caught in shears, and brushes. Long peduncles from improper clipping and buttons stuck in donut rolls or in wax on delivery boards can also cause severe injury and decay that OPP treatment could not control.

Efforts to increase OPP efficacy by raising the concentration of the SOPP solution or addition of SOPP to the wax are nonproductive. Residue levels may increase by use of such methods, but as shown in Fig. 1 a corresponding improvement in decay control should not be expected. Use of these overapplication methods use energy and money and may also increase the burn potential. Since burn does not usually show up for 24 hr or more, fruit can be packed into cartons before the burn is discovered leading to costly repacking or market complaints.

OPP is a sterilant and wound protectant. To prevent decay from packingline and handling injuries, a fungicide such as one of the imidazoles, which has some rind penetrating capabilities, should be used in addition to OPP.

Future experiments repeating this procedure but adding a fresh water rinse are recommended to more closely simulate packinghouse procedures and obtain data for comparison at normal treatment levels.

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IMPORTANT INSECT PESTS OF ANNONA SPP. IN FLORIDA[1,2]

J. E. Pena, H. Glenn and R. M. Baranowski
IFAS, University of Florida,
Tropical Research and Education Center,
18905 SW 280 St.,
Homestead, FL 33031

Additional index words. Seed borer, *Bephratelloides* sp. scales, *Philephedra* n.sp.

Abstract. **Two pests of** Annona **spp. in Florida are the seed borer,** Bephratelloides cubensis **Ashmead, (Hymenoptera:Eurytomidae) and the soft scale** Philephedra **n.sp., (Homoptera:Coccidae). Daily periodical occurrence of** B. cubensis **peaked at 1500 hr at an average temperature of 31-32°C. Ten to 20 times more adults were observed in August than during July or September 1984. Possible relation between fruit mummification and** B. cubensis **damage is discussed. Percentage of necrotic fruit that were infested with** B. cubensis **increased 4 times from early to late September.** Annona squamosa **L. was the preferred host for** Philephedra **n. sp., compared to** A. reticulata **L., and** Persea americana **Miller. Ethion + oil spray and methidathion provided a more acceptable control than oil spray or ethion alone.**

In recent years, the production of *Annona* spp. (*A. reticulata* L., *A. muricata* L., *A. cherimo'a* Hill) in Florida has escalated from backyard trees to commercial groves (1). This change has also increased the importance of insect pests attacking these crops. The insects that affect production of *Annona* spp. in Florida include major pests such as the seed borer, *Bephratelloides cubensis* (Ashmead), which reduces the marketability of fruit, the ambrosia beetle (poss. Xyleborus sp.) which reduces branch vitality, as well as secondary pests such as the scale *Philephedra* n.sp. which attacks leaves, young stems, and fruits. The impact incidental pests such as various Lepidopterous (*Sphingidae, Noctuidae*) larvae and some Hemipterans (*Acanthocephala femorata* (F) and *Leptoglossus phyllopus* (L.)) have on *Annona* sp. in Florida is unknown.

The seed borer is also considered to be an important pest of *Annona* spp. in the Caribbean (2). Another species, *B. maculicollis* Cameron, causes identical damage in Colombia (6), Venezuela (7, 8) and Surinam (3). A closely related species *B. ruficollis* Cam., has been identified in Panama and *B. paraguayensis* Crawford is found in Paraguay (2).

The scale, *Philephedra* n.sp. a pest of papaya and ornamentals, is found in Mexico, Texas, Colombia and recently was discovered in Florida.

In this preliminary study, the damage and diurnal activity of seed borer adults is described, evaluation of the possible relationship between insect presence and fruit mummification is made in order to properly assess the amount of loss due to this insect. To address the scale problem, investigations were also made of the damage, distribution and chemical control of *Philephedra* n.sp.

Materials and Methods

From July through September 1984, seasonal life history and damage studies of the seed borer *B. cubensis* were conducted at the Tropical Research and Education Center, Homestead, Florida. Ten custard apple (*Annona cherimola* x *A. squamosa*) trees, each 10-yr-old, spaced 5.4 m between trees and 6.3 m between rows, were selected for observation. A weekly count of the number of adults observed per tree was made. Daily adult activity was observed for 8 hr (800-1800 hr) during 5 consecutive days. Two evaluations were

[1]Florida Agricultural Experiment Stations Journal Series No. 5988.
[2]Chemicals used for research purposes only. No endorsements or registration implied herein.

made to determine fruit damage. First, 1 branch per tree (n = 10) was selected as the sampling unit. The number of fruits/branch counted and percentage of fruits with emergence holes determined. Furthermore, 5 whole trees were evaluated to determine if fruit mummification was related to insect infestation. Fruits were characterized as green or mummified, with or without emergence exit holes. Fruit diameter was measured and the number of infested seeds per fruit was counted. Possible differences in infestation were determined by use of single classification ANOVA with the unequal sample size (9).

