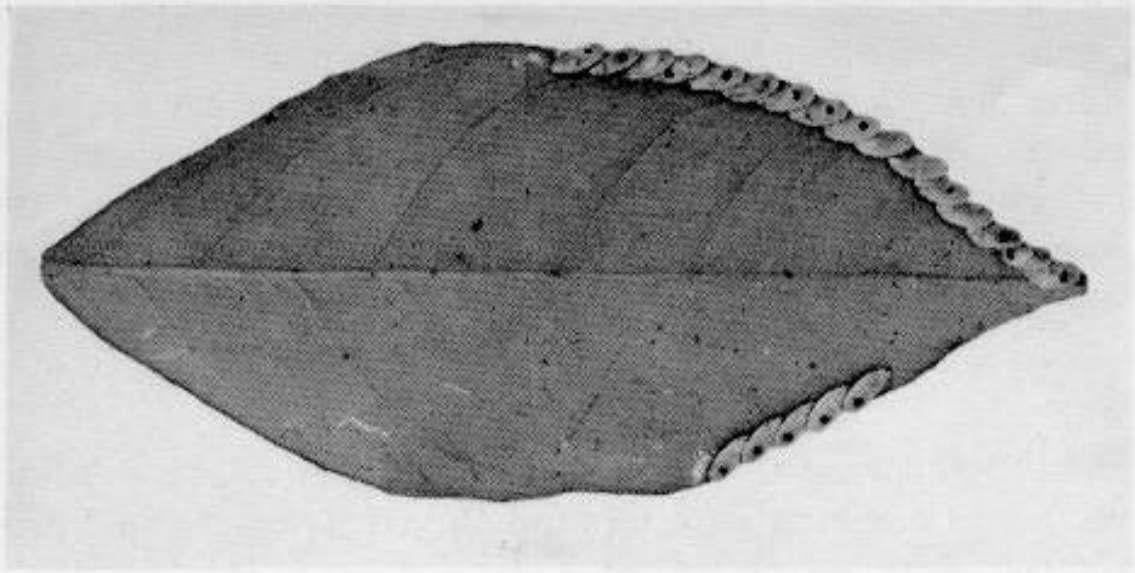
SUMMARY

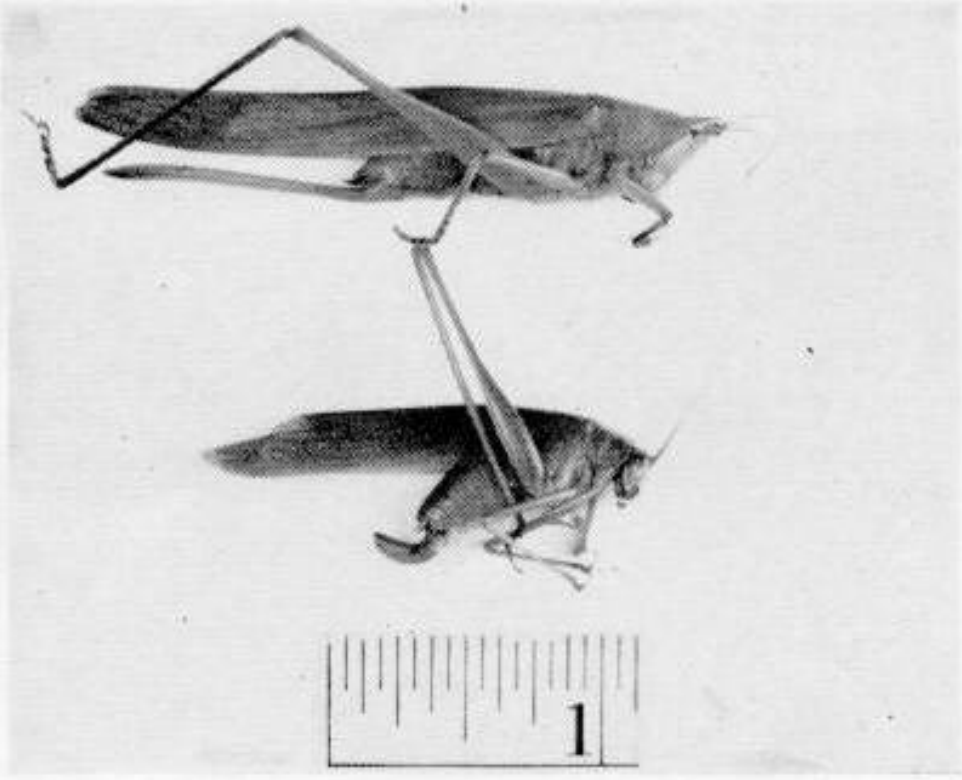
The broad-winged katydid *Microcentrum rhombifolium* (Sauss.) is a common insect found in citrus groves in Florida. Only rarely does it accomplish major injury and this is usually confined to young trees. It passes through four instars which take a period of approximately three months from egg to adult. Its eggs are highly parasitized by a Hymenopterous insect of the family Eupelmidae, *Anastatus mirabilis* (Walsh).







