MORPHOLOGICAL DIFFERENCES BETWEEN ADULT *ANTICARSIA GEMMATALIS* AND *MOCIS LATIPES* (LEPIDOPTERA: NOCTUIDAE)

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ABSTRACT

Adults of *Anticarsia gemmatalis* Hübner, the velvetbean caterpillar, and *Mocis latipes* (Guenée), referred to as the "striped grass looper", exhibit similar external morphologies and are apparently sympatric in the Western Hemisphere. Intraspecific and interspecific differences in wing maculation, leg scales and spines, and genitalia are discussed, as well as differences in abdominal sterna of females. These differences are useful for species identification and for segregation of blacklight and pheromone trap catches.

RESUMEN

Adultos de *Anticarsia gemmatalis* Hübner, y *Mocis latipes* (Guenée), tienen morfología externa similar y son aparentemente simpátricos en el Hemisferio Occidental. Se trata sobre diferencias intraespecíficas e interespecíficas en la maculación del ala, escamas de las patas y espinas, y genitalia, así como de diferencias en la esterna abdominal de las hembras. Estas diferencias son útiles para identificar especies y para segregar las capturas de trampas de luz negra y de feromonas.

In parts of the Western Hemisphere, *Anticarsia gemmatalis* Hübner, the velvetbean caterpillar (VBC), and *Mocis latipes* (Guenée), referred to as the "striped grass looper" (SGL), are pests of numerous legumes and grasses, respectively (Herzog & Todd 1980, Dean 1985). Both species belong to the subfamily Catocalinae (Hodges et al. 1983) and appear to be spatially and temporally sympatric in the Western Hemisphere (Chapin & Callahan 1967, Herzog & Todd 1980, Dean 1985). From 1980 to 1983, behavioral observations and blacklight trapping of adult VBC were conducted in the presence of both species (Gregory 1986). Due to external morphological similarities between VBC and SGL, moth identifications were difficult to make initially. Both species are approximately the same size, have the same silhouette, and exhibit similar wing maculation. Worn specimens look nearly identical. Forbes (1954) discusses the wing maculation of both species but makes no comparisons. Also, both species exhibit similar leg scale morphology but previous descriptions of their leg scales are vague or inaccurate (Bethune 1869, Forbes 1954, Greene 1974). To facilitate future investigations, similarities and differences between these two species are presented in this paper. Also, morphological details about the other *Mocis* spp. [i.e., *M. disserverans* (Walker), *M. marcida* (Guenée), and *M. texana* (Morrison)] that occur in the United States are discussed.

Materials and Methods

In September of 1980 and 1981, 50 males and 50 females of VBC and SGL were captured at night with an aerial net at the University of Florida's Green Acres Research Farm, Alachua County, Fla. Most adults were captured on bahiagrass, *Paspalum notatum* Flugge. All adults were examined visually and with a 70X dissecting microscope. Velvetbean caterpillar adults were compared with colony adults maintained at the Insect Attractants, Behavior, and Basic Biology Research Laboratory, ARS, USDA, Gainesville, FL, and with written descriptions of VBC external morphology by Watson (1916), Forbes (1954), Greene (1974), and Leppla et al. (1977). Striped grass looper adults were compared with written descriptions of external morphology by Bethune (1869), Hampson (1913), and Forbes (1954). Adults of both species were compared with specimens at the Florida State Collection of Arthropods (FSCA), Division of Plant Industries, Gainesville, FL. Adults of the other *Mocis* spp. were examined from specimens in the Louisiana State University Insect Collection (LSUC). Genitalia of all moth species were dissected to confirm species and sex identifications. Hodges' (1971) terminology is used to describe wing elements, major wing areas, and leg segmentation.

Results and Discussion

Both VBC and SGL exhibited the same wing span (ca. 35-40 mm) (Forbes 1954) and similar wing coloration and maculation (Figs. 1 and 2). Dorsal VBC wing coloration was extremely variable and ranged from light gray to grayish black and from light yellowish

