PREDATION OF *GASTERACANTHA CANCRIFORMIS* (ARACHNIDAE: ARANEIDAE) EGGS IN FLORIDA CITRUS GROVES BY *PHALACROTOPHORA EPEIRAE* (INSECTA: PHORIDAE) AND *ARACHNOPHAGA FERRUGINEA* (INSECTA: EUPELMIDAE)[1]

MARTIN H. MUMA[2] AND KARL J. STONE[2, 3]

University of Florida, Citrus Experiment Station,
Lake Alfred, Florida

ABSTRACT

Predation of 216 egg cases of *Gasteracantha cancriformis* (L.) collected from more than 20 groves involved 48.2% of the cases: 43.7% by the phorid, *Phalacrotophora epeirae* (Brues), 3.2% by the eupelmid, *Arachnophaga ferruginea* Gahan, and 1.3% by unidentifiable predators. The phorid completed development in 2 to 4 weeks with a mean attack rate of 17 larvae per egg case. The eupelmid completed development in 3 to 6 weeks with a mean attack rate of 12 larvae per egg case. A hyperparasitic eulophid, *Tetrastichus* sp., emerged from the pupae of the phorid. The attack rate of this hyperparasite was not determined but 70% of the spider egg cases attacked by the phorid also produced the eulophid. Spider egg destruction was not always complete in predated cases but the predator-parasite complex unquestionably reduces populations of this spider.

Gasteracantha cancriformis (L.) is a common, spiny-bellied orb-weaver in Florida citrus groves. Its compact orb-webs, suspended on long radial or guy lines that are flecked with tufts of silk, frequently festoon both the trees and inter-tree areas of unsprayed groves. Sprayed groves also may develop large populations between insect control treatments. Floridians unknowingly err in referring to the species as the "crab spider" because of its short, broad, strikingly spiny abdomen. Citrus fruit pickers are often bothered by the clinging webs, the possibility of being punctured by the spider's thorn-like abdominal spines, and the possibility of being bitten by the spider. The colorful egg cases of this spider are constructed predominantly on the lower surface of citrus leaves adjacent to the webs. The eggs are laid in a flattened ovate mass (Fig. 2), and the cases are flattened, ovate in outline, and composed of loosely tangled white, yellow, and green silk, strikingly marked with a longitudinal stripe of dark green silk. Large distinct attachment discs anchor the case to the leaf (Fig. 1).

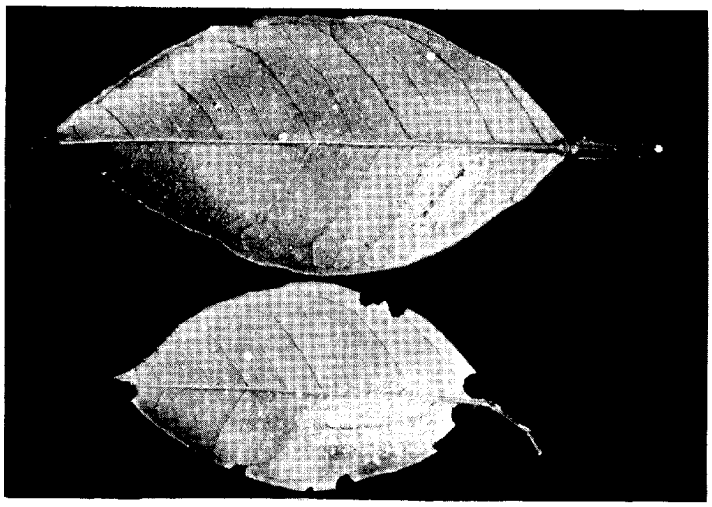
For many years, the senior author was aware that the eggs of *G. cancriformis* were commonly attacked by a small phorid and one or more species of parasitic Hymenoptera, but it was not until the winter of 1969 that the opportunity to study this biological control was presented. At that

---

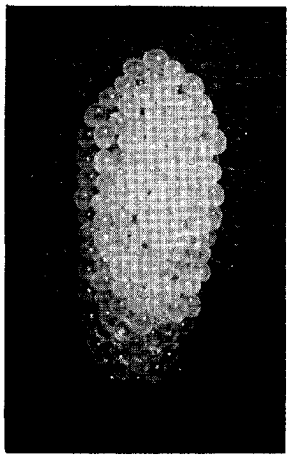
[1]Florida Agricultural Experiment Station Journal Series No. 3948.

[2]Research Associate, Florida State Collection of Arthropods, Division of Plant Industry, Florida Department of Agriculture and Consumer Services, Gainesville, Florida.