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SOME NOTES ON THE CITRUS ROOT WEEVIL [1]

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Extensive root injuries were found during a tree replacement program in a commercial Tahiti lime grove. Many burrows and excavations in the roots appeared to be wounds caused by insect feeding. Further observations disclosed larvae, pupae, and teneral adults of the citrus root weevil, *Pachnaeus litus* (Germar), in the soil about the tree roots. Four larvae, three pupae, and two immature adult forms were taken from the soil among the roots of one tree. Much root injury was also observed on this tree. Examinations of roots from orange and lime trees in other groves indicated that such root injuries were very common.

Adults were numerous in one orange grove and were feeding on the fruit and bloom so abundantly that an important portion of the fruit was destroyed. Commercial grove caretakers reported that the citrus root weevil was worse than they had ever observed. In view of the damage caused by this insect, a study was made of the literature pertaining to it. In addition, a reconsideration of the importance of the species appeared necessary. Much of the information presented here was gleaned from the literature as indicated.

Beetles collected from near Cayamas, Cuba, in 1824 were named *Cyphus litus* by Germar in 1825, according to Schwarz and Barber (1922). Horn placed the species in the genus *Pachnaeus,* according to Schwarz and Barber (1922), but confused *litus* and *opalus.* The synonym of *litus,* therefore, is *opalus. P. opalus* (Olivier) was accepted as a valid species by Schwarz and Barber (1922), with *P. distans* Horn as a synonym.

REFERENCES.—*Pachnaeus litus* (Germar) is known as the citrus root weevil in the United States and as the picudo verde-azul in Cuba and Puerto Rico. *P. litus* ranges from south Florida through the Keys, Cuba, and Jamaica and, according to Wolcott (1933), is a widespread pest in the West Indies. It was listed as a pest of economic importance in Florida by Moznette (1923) and by Watson (1918, 1939). It was reported a citrus pest by Gowdey (1923) in Jamaica. More reports concerning the species have come from Cuba, however, than from other

[1] Florida Agricultural Experiment Station Journal Series, No. 73.

areas. They are listed as follows: Bruner (1934, 1935), Bruner et al (1945), Bruner and Scaramuzza (1936), Cook and Horne (1908), Perdomo (1940), and de Zayas (1947).

Citrus plants appear to be the principal hosts of the citrus root weevil. Beans (Bruner (1935)), strawberries (Watson (1939)), and tobacco (Bruner and Scaramuzza (1936)), were also reported infested. The weevil has been observed feeding on avocado leaves. Beetles are taken occasionally from trees in a large avocado grove during a sampling procedure for the *Heilipus squamosus* beetle. Although beetles were observed to feed on fruit of the orange and grapefruit, none has been observed to feed on lime fruit; neither has any feeding wound been observed on lime fruit. Although Watson (1918) recognized the importance of the adults, he believed the larvae were more injurious.

Many life history details were reported by Cook and Horne (1908) and Bruner (1934). From their reports the life history is given very briefly as follows: Mature beetles begin emerging in April, reach a peak of abundance in May, become fewer during mid-summer, and by December have disappeared. Eggs are laid in groups, between two leaves or between a fold of the same leaf, and hatch in about a week. Newly hatched larvae drop to the ground, burrow beneath the surface, and begin feeding on the roots. Feeding seems to be superficial on the larger roots, but deeper wounds on the smaller roots and absence of certain small roots, suggest that entire roots are occasionally consumed. About ten months appear to be spent by the larvae in the soil.

Populations of the beetles vary extremely from year to year. Authors' writings emphasize this as a characteristic of the species. Explanations for it, however, were not found.

Watson (1918) early recommended lead arsenate for control of the beetle. He later (1932) recommended a fluosilicate. Bruner (1934) and de Zayas (1947) recommended collection of beetles. This is easily accomplished by jarring the trees. The beetles feign death in response to the jarring and fall to the canvas or other material on the ground used for the collection. Bruner (1934) believed the adult stage offered the best opportunity for combating the pest.

EXPERIMENTAL CONTROL.—A test was conducted in the spring of 1951 to study control of beetles feeding in an orange grove. About one-half of the trees were sprayed with cryolite, the trees

in two rows were left unsprayed, and the remainder were sprayed with parathion. The sprays were applied with a power sprayer. Cryolite (synthetic) was used at six pounds per 100 gallons of water and parathion (15 percent wettable powder) was used at one pound per 100 gallons of water. Beetle populations were determined one and three days after the treatments. This was done by shaking the beetles from each of five trees onto a parachute silk spread under the trees. Five trees of each treatment were shaken and the collections of beetles were recorded for each day's count. A tabular presentation of the data, giving the average number of beetles per tree, is given as follows:

Treatment	*One day*	*Three days*
Cryolite	5.6	3.8
Parathion	5.8	5.4
Check	7.6	8.2

Cryolite gave slightly more reduction than parathion. The differences between treatments are just short of statistical significance. Observations a week after treatment showed that the spray treatments had not given satisfactory beetle reductions. Improved control is needed to provide more satisfactory protection from the citrus root weevil.