Notes on the life history, distribution and damage of the scale *Philephedra* n.sp. were made using scales collected from infested branches at 2 locations in Homestead, Florida. Scale survival in soursop (*A. muricata*), sugar apple (*A. squamosa*), avocado (*P. americana* Mill), mango (*Mangifera indica* L.) and *Citrus* sp., plants (5-months old) was determined by placing an average of 54 crawlers per plant. Survival was observed for 30 days.

To determine chemical control of the scale, foliar applications of insecticides were made to scale-infested sugar apple potted plants (12-months old). Treatments included: oil spray (Ortho®) at 2800 ml/378 liters; ethion 4E at 0.10 kg a.i./378 liters; oil and ethion 4E 2800 ml and 0.19 kg a.i./378 liters; methidathion 2E at 0.06 kg a.i./378 liters; oil and methidathion 2E at 2800 ml and 0.06 kg a.i./378 liters, and the untreated control. Experimental design was a randomized block design consisting of 5 replications. Immature and adult stages of the scale were counted on each plant before treatment and at 4, 7, 15, 25, 32, and 39 days after treatment.

Results and Discussion

Seed borer damage consisted of emergence holes (0.1-0.15 cm in diameter) on green fruits. According to Bruner and Acuna (2) the newly emerged wasp prefers to oviposit on fruit 3-4 cm in diameter. However, fruit availability probably forces the female to oviposit in fruit of any size. Only females (n = 159) were observed, suggesting the possibility of parthenogenetic reproduction. Female body length ranged between 0.6-0.8 cm. Characteristic coloration is reddish-brown or light brown in some individuals. Under laboratory conditions (27 ± 2°C; 75 ± 1 RH), female life span ranged between 1 and 11 days. Duration of oviposition was 15 to 30 min. Eggs are oviposited in developing seeds. Egg incubation lasts 12 to 14 days and the larval stage lasts 42 to 55 days (2). In general, the entire larva is near white to cream colored, c-shaped, pointed at both ends, legless, and swollen near the center. The pupal stage is 12 to 13 days during the summer and 15 to 18 days during the winter (2). It is believed that at least 4 generations (66-87 days/generation) per year occur in south Florida. The emerging adult females tunnel a distance of 0.6 to 1.1 cm through the pulp. Exit holes are used frequently for entrance by sap beetles. This factor probably contributes to increased necrosis in the whole fruit.

Peaks of adult (n = 66) activity were observed at 1500 hr when the average temperature was 31 to 33°C (Fig. 1). Activity observed included oviposition, emergence and resting in the tree canopy. Few adults (n = 2) were observed in weeds surrounding the trees. Oviposition was more frequent (28%) at 1500 and 1600 hr compared to 800 (0%) and 1800 hr (0%) when average temperature ranged from 25.0 to 26.5°C. Adults were observed ovipositing in fruits located at any tree stratum. These results may indicate that chemical control of adult wasps must be practiced at 1500 or 1600 hr. More adults were observed during early August than in July or September, 1984. When a single branch/tree was sampled, the percentage of fruits with