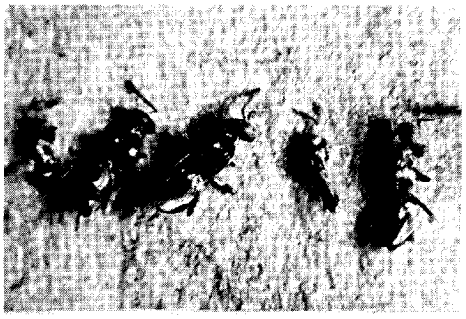
[3]Present address: Division of Science, Minot State College, Minot, North Dakota.



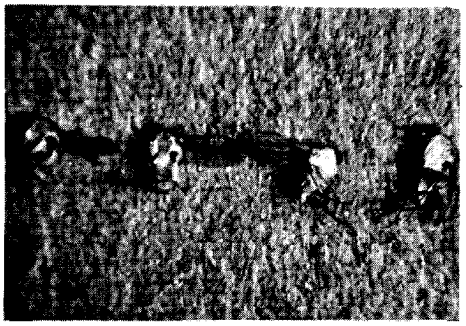
1



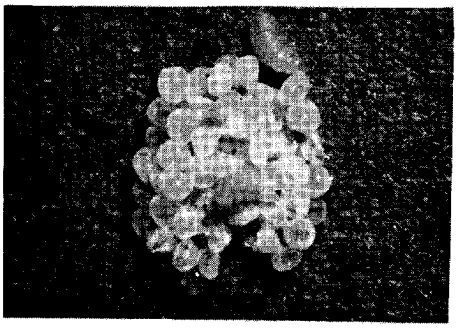
2



7

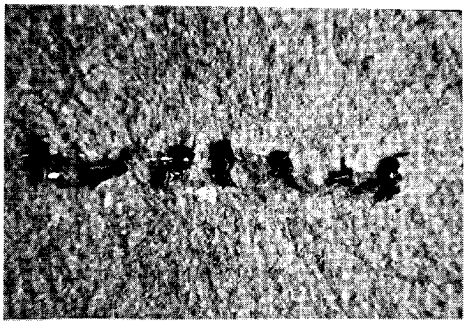


3

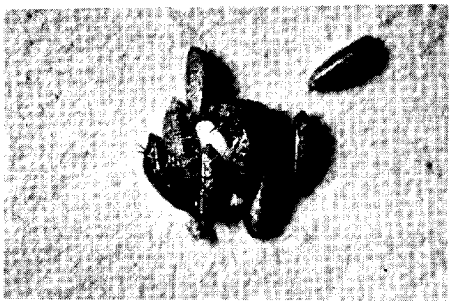


8

4



6



5

time, a phorid, *Phalacrotophora epeirae* (Brues), a eupelmid, *Arachnophaga ferruginea* Gahan, and a eulophid, *Tetrastichus* n sp. (identified by USDA—ERD specialists at the U. S. National Museum), were reared from the egg cases, and a decision was made to study the distribution, rate of attack, biology, and host-predator or parasite relationships of the several species. Results of this study are presented here.

Methods

Although 216 egg cases from more than 20 groves were studied under both grove and laboratory conditions, most comparative observations, experiments, and counts were conducted in the laboratory. Leaves with attached egg cases were placed in large test tubes for rearing of spiderlings, predators, or parasites. Predator larval and pupal counts were made by placing egg cases in dry 3-dram shell vials, dissolving the case silk in 5.25% sodium hypochlorite for 15 to 30 min, and rinsing and counting in tap water. Adult predator and parasite activity was studied in large test tubes. Larval activity and feeding were observed in cotton-plugged shell vials and small stender dishes. Silk was mechanically removed from the egg masses for predator-parasite feeding studies. Laboratory temperatures varied from 75 to 85° F. The sporadic addition of moisture to rearing cages also resulted in variable humidities from about 30 to 100% R.H.

Results

Distributional data obtained during the study are indicated by the collections of the 148 spider egg cases utilized for predation data in Table 1 and are presented in the Florida records for the 2 predator and 1 parasite species reared from the eggs of *G. cancriformis* from citrus groves. Data on the attack rate of *P. epeirae*, the most common predator of *G. cancriformis* egg cases, are cited in Table 1. Pertinent information on the host, the 2 predators, and the hyperparasite is recorded in the following paragraphs.

G. cancriformis (L.).—This spiny-bellied orb-weaver is found in virtually every commercial citrus grove in the state. Although populations are much larger in unsprayed groves than in sprayed groves, the spiders can become common between spray applications as indicated by the number of egg cases collected from the Griffin grove (Table 1).

