LIFE HISTORY AND CONTROL OF WHITE PEACH SCALE, *PSEUDAULACASPIS PENTAGONA* (HOMOPTERA: COCCOIDEA)[1], [2]

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ABSTRACT

The life history of *Pseudaulacaspis pentagona* (Targioni) was studied. Activities of scale crawlers, the development of the scale cover, and the sex activity are described. The time required for a complete generation ranged from 49 to 51 days. The scale was observed infesting 21 different species of plants. Local parasites and predators are listed. Several insecticides were investigated for control; ethion plus oil gave the best control.

White peach scale, *Pseudaulacaspis pentagona* (Targioni), is believed to be a native of Japan or China (Gossard 1902). It was described by Targioni (1886) in Italy. In Florida the scale was reported on peach, *Prunus persica* Linneaus, at Quintette in 1889. In the early nineteen hundreds many peach orchards were destroyed in Florida and south Georgia by this insect. *P. pentagona* is considered one of the most important peach pests in Florida, and with the recent renewed interest in peach production in this state, further study of its biology and control are necessary.

METHODS AND MATERIALS

All scale insects used for study in the laboratory were reared on Irish potato tubers (*Solanum tuberosum* Linnaeus). Scales were transferred to the potato tubers by placing peach cuttings, heavily infested with female scales and eggs, on top of the tubers and allowing the eggs to hatch. Crawlers moved from the limbs and anchored on the tubers. To infest tubers with 1 sex, field-collected eggs were sexed and placed on top of the tubers. Male eggs are creamy white and female eggs are orange.

Life history studies were conducted in the laboratory and in the field. Scales in the laboratory were held at approximately 70° F and 65% relative humidity. Field populations were supported on peach; chinaberry, *Melia azedarach* Linnaeus; native persimmon, *Diospyros virginiana* Linnaeus; Siberian elm, *Ulmus pumila* Linnaeus; and kudzu vine, *Peuraria thumbergiana* (Sieb. and Zucc.).

Insecticide studies were conducted on peach trees in the field in 1966. The chemicals tested were mixed in 25 gal quantities and applied to the point of runoff with a conventional hydraulic sprayer with 300 psi at the pump, and a hand gun attachment. The gun was adjusted to deliver a mist to avoid knocking scale from the limbs. Materials and dosages used are presented in Table 3.

A randomized complete block design with 3 replications was used. Mortality data were obtained by rating infested limbs from 4 sides of each tree. Ten to 20 scales were examined from each limb. A score system was used. Twenty percent mortality was rated 1, 40%—2, 60%—3, 80%—4, and 100%—5. A block score was obtained by averaging the 4 tree scores. The 3 block scores were averaged and converted to percent mortality (Table 3).

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[1]Institute of Food & Agricultural Science Journal Series No. 3679.

[2]Part of a thesis presented by the senior author in partial fulfillment of the requirements for the M.S. degree in Entomology, University of Florida.

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Results and Discussion

Life History and Habits

Eggs of *P. pentagona* generally hatched in 50 to 80 hr. Normally eggs of this species clearly fall into one of the 2 color groups indicating sex. However, eggs of an intermediate color were observed which produced either males or females.

Upon hatching, crawlers began seeking anchorage sites immediately. Male crawlers were less active than female crawlers and tended to congregate near the parent. Semi-protected sites were preferred for anchorage but were not necessary. Often crawlers would anchor under the cover of the parent. Crawler activity generally ceased after 12 hr.

Scale cover production began after the first molt which occurred 7 to 9 days after hatching. The covering of the male was elongate, glossy white, and was often accompanied by numerous silk threads. Female scale coverings were dull white and oval.

Upon completion of the second instar, males emerged and were ready to mate. *P. pentagona* adult males are bright orange and are extremely delicate insects. Body length including the style was approximately 0.6-0.7 mm, and the wing span was 1.3-1.5 mm. Emergence of males usually took place in the afternoon. Female scales molted shortly before male emergence and were ready to mate when the males emerged. Adult females were 0.8-0.9 mm long, oval, and yellow with a brown anal plate.

Males were readily attracted to virgin females. In the process of mating the male was observed standing on top of the female, pushing his style, which is bent under the body and pointing anteriorly, forward and under the cover to the female. Both sexes mated with several different individuals.

Females which were not allowed to mate exhibited unusual behavior patterns. From 4 to 6 days after peak male activity, the unmated females began moving from under the scale covering. They first protruded only the tip of their abdomen from under the covering but later moved entirely into the open. Once the females had moved from under the scale cover they began covering themselves with a mass of silk thread. Unmated females never laid eggs.

Oviposition began 20-21 days after mating and lasted 7-9 days. The orange female eggs were produced before the whitish male eggs. Brown and Bennett (1957) reported female eggs to be diploid and male eggs haploid. When a potato was used as the host the females laid an average of 125 eggs with a sex ratio of approximately 1 to 1 (Table 1).

The time required to complete a single generation in the laboratory ranged from 49 to 51 days. In the field, temperature variations greatly influenced the time required to complete a generation. Scales produced in early summer required as little as 45 days to complete a generation. However, in the fall the maturation rate was greatly reduced. *P. pentagona* overwintered as mated adult females (Table 2).