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PARATHION CONTAMINATION HAZARDS TO SPRAY LABOR [1]

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Florida Citrus Experiment Station, Lake Alfred

The application of parathion to citrus involves the subjection of spray labor to long, continuous periods of exposure, and the nature of the spray operation is such that it is impossible to prevent contact or contamination with the spray material. As a result, the use of parathion on citrus has been found to be more hazardous than its use on other crops.

In 1950, a report by Griffiths et al (1951) showed that there was some correlation between the job engaged in and the amount of parathion found on the respirator filter discs. This was in turn related to the incidence of parathion poisoning. This relationship was found for Speed Sprayer drivers and hand spray gun operators, but not for supply unit operators. In this latter instance, the amount of parathion found on filter discs was low and incidence of parathion illness high.

The purpose of this paper is to present further results on the analysis of parathion on respirator filter discs and to correlate the changes in cholinesterase levels with the amounts of parathion found on filter discs of the three spray groups mentioned above. The beneficial effect from the use of canopies for the protection of tractor drivers is also included. All observations were made during the 1951 season.

EXPERIMENTAL

Respirator filter discs were collected at the end of each day's spray operations from eight Speed Sprayer operators, six supply unit operators, and seven hand spray gun operators. One of the Speed Sprayer operators was protected from spray drift by a canopy over the tractor. A complete daily record was kept of the number of pounds of parathion handled by each man. The filter discs were stored in sealed jars and collected at least once a week. This procedure was carried out during the post-bloom and summer scalicide application periods.

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[1] Presented before the Florida Entomological Society at Winter Haven, Florida, September 13-14, 1951. Florida Agricultural Experiment Station Journal Series, No. 92.

[2] Resigned in 1951.

The parathion was extracted from the filter discs according to the following technique: two filter discs (one day's exposure) were placed in a 500 ml. narrow mouth Erlenmeyer flask containing 200 mls. of benzene. The flask was stoppered securely and placed in a horizontal shaker for one hour. The extract was then filtered through cotton and stored in a flask until analysis was made. One hundred to 150 ml. of the extract were evaporated from a 300 ml. tall-form beaker to a volume of 10 ml. on a steam bath with the aid of a current of air blowing across the top of the beaker. The last 10 ml. were evaporated by the air only. The analysis was made according to the Averill-Norris method (1948).

RESULTS

The results shown in Table 1 indicate that in hand spray operations the most parathion was found on the discs and the

TABLE 1. CORRELATION OF AMOUNTS OF PARATHION FOUND ON FILTER DISCS DURING KNOWN EXPOSURE PERIODS AND CHANGES IN CHOLINESTERASE LEVELS OF THREE GROUPS OF SPRAY OPERATORS.

Type of Spray Operation	Parathion Mcg. per Lb. Per Filter Disc*	Average Decrease in Cholinesterase Levels**	
		Red Blood Cells	Plasma
Filling Tank	.15	.4	20
Speed Sprayer Driver	.45	2.6	23
Hand Gun Operator	1.41	8	30

* Mcg. parathion per lb. of 15% parathion sprayed.

** These values, representing percentage points below normal, were obtained from Dr. J. W. Williams of Lakeland who was in charge of cholinesterase work in a cooperative experiment with the Citrus Experiment Station, Lake Alfred, and American Cyanamid Company.

TABLE 2. PROTECTION OF SPEED SPRAYER OPERATORS BY USE OF TRACTOR CANOPY.*

Parathion Mcg./100 Lbs./Filter Disc**			Percent Reduction by Use of Canopy	
No Canopy		Canopy	Sprayer #3 with #1	Sprayer #3 with #2
Sprayer #1	Sprayer #2	Sprayer #3		
94.8	91.5	22	76.8	76
73.7	120.8	4	94.6	96.7
51.4	76	4.5	91.3	94
109.8	96.3	4.5	96.0	95.4
119.1	126.2	6.4	94.6	95
116	114	15.5	85.6	89.3
	66.1	21.5		67.4
	101	18.7		81.4

* Commercial spray operations.

** Mcg. parathion per 100 lbs. of 15% parathion sprayed.

greatest decrease in cholinesterase levels resulted. The supply unit operators had the least; however, as previously reported (Griffiths et al., 1951), the latter group had a higher incidence of parathion illness. There was no hazard difference between the Speed Sprayer operators and the supply unit operators. Table 2 shows the reduced amounts of parathion contamination as a result of a protective canopy.