Although predation of *G. cancriformis* egg cases resulted in destruction of 48.2% of deposited masses, this destruction was not always complete. Seven egg cases contained predator pupae and unconsumed eggs or spiderlings.

P. epeirae.—This small, black to brown-marked, yellow phorid (Fig. 3) was by far the most common predator of *G. cancriformis* egg cases. It was taken from both sprayed and unsprayed groves. Only 3 examined

---

Fig. 1-8. Eggs and egg predators of *Gasteracantha cancriformis* (L.). 1. Egg case on lower surface of citrus leaf. 2. Egg mass removed from case. 3. Adult flies of phorid, *Phalacrotophora epeirae* (Brues). 4. Maggots of *P. epeirae*. 5. Pupae of *P. epeirae*. 6. Adults of hyperparasite, *Tetrastichus* sp. 7. Adult wasps of eupelmid, *Arachnophaga ferruginea* (Brues). 8. Larvae of *A. ferruginea*.

egg cases (1.3%) showed signs of unidentifiable predation, but 43.7% of the cases included in Table 1 were predated by this species.

Female flies laid their elongated milk-white eggs around the margin

TABLE 1.—PREDATION OF *Gasteracantha cancriformis* (L.) EGG CASES BY *Phalacrotophora epeirae* (BRUES) IN COMMERCIAL FLORIDA GROVES DURING 1969 AND 1970.

Grove, Control Program, and Location	Date Sampled	No. Cases Collected	No. Cases Without Predators	No. Cases With Predators	Mean No. Preds per Case	Percent Cases Predated
Bennett St.—Unsprayed	11/3/69	19	3	16	18	84.2
Auburndale, Florida	11/24/69	33	16	17	21	51.5
	1/20/70	11	4	7	11	63.6
Ryburn—Sprayed	10/23/69	9	6	3	42	33.3
Vero Beach, Florida	12/18/69	7	2	5	25	71.4
Griffin—Sprayed	10/15/69	24	22	2	15	8.3
Sebring, Florida						
Waverly—Sprayed	11/3/69	3	1	2	7	66.6
Waverly, Florida						
Wells—Sprayed	1/12/70	5	0	5	7	100.0
Nocatee, Florida						
Sottile—Sprayed	10/19/70	2	2	0	—	00.0
Avon Park, Florida						
Edwards Bros.—Sprayed	10/19/70	8	5	3	17	37.5
Arcadia, Florida						
Fletcher—Unsprayed	10/19/70	10	6	4	14	40.0
Arcadia, Florida						
Skipper—Unsprayed	10/19/70	8	3	5	17	62.5
Avon Park, Florida						
Collins—Unsprayed	10/26/70	9	9	0	—	00.0
Polk City, Florida						

of the case canopy either on the canopy or among the fine threads of the spongy layer between the canopy and the spider egg mass. These eggs, which varied in number from 1 to 61, hatched in 24 to 48 hr, and the newly hatched maggots worked their way down to and under the mass of spider eggs. Seventeen maggots (Fig. 4) completed development in 4 to 8 days and the flies emerged. Although the data in Table 1 indicate a mean attack range of 7 to 42 predators per egg case, 17 flies was the maximum number that emerged from a single case. It should also be noted that as many as 34 fly eggs were counted on 1 spider egg case. In the laboratory, 28 flies fed honey and water lived from 1 to 14 days for a mean of 6.4 days, but they may live longer in the field.

This species is hyperparasitized by *Tetrastichus* n. sp.

Selected Florida Records: All specimens were reared from the egg cases of *G. cancriformis* on citrus trees. Four females and 3 males, Auburndale, 27 January 1969 by M. H. Muma and H. L. Greene; 1 female and 1 male, Auburndale, 5 February 1969 by M. H. Muma and K. J. Stone; 5 females and 6 males, Fruitland Park, 15 January 1953 by M. H. Muma; 1 female and 11 pupae, Winter Haven, 21 December 1952 by M. H. Muma; 4

females, 3 males, and 4 pupae, Yalaha, 19 January 1953 by M. H. Muma; 4 females and 2 males, Avon Park, 11 January 1966 by M. H. Muma and H. L. Greene; 4 females and 4 males, Ocoee, 21 January 1969 by M. H. Muma, H. L. Grene, and K. J. Stone; and 3 females and 1 male, Clermont, 21 January 1969 by M. H. Muma and K. J. Stone.