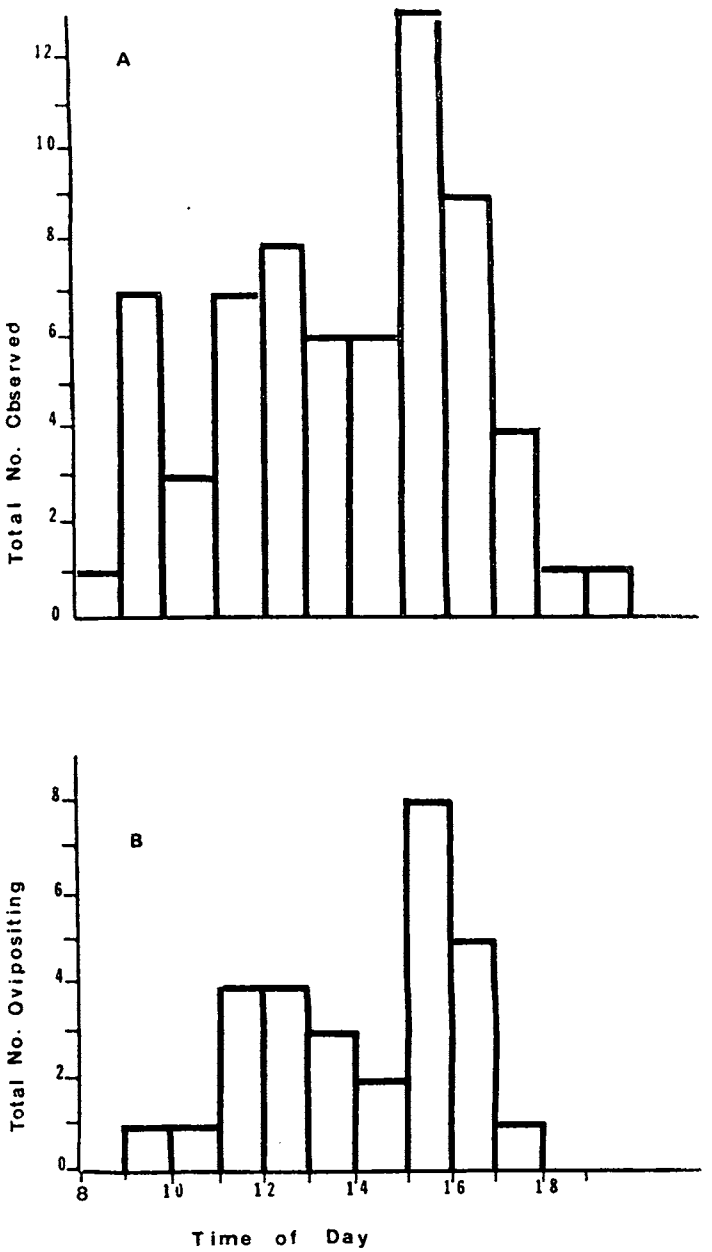

Fig. 1. Daytime wasp activity patterns observed between July and September, 1984. A. Total number of *B. cubensis* adults observed for each hour of the day. B. Total number of *B. cubensis* adults observed ovipositing for each hour of the day.

emergence holes increased from 4% in July to 21% in August (Table 1). The number of infested fruit peaked at mid-September (61%). When whole trees were sampled in early August, emergence holes were observed in 11% of the fruit (n = 95), 51% (n = 71) in early September and 61% (n = 42) later in September. Percentage of infestation on 4 to 9 cm diameter fruit was not significantly different ($P < 0.05$). However, 6 cm diameter fruit was infested 1.5 times more than 5 cm ones, and 4 times more frequently infested than 4, 7 or 8 cm diameter fruit. When fruits were evaluated as necrotic or green, the percentage of necrotic fruit that were infested increased from early to late September (Table 2). Percentage of infested green fruit without emergence holes decreased from 29% in early September to 7% in late September.

Infestations inside the fruit revealed that necrotic fruit without emergence holes had 9-17% of the seeds infested. Infested seed had 1 individual per seed. Larvae, pupae or

Table 1. Percentage of atemoya fruits infested by the seed borer, *Bephratelloides cubensis*, and number of adults observed per 10 trees at the TREC, Homestead, Florida, 1984.

	Date	No. fruits observed/10 trees	Fruit with emergence holes (%)	No. wasps observed/10 trees
July	25	69	4	2
	26	45	10	2
	27	45	10	0
	30	57	8	0
	31	58	9	3
August	1	55	12	16
	2	58	16	22
	3	46	21	13
	7	47	17	0
	9	50	19	1
	15	47	17	0
	17	53	13	0
	24	42	11	0
	28	41	11	0
September	5	32[z]	14	0
	11	26	18	0
	24	13	61	0

[z]Includes infested and not infested fruit that fell off the tree.

adults were found inside the seeds. Necrotic fruits with exit holes had 5-6% of the seeds infested. Green fruits without holes had 3-10% of the seeds infested and green fruits with emergence holes had 13-17% of the seeds infested.