DISCUSSION

The application of parathion by hand spray gun operators is a very dangerous operation, for it is extremely difficult to apply the spray correctly without the clothes of the operator becoming saturated with spray material. In view of the high rate of contamination, it would seem advisable to reduce this method of application to emergencies. When it is necessary, the exposure period of the men should be limited to not more than five consecutive days.

It is quite apparent that the Speed Sprayer operation is much safer, and the safety factor can be increased further by the use of a canopy which will practically eliminate the contamination problem. This does not mean, however, that the operator can discard his respirator.

As previously stated, low amounts of parathion are found on filter discs worn by supply unit operators. This does not agree with facts concerning the high incidence of parathion illness in this group. Thus, because this job can be carried out with but little contamination, it should be a safe one. However, it is apparently a job in which carelessness can result in excessive exposure. The illnesses occurring to men engaged in this operation would, thus, appear to be the result of carelessness and therefore could readily be prevented.

The decrease in the cholinesterase levels in the blood appear to be somewhat in line with the results obtained in previous work which was reported in 1951 (Griffiths et al.).

CONCLUSIONS

1. The hand spray gun operator group showed the greatest amount of contamination and also showed the greatest decreases in cholinesterase levels. Thus, other safer methods of applying parathion sprays should be employed wherever possible.

2. Speed Sprayer applications are safer than hand gun operations. The safety can be increased by using a canopy to protect the operator from spray material.

3. Supply unit operators have a low incidence of contamination but have a relatively high rate of illness due to parathion. This is probably the result of occasional lapses in safety precautions which result in massive contamination.

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A NEW SPECIES OF MICRACANTHIA FROM FLORIDA (HEMIPTERA: SALDIDAE)

C. J. DRAKE [1] AND H. C. CHAPMAN [2]

The genus *Micracanthia* Reuter (1912), shore bug family Saldidae, is represented in the world by nine species, including the new one described below from Florida and Mississippi. The latter now makes Florida the type locality for three of the six species indigenous to the Americas—*M. humilis* (Say), *M. pumpila* Blatchley and *M. husseyi*, n. sp. Another member of the genus, *M. quadrimaculata* (Champion) also occurs in Florida.

The species of the genus *Micracanthia* inhabit and breed in the narrow, wet areas near the shore line of bodies of running and standing waters. This narrow strip of wet land (sparsely dotted with scattered vegetation) is washed by the waves and more or less deeply inundated at high water. The thinly scattered plants provide cover and shelter needed for protection, especially by immature stages and brachypterous imagoes.

Very little is known about the biology, predacity, and habitat requirements of any of the species. *M. humilis* is by far our commonest and most widely dispersed species. It ranges across southern Canada and throughout the United States (it is most abundant and generally dispersed east of the Rocky Mountains) and then south into Mexico and the West Indies. Recently, it was also reported from Brazil. *M. quadrimaculata* ranks next in geographies, ranging from Panama across Central America and Mexico, deep into United States and along the west coast north into British Columbia. The other native species as well as the two old world species found in North America are poorly represented in collections, probably because of their singular habits and spotty distribution.

M. quadrimaculata finds suitable abodes near the water's edge along borders of fresh, alkaline and salt waters. The species was collected along the shore of a large salt water lagoon, Veracruz, Mexico, July 29, 1950; Lake Tahoe, California, Aug. 8, 1937; Williamette River, near Corvallis, Oregon, May 10, 1936; and Soap Lake, Washington, Aug. 30, 1949, all by C. J. Drake. Most of the specimens of *M. pumpila* and *M. husseyi*

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examined were collected in the vicinity of brackish waters or salt marshes, but they are not restricted to such habitats. The singular habits of the latter are discussed below with its description.

Micracanthia husseyi, sp. nov.[3]

FORM AND COLOR: Small, elongate-ovate, black with the outer margin of the hemelytra more or less widely and irregularly margined with whitish testaceous, also frequently with a small spot near apex of clavus and three other rounded spots near outer margin of inner clavus whitish. Hemelytra with darkened part velvety black, not as dark as scutellum and pronotum, sometimes with some bluish pruinose spots, the darkened area often extending at one or two places into outer corium; membrane pale, with a small fuscous spot in small outer cell and two spots in each of the three larger inner cells. Antennae fuscous-black, with basal segment more or less pale. Body beneath black, the venter densely clothed with rather long grayish pubescence. Pronotum, scutellum, and head slightly shining, the grayish pubescence inconspicuous. Hemelytra with prominent golden pubescence in blackish areas and pale inconspicuous pubescence in pale areas.

SIZE: Length, 2.50-3.00 mm.; width, 1.25-1.40 mm. Female generally a little broader than the male.