Tetrastichus n. sp.—This tiny, black, iridescent eulophid wasp (Fig. 6) emerged from the pupae of *P. epeirae*. It was taken from both sprayed and unsprayed groves. Although the biology of the species was not studied carefully, some data are available from collection and rearing records. Fifty-three egg cases containing visible pupae of *P. epeirae* (Fig. 5) were held for rearing. Of these, 16 cases produced only *P. epeirae*, 15 produced only the hyperparasite, and 22 produced both *P. epeirae* and *Tetrastichus*. This means that nearly 70% of the cases attacked by *P. epeirae* were also visited by this hyperparasite which, in about 28% of the cases, eliminated predator emergence.

Attempted rearings of individual fly pupae also resulted in rearings of this parasite. As many as 11 parasitic wasps emerged from a single fly pupa with a mean of 5.6 wasps per pupa from 12 pupae. Multiple hyperparasitism was also indicated by case rearings where as many as 62 females and 14 males were reared from a single spider egg case.

Selected Florida Records: All specimens were reared from the pupae of *P. epeirae* taken from or in *G. cancriformis* egg cases on citrus trees. Numerous females and males, Auburndale, 3 February 1970 by M. H. Muma and H. L. Greene; 10 females and 3 males, Winter Haven, 12 December 1952 by M. H. Muma; 4 females, Tampa, 8 January 1953 by M. H. Muma; 3 females and 2 males, Clermont, 21 January 1969 by M. H. Muma and K. J. Stone; 1 female and 1 male, Avon Park, 14 January 1969 by M. H. Muma, H. L. Greene, and K. J. Stone; 5 females and 2 males, Ocoee, 21 January 1969 by M. H. Muma, H. L. Greene, and K. J. Stone; numerous females and males, Fruitland Park, 15 January 1953 by M. H. Muma; 3 females and 2 males, Yalaha, 9 January 1953 by M. H. Muma; and numerous females and males, Haines City, 24 February 1966 by M. H. Muma and H. L. Greene.

A. ferruginea.—This small, elongate, white-marked, brown eupelmid (Fig. 7) was an uncommon predator of *G. cancriformis* eggs in citrus groves. Seven out of the 8 rearings of the species were from unsprayed groves. These figures represent only 3.2% of the total egg cases studied. As indicated by the Florida records below, 1 case produced 9 females and 13 males but the mean number of parasites per attacked case was only 7 (6.7) females and 5 (4.7) males.

Female wasps standing on the case canopies laid their eggs within the spider egg masses. Egg deposition required 1 to several hours. Incubation of isolated eggs was not determined, but eggs of 3 depositions hatched in 24 to 48 hr. Larval development of 41 isolated larvae (Fig. 8) was completed in 10 to 27 days; most larvae completed development in 14 days, but occasional specimens required 20 or more days. Pupation of 40 specimens required 8 to 14 days. An isolated spider egg mass produced 19 larvae, but only 18 of these emerged as adults. In the laboratory, 41 wasps fed honey lived 3 to 14 days. Females lived several days longer than males.

Florida Records: All specimens were reared from the egg cases of *G. cancriformis* on citrus trees. Three females and 4 males, Auburndale, 1 January 1969 by M. H. Muma and H. L. Greene; 1 female, Lake Alfred, 16 February 1966 by M. H. Muma and H. L. Greene; 11 females and 4 males, Arcadia, 14 January 1969 by M. H. Muma and H. L. Greene; 2 females, Weirsdale, 1 January 1969 by M. H. Muma and K. J. Stone; 13 females and 7 males, Avon Park, 4 January 1969 by M. H. Muma, H. L. Greene, and

K. J. Stone; 1 female and 4 males, Avon Park, 19 October 1970 by M. H. Muma and H. L. Greene; 9 females and 13 males, Arcadia, 19 October 1970 by M. H. Muma and H. L. Greene; and 14 females and 6 males, Avon Park, 19 October 1970 by M. H. Muma and H. L. Greene.

Discussion

Although several workers have studied the predators and parasites of spider egg cases, and Auten (1925), Kaston and Jenks (1937), and Eason, et al. (1967) have recently summarized our knowledge in this area, no predators or parasites have been recorded from the egg cases of *G. cancriformis*. Further, it appears that the egg case structure of this common southern spider has not been previously reported.

P. epeirae has been previously reported from the cases of *Epeira sclopetaria* (Clerck) by Auten (1925) and of *Epeira sericata* (Clerck) by Brues (1903). *A. ferruginea* has been recorded from *Epeira pegnia* Walck by Muesebeck et al. (1951). *Tetrastich*us spp. were reported by Auten (1925) from *Philodromus canadensis* Emerton and *Epeira* sp. The records reported in the present paper may then be the first for the genus *Gasteracantha* in North America.

