

COMPARATIVE LIFE-HISTORIES OF  
THREE *MOCIS* SPP. IN FLORIDA  
(LEPIDOPTERA: NOCTUIDAE)<sup>1</sup>

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ABSTRACT

Average numbers of fertile eggs laid by *Mocis disseverans* (Walker), *M. latipes* (Guenée), and *M. marcida* (Guenée) were 308.0, 277.4, and 183.6, respectively. Pre-oviposition periods ranged from 2-12 days with averages of 4, 4, and 5 days, respectively, for the 3 species. *Mocis* larvae were reared successfully on all grasses supplied but not on the legumes lima beans, *Phaseolus limensis*, Macf; peanut, *Arachis hypogaea* L.; and *Glycine max* L. There were 6 or 7 larval instars; larvae pupated within folded leaves. At  $75 \pm 5^\circ\text{F}$ , the life-cycles on quineagrass, *Panicum maximum* Jacq. of *M. disseverans*, *M. latipes*, and *M. marcida* averaged 34.6, 27.4, and 45.8 days, respectively, but the ranges overlapped. Mated females of *M. latipes* and *M. disseverans* each lived 13 days, while *M. marcida* females lived 15.2 days. All 3 species had a 1:1 sex ratio. No parasitoid was found to be specific to any *Mocis* sp. Parasitoids reared from *Mocis* pupae were the sarcophagids, *Sarcodexia sternodontis* Townsend, and *Sarcophaga* sp. the braconids, *Apanteles scitulus* Riley, *Meteorus autographa* Muesebeck, and *Microplitis matorus* Weed; the chalcids, *Brachymeria ovata ovata* (Say), and *B. robusta* (Cresson); and the ichneumonids, *Coccygomimus aequalis* (Provancher), *Enicospilus purgatus* (Say), *E. arcuatus*? (Felt), and *Gambrus ultimus* (Cresson). Predators of *Mocis* larvae were a tenebrionid adult, *Bothrothes fortis* (Casey) and a carabid larva, *Pinacodera* sp.

The *Mocis* spp. occurring in Florida are *M. disseverans* (Walker), *M. latipes* (Guenée), *M. marcida* (Guenée), and *M. texana* (Morrison) (Kimball 1965). *Mocis* larvae, commonly called grass loopers or striped grassworms, are major pests of pastures. Genung (1964, 1967, 1968) reported outbreaks on sudangrass, *Sorghum vulgare* var. *sudanense* (Piper) Hitch; ryegrass, *Lolium multiflorum* Lam; and paragrass, *Panicum purpurascens* Raddi. *Mocis* larvae also have been reported to feed on non-grass plants (Bastos Cruz et al. 1962, Bissell 1940, Kimball 1965, Wolcott 1923, Ware 1973). We questioned whether *Mocis* larvae fed on non-grass hosts, therefore, we studied the utilization of 3 legumes by these insects. The life-history of *M. latipes* has been extensively studied (Vickery 1924, Dinther 1954, Labrador 1964, Reinert 1975, W. G. Genung and R. J. Allen unpublished data). Dyar (1902) described the larval stages of *M. latipes*. We studied and compared the life-histories of *M. disseverans* and *M. marcida* with that of *M. latipes* in Florida. We also surveyed for the natural enemies of *Mocis* larvae. Data on *M. texana* were scanty and, therefore, not reported in this paper.

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## MATERIALS AND METHODS

## LIFE-HISTORY

Each female moth of *M. disseverans*, *M. latipes*, and *M. marcida*, collected at light traps in Gainesville and Belle Glade, was held for oviposition in a 1/2 pint cardboard cup covered with polyethylene plastic. Absorbent cotton soaked in 10% sucrose solution was pinned to the inside of each cup as a food source. Moths were transferred daily to new cups until death and the eggs laid were counted. Laboratory cultures were augmented with adults caught on the wing in Gainesville and with adults reared from larvae and pupae collected in a pasture in Newberry. The newly hatched larvae were placed individually in 9 cm diam glass petri-dishes. The larvae of all species were reared at  $75 \pm 5^\circ\text{F}$  and a 16L:8D photoperiod. Developmental durations, to adult eclosion, of newly hatched larvae; percentage larval mortalities; and pupal weights of the 3 species were compared. The larvae were reared on greenhouse grown leaves of corn, *Zea mays* L.; guineagrass, *Panicum maximum* Jacq.; St. Augustinegrass, *Stenotaphrum secundatum* (Walt.) Kuntze; and wheat, *Triticum aestivum* (L.). Newly emerged male and female moths were held for mating and oviposition in the cardboard cages. Males were removed and held in separate cages when females started to oviposit. Fecundity and oviposition behavior of each female and the longevities of mated males and females were recorded.