In Florida, it is believed (4) that fruit mummification is dependent on fruit infestation by the seed borer. However, studies of anthracnose of the Annonaceae in Puerto Rico (5) only relate pathogenicity with high humidity patterns. Our preliminary data (Table 2) demonstrates that *B. cubensis* can be found in necrotic or green fruits. No larvae or pupal stages were found on very small (less than 3 cm diameter) necrotic fruit. Larger necrotic fruits had a higher percentage of seeds infested/fruit than the green ones. We hypothesize (without evidence) that under south Florida conditions, the severity of the disease is probably doubled by the seed borer activity.

Generally the harvest time in southern Florida occurs from July to September when populations are increasing. Therefore, all the fruit marketable or not, should be harvested to reduce future infestations.

Philephedra n.sp. damage on sugar apple plants was detected on 2 locations in Homestead, Florida on June 6, 1983. Most (73%) of gravid females were found on older leaves and the remaining ones (28%) on new leaves; the immature scales (49%) were equally distributed and found on new (49%) and old leaves (51%). Scales were also found on young stems and leaf petioles. Ninety percent of the scale population found on the underside of leaves. On the leaf underside, females attach to any part of the leaf, whereas first instars and males were typically found along mid and secondary veins. Third to fourth instar female scales secrete honeydew and sooty mold develops mainly in the lower plant canopy. Scales are also found attached to green fruits. Gravid female scales found on sugar apple plants produced 16 to 709 crawlers, when held at 27°C, 62 to 325 when held at 19°C, and 305 to 595 when held at 26°C. Seventy-two percent of the scales infesting *A. squamosa* plants survived for 28 days (Table 3). Only 8% survived on *A. reticulata*, 17% on *P. americana* and 3%, on either citrus species, or *M. indica*. This demonstrates that *A. squamosa* is a preferred host of *Philephedra* n.sp.

None of the materials caused an initial reduction of numbers of scales 4 days after treatment (Table 4). All ma-

Table 3. Survival of *Philephedra* n.sp. immature stages in 5 plant species from September 8 through October 7, 1983, Homestead, Florida.

Plant species	Survival (%)[z] Sept 8	Sept 16	Sept 28	Oct 7
Annona reticulata	100 (66)[z]	12 (8)	8 (5)	8 (5)
A. squamosa	100 (25)	84 (21)	84 (21)	72 (18)
Persea americana	100 (35)	74 (26)	11 (4)	17 (17)
Citrus sp.	100 (72)	65 (47)	13 (9)	3 (3)
Mangifera indica	100 (71)	4 (3)	4 (3)	3 (3)

[z]Avg. no. of immature stages surviving per plant indicated in parenthesis.

Table 2. Percentage of atemoya fruits infested by *Bephratelloides* on September 11-25, 1984, Homestead, Florida.

Fruit characteristics	September 11 Fruits sampled (no.)	Infested fruit[z] (%)	Seeds infested/ fruit (%)	September 25 Fruits sampled (no.)	Infested fruit (%)	Seeds infested/ fruit (%)
Necrotic without emergence holes	14	6	17	12	29	9
Necrotic with emergence holes	23	5	6	12	10	5
Green without emergence holes	45	29	10	3	7	3
Green with emergence holes	9	9	27	8	19	13

[z]Infested fruit was indicated by the presence of *B. cubensis* immature or adult stages.

Table 4. Chemical control of *Philephedra* n.sp., on potted sugar apple plants, 1983, Homestead, Florida.

Treatment (kg or ml a.i./378 l)	No. scales pre-treatment	Scales surviving (%) Days post-harvest 4	7	15	25	32	39
Ortho® oil spray (2800 ml)	79	44 a	15 a	2.0 a	1.0 a	0.0 a	0.0 a
Ethion 4 (0.10 kg)	63	19 a	5 a	2.0 a	1.8 a	0.4 a	0.4 a
Ethion 4 + oil spray (0.10 + 2800 ml)	46	35 a	17 a	1.0 a	0.0 a	0.0 a	0.0 a
Methidathion 2E (0.06 kg)	74	19 a	8 a	0.2 a	0.0 a	0.0 a	0.0 a
Methidathion 2E + oil spray (0.06 kg + 2800 ml)	60	18 a	11 a	1.8 a	0.4 a	2.2 a	0.0 a
Check	52	50 a	46 b	19.0 b	19.0 b	15.0 b	15.2 b

[z]Mean separation in columns by Duncan's multiple range test, 5% level.

terials showed significant differences in scale survival compared with the control 7 to 39 days after treatment. There were no significant differences among materials. None of the materials were phytotoxic.