Hosts

In the Jefferson and Madison County areas of north Florida the authors observed *P. pentagona* infesting 21 different species of plants, in-

TABLE 1. TOTAL AND AVERAGE NUMBER OF FEMALE AND MALE EGGS OF *Pseudaulacaspis pentagona* WHEN INFESTING 5 HOSTS

	Potato	China-berry	Siberian Elm	Kudzu	Per-simmon
Number of scales	15	12	12	10	12
Eggs counted	1975	1404	1320	1600	1620
Average no. female eggs	65.9	56.5	57.6	80.3	66.7
Average no. male eggs	65.6	60.4	52.3	79.7	67.2
Average eggs per female	125	117	110	160	135

TABLE 2. LIFE HISTORY OF *Pseudaulacaspis pentagona* UNDER FIELD CONDITIONS WITH CHINABERRY AS HOST

	Generations Observed		
	1st	2nd	3rd
Date of egg deposition	6/5	7/20	9/12
Days required for eggs to hatch	2	3	3
Date of peak male emergence	7/1	8/22	11/2
Days from hatch to peak male emergence	24	30	48
Date of peak egg laying	7/20	9/12	Overwintered
Days from hatch to peak egg laying	43	50	as Mated
Days for complete generation	45	54	Female

cluding 4 which were previously unlisted as hosts. They were Jerusaleum oak, *Chenopodium botrys* L.; pokeweed, *Phytolacca americana L.*; *Pinckneya bracteata* (Bartr.); and a grape, *Vitis* sp. Dekle (1965) listed 97 host plants of *P. pentagona* in Florida. Ferris (1937) stated that this insect can live on all plants with the possible exception of the conifers. Chinaberry, native persimmon, and peach were the hosts most commonly and severely infested in the area studied.

DISPERSAL

The authors believe that *P. pentagona* is chiefly spread by wind currents. Quayle (1916) found black scale crawlers, *Saissetia oleae* (Bernard), to be mainly dispersed by wind. In his experiments, crawlers were captured on tanglefoot up to 430 ft from the source. White peach scale spreads rapidly throughout a given area. Although other animals surely transport some crawlers, only a fraction of those dispersed could use this mode. Patterns of infestation in several orchards which were studied in detail had heavy infestations near the assumed source and which diminished at greater distances, supporting the belief that crawlers are carried by wind currents.

NATURAL ENEMIES

The hymenopterous parasite, *Prospaletella berlesei* (Howard), was frequently observed infesting white peach scale. The degree in which *P. berlesei* parasitized *P. pentagona* varied greatly. The effectiveness of *P.*

TABLE 3. MATERIALS TESTED, RATES, APPLICATION DATES AND SUMMARY OF CONTROL OF *Pseudaulacaspis pentagona* ON PEACH

Materials used	Rate per 100 gal	Percent control
Test I—Mature Adults	Treatment 6/28 and 9/1	
Dieldrin	3 lb	30.8
Dieldrin &	2 lb	
Oil emulsion	3 qt	32.6
Endosulfan	1.5 lb	
Ethion, &	3.3 lb	
Oil, miscible	2 qt	65.8
Ortho 9006†	12 oz 6E	35.8
Check		31.6
Test II—Mature Adults	Treatment 9/16 and 10/1	
Ethion &	3.3 lb	86.6*
Oil emulsion	2 qt	
Azinphosmethyl	0.5 lb	50.4
Dimethoate	0.25 lb	44.0
Demeton	3.1 lb	26.6
GC 6505††	1 qt. E.C.	33.2
Check		13.2
Test III—Crawlers	Treatment 10/12	
Oil emulsion	3 gal	50.8
Ethion &	0.125 lb	98.2
Oil emulsion	1 gal	
Ethion &	0.5 lb	100.0
Oil emulsion	1.5 gal	
Ethion &	0.33 lb	100.0
Oil emulsion	2 gal	
Parathion &	0.3 lb	81.6
Oil emulsion	1.5 gal	
Check		0.0
Test IV—Dormant Spray	Treatment 12/2 and 12/16	
Oil emulsion	3 gal	59.1
Ethion &	0.5 lb	85.7
Oil emulsion	2 gal	
Diazinon**	2.5 lb	52.8
Ethion &	0.35 lb	45.7
Oil emulsion	0.5 gal	
Parathion &	0.3 lb	66.2
Oil emulsion	2 gal	
Check		15.9

*Some trees heavily populated with parasites and predators
**December 16th spray application omitted
†O, S-dimethyl phosphoroamidithioate.
††dimethyl p—(methylthio)phenyl phosphate

berlesei was often greatly reduced by the hyperparasite *Thysanus flaropalliatus* (Ashmead) which attacked the larval and pupal stages of the parasite.

Two coccinellids, *Lindorus lophanthae* (Blaisdell) and *Chilocorus stigma* (Sap), were frequently observed feeding upon *P. pentagona,* often exerting considerable pressure on the infestation. The beetles attacked all scale stages. Several other less important predators were also noted, including a species of thrips, a dipterous larva, a *Chrysopa* species larva, and the lepidopterous larva, *Pyroderces rileyi* (Walsingham).

Insecticide Tests

Because of the high reproductive potential of *P. pentagona* the authors felt that insecticides should produce at least 90% mortality to be considered commercially acceptable. All insecticides applied to active and dormant adult females failed to produce the desired mortality. Dormant females which had been treated were not checked at winter's end. By this time, cold weather coupled with the insecticides might have produced higher scores.

Several insecticides were very effective when applied to crawlers. Ethion plus oil gave 100% mortality scores. Ethion plus oil, and parathion plus oil also gave good results (Table 3).

P. pentagona is well protected in the adult stage by its covering and was much more difficult to kill with insecticides than the unprotected stages. The scale is without a covering for approximately 7 to 9 days after hatching and was quite easy to kill with the effective insecticides.

Acknowledgments

The authors are pleased to express their indebtedness to Dr. Harold Young, Head of the Big Bend Horticultural Laboratory, for his support and interest in this investigation.

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