## FOOD TESTS

All larvae used were progeny of moths reared in the laboratory. The test foods, all greenhouse grown, were lima beans, *Phaseolus limensis* Macf.; peanut, *Arachis hypogaea* L.; and soybean, *Glycine max* (L.) Merr. Twenty-five 1st and 4th larval instars for each species were supplied with young leaves of each test food. Survival and duration of the larval stage on each test food were recorded. In another test, freshly cut leaves of lima beans, peanut, corn, and guineagrass were placed 1 in each quadrant on Whatman no. 4 filter paper in petri-dishes. A 1st instar was placed on the lima bean leaf and the larva was observed until it began feeding. This test was replicated 5 times for each species.

## FIELD SURVEY

Weekly observations were made on forage crops and lawns in Gainesville and life stages of *Mocis* were collected and documented.

## RESULTS AND DISCUSSION

*M. disseverans* laid the highest average number of fertile eggs while *M. marcida* laid the least (Table 1). *M. latipes* laid 37.5 more eggs than Reinert (1975) reported. Average widths ( $n=40$ ) and ranges, in parentheses, of *M. disseverans*, *M. latipes*, and *M. marcida* eggs were 0.73 (0.60-0.90) mm, 0.64 (0.56-0.68) mm, and 0.84 (0.75-0.90) mm, respectively. Preoviposition periods under laboratory conditions varied from 2-12 days with means of 4, 4, and 5 days, respectively. The incubation period averaged 4 days for each species with a range of 2-5 days. Females laid eggs singly for the most part, but sometimes eggs were clustered such that 2-15 eggs were in contact with each other. Dinther (1954) and Fennah (1947) recorded egg masses of 8 and 40-60 respectively, for *M. latipes*. Females of all species caged on potted wheat oviposited mostly on the cage screen, floor and wooden frames. In the field moths

TABLE 1. FECUNDITY OF FEMALES; AND LONGEVITY OF *Mocis disseverans*, *M. latipes*, AND *M. marcida* REARED IN THE LABORATORY. GAINESVILLE. 1973-74.

Species	Fecundity		Longevity (days)**	
	No. of eggs	Avg. No.* fertile eggs	Mated	Mated
<i>M. disseverans</i>	214-538	304.9	15.5	13.0
<i>M. latipes</i>	94-458	277.4	11.4	13.0
<i>M. marcida</i>	92-412	183.6	12.4	15.2

\*Average of 5 females.

\*\*Average of 10 insects.

apparently preferred low grasses for oviposition; eggs were found on the undersurface of the leaves of bahiagrass, *Paspalum notatum* Flugge; and transvaalagrass, *Cynodon transvaalensis* Davy. Prior to hatching, the chorion became transparent dorso-laterally. Larvae exit through the abraded chorion, leaving white egg shells. These were not devoured contrary to observation of Dinther (1954).

Upon eclosing larvae immediately began looping and feeding. Larvae passed through 6 or 7 instars; however, 1 *M. marcida* larva went through 8 instars. The larval stages were generally as described by Dyar (1902) for *M. latipes*. The head capsule widths of the larval instars are presented in Table 2. Descriptions and keys to mature larvae and pupae will be published in a separate paper. Durations in larval stages varied within progeny of the same female for each test food, and also within species for all test foods. The ranges of larval durations on the test foods broadly overlapped within species (Table 3). If duration of the larval stage is a criterion to establish host preference, all species most preferred wheat, followed by corn and guineagrass; St. Augustinegrass was least preferred. Larval mortalities on St. Augustinegrass, a high

TABLE 2. HEAD CAPSULE WIDTHS OF THE LARVAL INSTARS OF *Mocis disseverans*, *M. latipes*, AND *M. marcida* REARED IN THE LABORATORY. AVERAGE OF 40 MEASUREMENTS.

Instars	Head capsule widths (mm)					
	<i>M. disseverans</i>		<i>M. latipes</i>		<i>M. marcida</i>	
	Mean	Range	Mean	Range	Mean	Range
1	0.44	0.41-0.48	0.38	0.33-0.41	0.46	0.45-0.48
2	0.59	0.53-0.68	0.56	0.49-0.63	0.68	0.56-0.75
3	0.95	0.75-0.98	0.90	0.79-1.01	1.00	0.83-1.09
4	1.26	1.13-1.53	1.40	1.13-1.54	1.42	1.25-1.58
5	1.70	1.59-2.20	1.70	1.64-2.00	1.84	1.69-2.20
6	2.50	2.24-2.63	2.30	2.20-2.50	2.64	2.47-3.21
7	3.06	2.95-3.40	3.01	2.95-3.26	3.21	3.10-3.40

TABLE 3. DURATION OF STAGES AND PUPAL WEIGHTS OF *Mocis disseverans*, *M. latipes*, AND *M. marcidia* REARED ON CORN, GUINEAGRASS, ST. AUGUSTINEGRASS, WHEAT, AND VELVET BEAN CATERPILLAR DIET (VBCD).