HEAD: Width across eyes, 0.87 mm. Black with a luteous spot on each side between the eye and ocellus, with the usual long stiff hairs; ocelli pale brown, separated by slightly less than diameter of an ocellus; front plain, without median longitudinal groove; apical callosities large, convex above, whitish testaceous, sometimes brown or black, with the inner ends not meeting on the median line; a small white callosity on each side of clypeus in adjacent area; labrum very large, shieldlike in shape, dark ferrugineous in color. Rostrum very long, testaceous. Antennae moderately long, shortly pilose with pilosity rather sparse on first two segments and quite dense on last two segments; segment II slenderest, varying from slightly shorter to subequal to III in length; III and IV equal in length; length of segments—I, 20; II, 26-29; III, 30-32; IV, 30-32.

THORAX: Pronotum moderately narrowed anteriorly, the lateral margins nearly straight; hind margin deeply broadly excavated; collar very short, sharply marked off from callus by a deep transverse sulcus; callus moderately elevated, with a large deep rounded impression on the disc, slightly longer than hind lobe, not extending laterally on explanate margins, delimited behind by a deep transverse suclus which is pitted at the bottom; hind lobe moderately convex. Scutellum with color and pubescence as on pronotum, transversely impressed just in front of the middle, the hind part finely transversely rugulose.

Hemelytra with pubescence a little longer than on pronotum; underside of midvein of corium deeply transversely notched near the base for the reception of a short, fingerlike, lateral projection on metapleura, the two

[3] Named in honor of the Florida aquatic hemipterist, Dr. R. F. Hussey, who has contributed many fine papers on American Hemiptera.

structures functioning together as a wing stabilizer when the hemelytra are in repose.

ABDOMEN: Front margin of second connexival segment (on each side) in male provided with two rows (alternate rows with rows and pegs placed close together) of stridulatory pegs, the pegs with rounded tops and pointed anteriorly. No stridulatory pegs in female. Male parameres small with apices narrowed and turned downwards, with a very distinctly raised area or bump-like area on the inferior side just beneath the narrowed apical part; dorsal surface evenly and slowly bowed (convex) with the basal part just beneath the curved part abruptly narrowed.

HOLOTYPE ♂ AND ALLOTYPE ♀: Lakeland, Fla., Feb. 24, 1950, collected by J. E. Burgess, in Drake Collection.

PARATYPES (*many specimens*): Pierce, Polk County, Fla., May 28, 1950, R. F. Hussey; Pascagoula, Miss., Aug. 8, 1921, C. J. Drake; Oak Hill, Cocoa, Titusville and Orlando, Fla., 1951-52, all by H. C. Chapman.

AFFINITIES: *M. husseyi* is most closely related to *M. humilis* and *M. pumpila*. The three species may be differentiated as follows:—

M. pumpila Blatchley—Scutellum with apex strongly swollen or tumid, deep black, shining, sparsely pubescent. Antennae with segment II thinner and much shorter than III; III and IV distinctly thicker and densely pubescent, nearly equal in length, both segments longer than in either of the other species. Callus also larger and more elevated than in the other two species.

M. humilis (Say)—Scutellum concolorus, evenly pubescent, the apical part little convex, not tumid, finely transversely rugulose. Antennae with segment II distinctly longer than III; III and IV subequal in length and thickness. Callus moderately elevated.

M. husseyi, n. sp.—Scutellum about the same as in *humilis*, the apical part also feebly convex and finely transversely rugulose. Antennae with segment II a little shorter or at most about subequal to III in length, not longer; III and IV equal in thickness and length; in some specimens segments II, III and IV are all subequal in length. Callus moderately elevated.

This species inhabits two types of habitats—brackish and fresh waters. It is not easily disturbed and does not fly readily. When picked up, it will often crawl around on one's hand without flying away. In this respect it differs greatly from *M. humilis*, which is easily disturbed, very agile, and a flighty species. *M. pumpila* is intermediate in agility between the two species; nymphs and short-winged forms, when disturbed, hide in the thin vegetation. The latter form is sometimes found in deep shade; it too breeds in both fresh and salt water habitats.

Attention is called to the singular habits of many individuals of *M. husseyi*. Most of the specimens collected by H. C. Chapman were taken from the exposed parts of grasslike plants growing in salt marshes in Florida, sometimes some distance

out in the water from the shore line. The roots of the plants were growing in soil submerged under several inches of salt water, with only the upper parts of the plants extending above the surface in the air. Judging from the number of specimens encountered, *M. husseyi* prefers to seek its prey while resting on the parts of grasslike plants that are above the surface of the water rather than on the wet shore near the edge of the water. Only a few specimens were found on the wet shore, whereas the species was fairly common on the partly submerged plants, even out some distance from the shore.

In cypress swamps in central Florida, *M. husseyi* was often found on logs and other objects floating on the water. The little waterstrider, *Mesovelia amoena* Uhler, was frequently collected on the same floating logs. In this connection, it should be noted that the writers have netted several other species of shore bugs of the genera *Saldula* Van Duzee, *Salda* Fabricius, *Ioscytus* Reuter and the rare *Lampracanthia crassicornis* (Uhler) on the upper parts of grasses or grasslike plants extending above the water level in submerged meadows along rivers, in bogs, swamps, lakes and other bodies of fresh water, sometimes as far as 50 feet from the edge of the shore. Some species of saldids rest on stones out in the water as well as stones on the shore near the edge of the water.