Understanding of insect damage to *Annona* spp. plants is still in a preliminary phase. Additional study is necessary to develop a better knowledge of the relationship between insect pests and plants within the Annonaceae.

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ORIENTAL PERSIMMONS (DIOSPYROS KAKI L.) IN FLORIDA[1]

E. P. MILLER
University of Florida, IFAS, Fruit Crops Department, Gainesville, FL 32611

Additional index words. culture, rootstock, cultivars.

Abstract. **Twenty-three persimmon** (Diospyros kaki **L.) cultivars were evaluated in plantings at locations in north, central and south Florida. Major disease problems included** Cephalosporium **wilt,** Cercospora **leaf spot, and anthracnose fruit rot. Biennial bearing was a problem in some cultivars. Fruit thinning and maintenance of uniform soil moisture content reduced biennial bearing and vigorous upright vegetative growth. Fruit size ranged from 3.5 to 8.8 oz. and yields from 50 to 150 lb./tree. The most promising astringent cultivars were 'Giombo', 'Tannenashi', 'Eureka' and 'Sheng'. 'Ichikikeijiro', 'Jiro' and 'Fuyu' were the most promising of the non-astringent types.**

The oriental persimmon has been cultivated in Florida since the mid-1800's. Originally from China, cultivars were imported into this country in the early 19th century. Popularity in the U.S. is not great, though it is a major fruit in oriental societies. It is grown commercially in many countries and in California.

Fruit are yellow to deep orange-red and have a high sugar content. The tree is easy to grow in Florida, with a compact spreading habit, low maintenance requirements, and ornamental beauty. It is adaptable to home use and to small plantings for local production.

Persimmons may be divided into groups based on fruit astringency and fruit flesh color when seeds are present. The non-astringent types have fruit which loose their astringency while still hard, whereas fruit of astringent types must be soft or artificially treated before astringency is completely removed. The flesh color in pollination variant types has a dark tannin tissue associated with seed formation but when seeds are absent flesh is clear. Astringent pollination variant persimmons will be non-astringent in the dark fleshed seeded portions of the flesh when the fruit is still firm. Pollination constant persimmons lack the dark tannin tissue regardless of seed formation (3, 6, 12).

Persimmon production is affected by a number of factors including diseases (2, 3), freeze damage (14), pruning (9, 10), thinning (8), fruit drop (1, 8), and alternate bearing (5, 11). *Cephalosporium* wilt (2), anthracnose and *Cercospora* (3) are major fungal diseases. Freeze injury is a problem particularly in seasons with alternating warm-cold cycles (14). Alternate bearing is common in many cultivars and is related to crop load (5), seed production (1, 5), tree age or vigor (8), soil moisture (3) and pollination (4, 5, 7).

Due to an increasing interest in oriental persimmons an evaluation of cultivar performance, disease problems, alternate bearing and fruit quality were made to determine the best cultivars for use in Florida.

Materials and Methods

Evaluations were made at 4 plantings in the vicinity of Gainesville and one in Monticello, Florida. Information was gathered on plantings in Naples, Wauchula, Gulf Hammock and Anthony through personal communication. The oldest planting examined was a 25-yr-old orchard near Alachua. Trees on a hillside and its crest had been top-worked to native *D. virginiana* L. rootstock. Graft unions ranged from 2 to 5 ft above ground level. Records were kept on fruit drop, yield and quality for 10 different cultivars in 1983 and 1984. Resistance to *Cercospora* leaf spot and effects of *Cephalosporium* wilt were also noted. The orchard received no pruning, insect or disease control, supplemental fertilization or irrigation. Occasional mowing of the underbrush and grass was done.

Yields and performance of 'Tannenashi' were recorded in the 1983-84 season on top-worked trees near High Springs. Grafting was done in the winter of 1982 on *D. virginiana* trees which were approximately 7-yr old with unions in juvenile wood 5 ft from the ground. Weeds were controlled with herbicides and trees were fertilized in March and June. Late summer and fall tent caterpillar infestations were controlled using insecticides. Limbs damaged by twig girdlers were removed and burned.

A 5-yr-old orchard in Chiefland was observed in 1984. Seven different cultivars were grafted to *D. virginiana* rootstock. Unions were 6 to 24 inches from the ground. A few

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