Most references on spider egg predators and parasites are concerned with the species recorded and biological notes on predators or parasites. However, Cazier and Mortenson (1962) gave some information on the biological control potential on a per egg case and per year basis for predatory clerid larvae attacking the eggs of *Diguetia canities* (McCook); Eason et al. (1967) reported a total incidence of 1.6% parasitism of 1,679 specimens of Lycosidae and Oxyopidae in Arkansas; and Kaston and Jenks (1947) stated that *Pseudogaurax signata* Loew "may well be a means of biological control of the black widow, *Latrodectus mactans* (Fabr.)." From the data on *P. epeirae* in the present paper, there is little doubt that predation by this fly exerts considerable biological control pressure on *G. cancriformis* in Florida citrus groves. Although the rate of attack varies from grove to grove and may be somewhat greater in unsprayed groves than in sprayed groves, it appears that more than half of the potential spider population is destroyed in the egg cases by this predator. On the other hand, the much smaller spider populations in sprayed groves are probably the result of the combined action of insecticidal and biological control.

Literature Cited

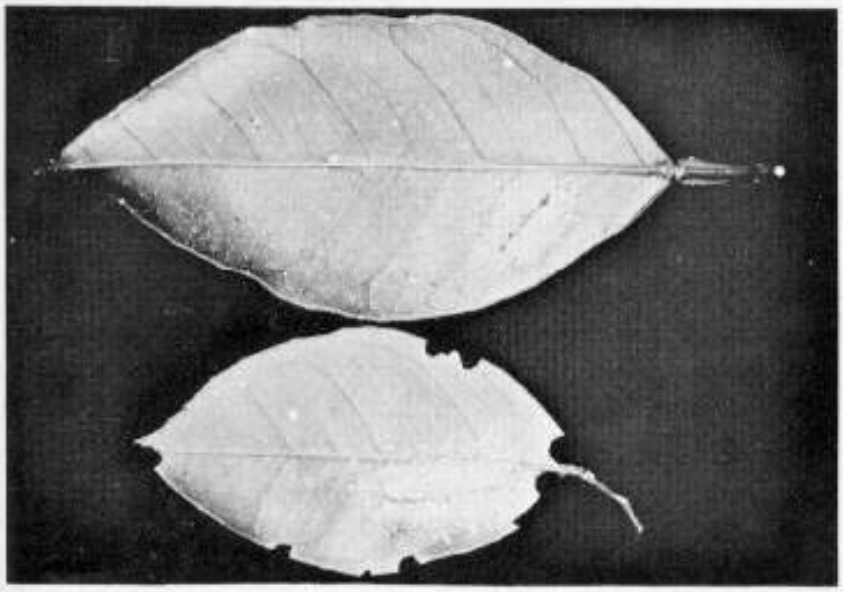
Auten, Mary. 1925. Insects associated with spider nests. Ann. Entomol. Soc. Amer. 18: 240-250.

Eason, R. R., W. B. Peck, and W. H. Whitcomb. 1967. Notes on spider parasites including a reference list. J. Kans. Entomol. Soc. 40(3): 422-434.

Cazier, M. A., and M. A. Mortenson. 1937. Analysis of the habitat, web design, cocoon, and egg sacs of the tube weaving spider *Diguetia canities* (McCook) (Aranea, Diguetidae). Bull. Southern Calif. Acad. Sci. 61(2): 65-88.

Kaston, B. J., and G. E. Jenks. 1937. Dipterous parasites of spider egg sacs. Bull. Brooklyn Entomol. Soc. 32: 160-163.

Muesebeck, C. F. W., K. V. Krombein, and H. K. Townes. 1951. Hymenoptera of America north of Mexico, Synoptic Catalogue. USDA, Agr. Monograph 2: 1-1420.



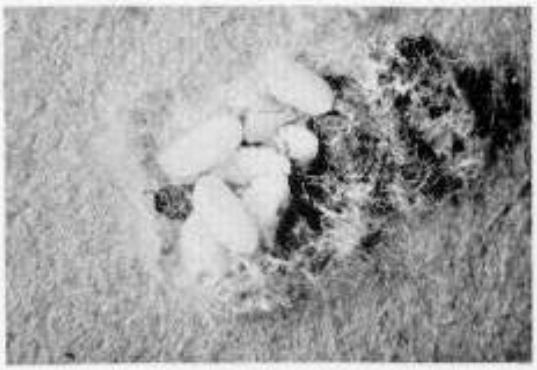
1

2

7

3

8



4

6

5