NOTES ON TABANID FLIES AND OTHER VICTIMS CAUGHT BY THE CARNIVOROUS PLANT, SARRACENIA FLAVA [1]

CORNELIUS B. PHILIP [2]

Incidental to a few days' collecting in April of early Tabanidae along the Gulf Coast, more specimens surprisingly were taken from the leaf traps or so-called "pitchers" of the carnivorous plant, *Sarracenia flava* Linn., than by any other method of early, local sampling in proportion to the time spent. The condition of the captive specimens varied. This was obviously in relation to the length of time in the traps, and also to the presence and number of almost ubiquitous sarcophagid larvae of varying sizes feeding upon the captured contents. One large female of *Tabanus atratus* Fabr. was still alive and futilely struggling to escape when removed, and it already had a small sarcophagid larva attacking it near the neck. The previously unknown male of a rare, southeastern tabanid species was taken from one of these pitchers, and is described later. Two other little known species were recovered from these plants permitting some discussion of variation.

Many hours of collecting in various localities around tame stock, in outbuildings, about the person, and sweeping in likely spots yielded fewer specimens, all females, than were taken in much less proportionate time from these carnivorous plants. Specimens of *Chrysops fuliginosa* Wied., *C. dorsovittata* Hine, *C. dimmocki* Hine, *Agkistrocerus finitima* (Stone), *T. lineola* Fabr., *T. bishoppi* Stone, and *T. sparus* subsp. *milleri* Whit. were captured by these methods, mostly on the wing.

A total of approximately four hours was spent examining the contents of some 400 *S. flava* leaves which were slit open with a razor blade. The following species were recovered in recognizable condition in a patch of plants scattered over about an acre of wet meadow on the outskirts of Panama City, Florida, 19 and 21 April 1952: *Tabanus atratus* ♀, *T. vittiger* subsp. *schwardti* Phil. ♂, ♀, *Hybomitra hinei* subsp. *wrighti* (Whit.) 2 ♂, *Hamatabanus annularis* (Hine) (?) 4♂, 6♀, *Anacimas limbellatus* End. ♂, and *Chrysops fuliginosa* ♀.

Only the last of these species was also seen on the wing. An equal amount of time on a sunny, still morning was spent

[1] From Federal Security Agency, Public Health Service, National Institutes of Health, National Microbiological Institute.

[2] Rocky Mountain Laboratory, Hamilton, Montana.

collecting from a tethered horse in an adjoining field and only 3 *Tabanus* were taken. Thus, examination of pitcher plants in a given suitable neighborhood appears to offer a valuable survey aid supplemental to general collecting.

The male of the rare *A. limbellatus* (genotype species of *Anacimas*) has not previously been reported and a specimen in better than fair condition from a pitcher near Springfield, Florida, 19 April, is here described as allotype.

Anacimas limbellatus End. ♂, 12 mm. Darker than the ♀ but readily associated on the basis of the peculiarly-shaped, hairy antennae, sparsely hairy eyes, and wing veins broadly margined with brown. Enlarged eye facets occupying 2/3 of eye area, not as perceptibly hairy as in *A. dodgei;* body and appendages unusually hairy; palpi, legs, and basal 2 segments of antennae brown, the flagellum contrasting yellow, the plate with the dorsal, low angle in the middle and a few, strong black hairs, and with lower edge evenly convex; palpi subovoid less swollen than in *A. geropogon*; no perceptible lines on mesonotum in contrast to *A. dodgei;* the abdomen dark, testaceous, with pale incisures below, and evidence of 3 rows of pale triangles above, the middle row evanescent, the sublateral rows oblique.

The writer has a male *A. geropogon* Phil. labeled simply "Fla.," April, with much redder abdomen and indistinct pattern agreeing in this and antennal characters with the allo- and paratypes from North Carolina (Philip, 1936). It has a brownish, transverse spot under the scutellum on tergite 1, and a longitudinal, ovoid spot mesally only on 2. The legs are brighter orange. This provides a new State record for Florida, corroborated by capture of a female on Dog Island, Franklin County, 17 October, 1947.

Hamatabanus annularis (Hine). Only one male specimen from Pascagoula, Miss., and a female from Lucedale, Miss., have been taken since description in 1917 of the type series, two males and a female from Ocean Springs, Miss. All were captured in April or early May. The related *H. sexfasciatus* (Stone) is likewise rare; only four females of this species are known to the writer: the type from Largo Key, Fla., and the paratype and another specimen also from Florida as well as one from Savannah, Georgia, which also constitutes a new State record. The last was taken in May, and the 3 Florida specimens in March.