Test Food	Days to complete life-cycle; pupal weights (mg.)														
	<i>M. disseverans</i>					<i>M. latipes</i>					<i>M. marcidia</i>				
	Egg (4)	Larva	Pupa	Total	Pupal Weight	Egg (4)	Larva	Pupa	Total	Pupal Weight	Egg (4)	Larva	Pupa	Total	Pupal Weight
	Mean					2-5					2-5				
	Range														
Corn	Mean	(24.4)	(10.7)	(39.1)	(315.4)	(4)	(16.5)	(8.3)	(28.8)	(254.2)	(4)	(31.0)	(13.0)	(48.0)	(509.0)
	Range	22-27	7-12	31-44	185-368		15-20	6-9	23-34	176-274		26-41	11-19	39-64	318-700
Guineagrass	Mean	(20.1)	(10.6)	(34.6)	(397.8)	(4)	(14.8)	(8.6)	(27.4)	(245.8)	(4)	(29.7)	(12.2)	(45.8)	(590.1)
	Range	18-22	9-14	29-41	279-455		14-19	8-10	24-34	177-280		24-38	10-14	36-57	526-600
St. Augustine- grass	Mean	(28.6)	(11.0)	(43.6)	(297.5)	(4)	(22.0)	(10.2)	(36.2)	(228.5)	(4)	(36.0)	(13.9)	(53.9)	(385.3)
	Range	26-34	9-15	37-54	171-343		17-24	9-16	28-45	168-250		25-44	12-16	39-65	300-522
Wheat	Mean	(16.01)	(9.3)	(29.4)	(292.1)	(4)	(12.95)	(8.35)	(25.1)	(236.2)	(4)	(25.7)	(12.2)	(41.9)	(413.2)
	Range	14-18	7-12	23-35	189-388		10-15	6-9	18-29	186-313		16-28	11-14	39-46	350-537
VBCD	Mean	(21.0)	(11.6)	(36.6)	(300.0)	(4)	(18.0)	(9.4)	(30.5)	(261.0)	(4)	-	-	-	-
	Range	18-28	9-14	29-47	267-351		17-26	8-14	28-45	191-301		-	-	-	-

percentage of which occurred in the early instars, were 20.0, 25.3, and 36.0% for *M. latipes*, *M. disseverans*, and *M. marcida*, respectively. On other test grasses mortalities were below 15%. We observed high mortalities from drowning of 1st larval instars in the field. Excessive moisture is critical to survival of these larvae especially in the morning when dew collects on leaf tips. Reinert (1975) also observed that the 1st larval instar was the most vulnerable in the life-cycle on *M. latipes*.

*Mocis* larvae supplied with the legumes (lima beans, peanuts, and soybeans) died without feeding and usually survived less than 4 days (Table 4). The larvae of each species given free choice of food fed only on grasses. These results contradicted Bastos Cruz et al. (1962); Bissell (1940); and Kimball (1965) who reported *M. latipes* feeding on groundnut; soybean; broadbean, *Vicia faba* L., respectively; and Wolcott (1923) who reported *M. marcida* feeding on cowpea, *Vigna sinensis* (Torner). The report of *Mocis* larvae infesting Washington palms, *Washingtonia robusta* Wendl. (Ware 1973) is also apparently incorrect.

TABLE 4. TIME TO MORTALITY, IN THE LABORATORY, OF 1ST AND 4TH LARVAL INSTARS OF *Mocis disseverans*, *M. latipes*, AND *M. marcida* SUPPLIED WITH LEGUMES. AVERAGE OF 25 INSECTS PER TEST FOOD. GAINESVILLE. 1973-74.

Test Food	Time to mortality (in days)					
	<i>M. disseverans</i>		<i>M. latipes</i>		<i>M. marcida</i> *	
	1	4	1	4	1	4
Lima beans	3.33	3.75	2.00	2.00	3.25	4.00
Peanuts	2.00	4.00	2.00	3.75	3.00	4.00
Soybeans	2.75	4.00	2.00	3.75	3.60	4.00

\*Average of 10 insects.