The present series of four males and six females from *Sarracenia,* therefore, is double the previous combined total, and permits of some comment on variation in spite of poor condition of part of the series. In several respects, this group of speci-

mens shows intergrading characters between the above two species which emphasize the desirability of more material. The antennal plates are bright reddish in all but two which are brown, and only two show tendency for the dorsal "thumb" to be decurved apically as figured by Stone (1938, fig. 5B) for *H. sexfasciatus*. There is as much variation in shape as seen in larger series of related *H. carolinensis* Macq. (syn. *scitus* Wlk.). All the present series have the characteristic pallid incisures, but most have the abdomen predominantly black from tergite 3 caudad, plus more or less evidence of median pale-haired triangles which are probably easily obliterated by wear. The pattern on tergite 2 varies but most specimens have at least suggestions of that seen in *H. carolinensis* with a median geminate, blackish spot divided by the pale, median triangle, reddish on either side (not gray as in the latter), and often with darker lateral areas. None has the entirely clear brown color of *H. sexfasciatus*. Most have at least the mid and hind pairs of femora distinctly darker than the reddish tibiae. Sizes also vary in both sexes: ♂, 11 to 15 mm., ♀, 11 to 13 mm.

It appears best at present to assign these to *H. annularis* (Hine) which will extend the distribution of the species eastward and provide a new Florida record.

Chrysops abata Phil. Since discription in 1941 of the unique holotype from Florida, another female has turned up in the U. S. National Museum from Orlando. A third female was taken by the writer in the leaf trap of a smaller species, *Sarracenia minor* Wall., near Gulfport, Miss., 20 April 1952, also providing a new State record and extending reported distribution of the species westward. This specimen is in surprisingly good condition indicating but short immersion in the pitcher liquid. The following variation from the holotype is noted: A little smaller, 7 mm. All dark parts more pronounced blackish, including appendages, halteres and infuscation of the wings. The median maculation on tergite 2 is not a uniform, reniform spot as figured for the holotype (Philip 1941, pl. 15, fig. 1), but entirely crosses the segment and is sharply constricted just above the base on the incisure giving a remarkable likeness to the frontal outline of the sphinx. The median gemination on tergite 3 is less plainly emarginate behind and is very little wider than that on tergite 2. There is no evidence of the median narrow line seen on sternites 2 and 3 of the holotype. The

median pollinosity of the face is barely complete, being more attenuated below.

DISCUSSION

Wray and Brimley (1943) reported one each of *Chrysops celer* O.S., *C. flavida* Wied., *Tabanus pumilus* Whit., plus 4 unidentified males of *Chrysops* and 2 *Tabanus* from North Carolina during the months of May to August. They examined an estimated minimum of 5000 pitcher leaves. They also found *S. flava* to be the most productive.

In addition to insects, 3 lizards, several spiders, snails, slugs, and a small frog were seen by the writer in these *Sarracenia* traps. It is likely some of these followed their prey into the traps. Undoubtedly many more trapped tabanids were unrecognizable through maceration, as well as through destruction by sarcophagid larvae commonly seen in most pitchers. These larvae obviously resist digestion by the pitchers, but the manner of pupation and escape from the traps is curious, and may take place after the leaf is dead and dried.

The fact that both sexes of tabanids, and several orders of insects including Neuroptera, Trichoptera, Orthoptera, Hemiptera, Homoptera, Lepidoptera, Hymenoptera, and Diptera (including mosquitoes) were represented in catches, suggests the potential utility of the unknown attractant, if it could be extracted, for artificial baiting. In some instances, a mass of one species, such as tipulids, June beetles,[3] or certain small Hymenoptera were crowded into one pitcher and were not or scarcely

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[3] *Phyllophaga*, obviously of 2 species, were quite common in the pitchers, crowded down as far as they could go in the narrowing throat, and occluding the passage for other insects before reaching the liquid below. Many were still alive when released, and two of these immediately flew to new leaves as though trying to re-enter them.

Reporting on a few that were saved for identification, Professor H. J. Reinhard writes "As you know, most species of *Phyllophaga* are nocturnal in habit and I am wondering if the beetles were attempting to secrete themselves by crawling into the pitcher plants. It is also quite interesting that you found them in large numbers all the way from Panama City, Florida, to Gulfport, Mississippi. No one else seems to have observed or previously recorded this most unusual habit among the Phyllophagas.

"Of the seven male examples taken from pitcher plants, two are readily placed as *Phyllophaga micans cupuliformis* Langstan; the remaining five are unknown to me at present and will require more study for definite determination." These five represented the most numerous June beetles in the traps, all head downward. Perhaps the later collecting accounts for the absence of *Phyllophaga* in the extensive list of Wray and Brimley (1943).

represented in nearby plants. The insects may have followed one another into the same leaf by some common specific response in these instances. There was obvious variation in the ages of the leaves but the older leaves did not necessarily contain the larger catches.