We observed *Mocis* larvae feeding on the following grasses in the field: bahiagrass, bermudagrass, *Cynodon dactylon* (L.) Pers.; dogtoothgrass, *C. incompletus* Nees; rhodesgrass, *Chloris gayana* Kunth; pearl millet, *Pennisetum glaucum* (L.) R. Br.; sudangrass; St. Augustinegrass; transvaalagrass; and *Pennisetum americanum* (L.) Schum in Engl. This list does not completely cover the host plants of *Mocis* larvae. Allen and Genung (1974) reported that *M. latipes* attacks 44 different species of grasses. The 1st and 2nd larval instars fed on epidermal layers only; 3rd and later instars fed by making notches on leaf margins. During an outbreak, larvae completely defoliated fields of transvaalagrass. Damage to food plants could be light or severe depending on intensity of attack and stage of larvae (Labrador 1964). Larvae were observed to feed at night at which time they crawled up the plant; during the day larvae lay curled in clumps of grass or on the ground in fields of low grasses. Larvae on plants when touched, dropped to the ground and lay curled. Pupation took place in folded leaves as described by Labrador (1964). Duration in pupal stage (as well as pupal weights) varied less widely among progeny of the same female, and also within species reared on different hosts than did duration of the larval stage (Table 3). Based on pupal weight, *M. latipes* did

better on the velvet-bean caterpillar diet and corn while *M. disseverans* and *M. marcida* did best on guineagrass. All 3 species weighed least when reared on St. Augustinegrass. Data on Table 3 do not show a distinct correlation between larval duration and pupal weight, which is principally determined by species size, quality and quantity of food consumed by the larvae.

Only 1% of all adults reared in the laboratory had deformed wings. It is probable that exposure to excessive heat in the pupal stage was the cause of wing deformation. Adults flew vigorously at night and were always attracted to light. During outbreaks large number of *Mocis* adults could be collected from walls of public buildings (Vickery 1924). Longevities of mated males and females of each species are presented in Table 1. Each species had a 1:1 sex ratio (n=140). *M. latipes*, the smallest species, generally completed its life-cycle faster than *M. disseverans* and *M. marcida* (Table 3). The life-cycle of *M. latipes* reared on corn averaged 28.3 days with a range of 25-33 days. Vickery (1924) recorded an average of 36 days at 76°F and Bodkin (1914) reported 26-31. On St. Augustinegrass, *M. latipes* completed its life-cycle in 36.2 days, 3.8 days more than reported by Reinert (1975). Outbreaks of *Mocis* spp. occurred from August to November in 1973; peak of emergence, based on light trap catches, was late July to early August for *M. marcida*; and late September and early October for *M. latipes* and *M. disseverans*. Larvae were collected on grasses previously listed, and pupae from blackberry, *Rubus cuneifolius* Pursh; dogfennel *Eupatorium compositifolium* Walt; ragweed, *Ambrosia artemisifolia* L; and Florida pusley, *Richardia scabra* L. It is probable that non-grass host records were based upon plants from which pupae were collected.

We collected 325 pupae of which 6% were parasitized. This low level of parasitism supports the claims of Allen and Genung (1974) that parasitoids do not prevent the development of economic levels of *M. latipes*. They reported 2 viruses as more important natural control factors. Parasitoids reared from *Mocis* pupae were the sarcophagids *Sarcodexia sternodontis* Townsend, and *Sarcophaga* sp.; the braconids *Apanteles scitulus* Riley, *Meteorus autografe* Muesebeck, and *Microplitis matorus* Weed; the chalcids *Brachymeria ovata ovata* (Say), and *B. robusta* (Cresson); and the ichneumonids *Coccygomimus aequalis* (Provancher), *Enicospilus purgatus* (Say), *E. arcuatus?* (Felt) and *Gambrus ultimus* (Cresson). A tenebrionid adult, *Bothrothes fortis* (Casey.) and a carabid larva, *Pinacodera* sp. act as predators of *Mocis* larvae.

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ENHANCED TOXICITY OF CARBARYL WHEN COMBINED WITH SYNERGISTS AGAINST LARVAE OF THE BOLLWORM AND THE TOBACCO BUDWORM<sup>1,2</sup>—(Note.) Methyl parathion is combined with carbaryl and recommended for control of the bollworm, *Heliothis zea* (Boddie), and the tobacco budworm, *H. virescens* (F.), in Texas. We do not know whether this mixture is additive,

<sup>1</sup>In cooperation with the Texas Agricultural Experiment Station, Texas A&M University, College Station 77843.

<sup>2</sup>This paper reflects the results of research only. Mention of a pesticide or a proprietary product in this paper does not constitute a recommendation or an endorsement of this product by the USDA.