Since there was an abundance of standing water and vegetation in the environs, it seems unlikely the tabanids were seeking moisture or shelter only. The flies immersed in the liquid at the bottoms of the leaves in *S. flava* near Springfield (Panama City, Fla.) did not appear to go to pieces as fast as those captured by the smaller *S. minor* in the environs of Gulfport, Miss., though it was not known if the freshness of the plants in the two localities was at all comparable. Examination of a few patches of a third species, *S. rubra*, yielded little of interest.

Several engaging accounts of insects living in association with these plants have been published (see Lloyd 1942) but little attention has been paid in print to the invertebrate and vertebrate victims other than the report of Wray and Brimley (l.c.). A fascinating ecological study of the many kinds of attracted victims could be made.

SUMMARY

Comments are made on the utility of carnivorous plants for supplemental survey of tabanid flies in suitable localities. Seven species of either or both sexes are recorded as victims in Florida and Miss., enabling description of the allotype ♂ of *Anacimas limbellatus* End., and of variation in *Chrysops abata* Phil., and *Hamatabanus annularis* (Hine).

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A NEW SPECIES OF SUPHISELLUS FROM FLORIDA (COLEOPTERA: NOTERIDAE)[1]

FRANK N. YOUNG

The many small species of the genus *Suphisellus* Crotch (= *Canthydrus* Sharp of various authors) are in great need of revision. Even the exact identity of several of the Eastern North American forms is still in doubt. The new species described below, however, is remarkably distinct in the peculiar elytral punctation from any of the known forms, and probably represents a distinct population restricted to central Peninsular Florida.

The types, the only known specimens, were collected at night near Sebring (Highlands County), Florida on July 20, 1942, by Dr. Carl T. Parsons, and were sent to me by Mr. Hugh B. Leech of the California Academy of Sciences some years ago. I take pleasure in naming the species for Dr. Parsons, who has been indefatiguable in adding to our knowledge of the North American fauna.

Several trips to the area in which the types were collected have failed to produce additional specimens. It may be that the species occupies a different habitat from those of the common forms of the region.

Suphisellus parsonsi sp. nov.

DIAGNOSIS: Superficially similar to *S. gibbulus* (Aubé), but differing notably in the finer, denser punctation of the elytra, the less convex body form, narrower prosternal process, more nearly uniform dark reddish brown color of pronotum and elytra, and in the male genitalia. The moderately coarse, very dense, and in part confluent punctation of the elytra differs from that of any described species of the genus known to me.

HOLOTYPE MALE: Oval, broadest near bases of elytra, but not very strongly narrowed behind. Total length 2.27 mm. Width of pronotum at base 1.19 mm.; width of pronotum at apex 0.698 mm. *Head*: Microreticulate with scattered fine punctures; coarser punctures in usual position for genus. *Pronotum*: Microreticulate about as on head with moderately fine punctures on disk and coarser punctures along front margin and base; punctures along base closely placed and in part confluent. *Elytra*: Rather coarsely microreticulate between the moderately coarse, closely placed, and partly confluent punctures; subserial punctation almost obscured; but vaguely discernible as rows of hair-bearing punctures; no impressed rows

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of coarse punctures on disk as in *gibbulus;* punctation nearly uniform over elytra, only a narrow strip along the suture less densely and more finely punctate. *Venter*: Prosternal process narrower between anterior coxae and at the apex than in *gibbulus;* width of coxal laminae at apex less than in *gibbulus.* Ventral platform (prosternal process and coxal laminae) with coarse, elongate, hair-bearing punctures nearly uniformly distributed. Metacoxal plates, epipleurae, and abdominal sternites with coarse, granular and rugose microsculpture which nearly obscures the punctation; abdominal sternites with transverse, depressed bands of coarse punctures. *Male genitalia*: Parameres somewhat similar to those of *gibbulus,* but the right paramere not so strongly expanded at the tip, the left relatively shorter and slenderer. Aedeagus broader than in *gibbulus* with the tip more strongly bent down and sharply pointed. *Anterior and middle tarsi* rather strongly modified with relatively large suction cups, the one on the second segment conspicuously large. *Color*: Head yellowish brown. Pronotum darker, reddish brown, not much lighter than the dark reddish brown elytra. No transverse fascia or infuscate areas on dorsum. Venter yellowish brown.

ALLOTYPE FEMALE: Similar to male, but somewhat larger and with the elytra more parallel sided in the basal two-thirds. Total length 2.44 mm. Width of pronotum at base 1.27 mm.; width of pronotum at apex 0.87 mm.

LOCATION OF TYPES: The holotype will be returned to the collection of Mr. Hugh B. Leech at the California Academy of Sciences. The allotype will be deposited in the University of Michigan Museum of Zoology at Ann Arbor, Michigan.