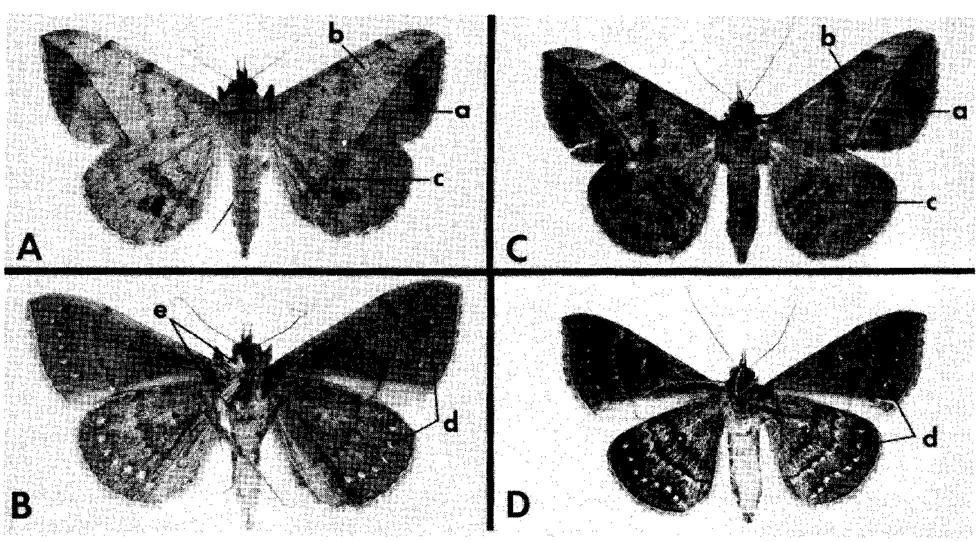

Fig. 1. *A. gemmatalis*. A. Male, dorsal. B. Male, ventral. C. Female, dorsal. D. Female, ventral. Legend: a = postmedial line, b = reniform spot, c = postmedial line, d = subterminal line, e = long setae on male legs. Adults collected by G. Strickland: male, 24-IX-1969, East Baton Rouge Parish, LA; female, 3-X-1970, East Baton Rouge Parish, LA. Both specimens are on deposit at the Florida State Collection of Arthropods.

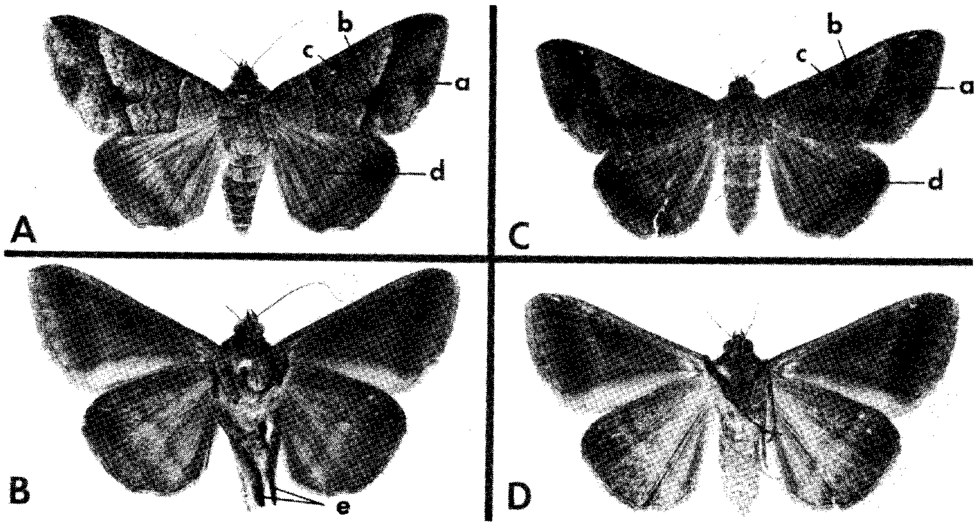

Fig. 2. *M. latipes.* A. Male, dorsal. B. Male, ventral. C. Female, dorsal. D. Female, ventral. Legend: a = postmedial line, b = reniform spot, c = subreniform spot, d = postmedial line, e = long setae on male legs. Adults collected by T. Dean: male and female, 31-X-1984, Alachua County, Gainesville, FL. Both specimens are on deposit at the Florida State Collection of Arthropods.

brown to brownish red; ventral wing coloration was less variable and tended to be light brown or cinnamon brown. Dorsal SGL wing coloration was less variable than VBC and ranged from light gray to blackish gray and from yellowish gray-brown to purplish gray-brown; ventral wing coloration ranged from light gray to light brown. Intersexual differnces in wing coloration and maculation of each species were negligible except that SGL females were sometimes more reddish than males as noted by Forbes (1954).

The main difference between the dorsal wing maculation of VBC and SGL was the placement of the forewing and hindwing postmedial lines. In both species, the union of these lines formed a straight line that crossed the forewing and hindwing when the wings were spread (Fig. 1, A and C, a and c; Fig. 2, A and C, a and d). On VBC this line began at the forewing apex and ran obliquely across the wing surface and onto the hindwing. On SGL this line began near the distal costal margin of the forewing and ran parallel to the outer wing margins; on the hindwing this line was vague.

Another difference between the dorsal wing maculation of VBC and SGL was the occurrence of the reniform and subreniform spots on the forewing. The reniform spot on VBC was figure-eight in shape, usually faint and sometimes obscure (Fig. 1, A and C, b); the subreniform spot was not visible. The reniform spot on SGL was generally evident, vaguely kidney-shaped and usually touched the subreniform spot (Fig. 2, A and C, b). The subreniform spot was usually distinct and circular, and sometimes opened onto the postmedial line (Fig. 2, A and C, c).

A notable difference between the ventral wing surfaces of the two species was the development of the subterminal lines. On VBC the subterminal line was a series of white dots that ran parallel to the outer wing-margins (Fig. 1, B and D, d). This line was not present on SGL (Fig. 2, B and D).

Both species exhibited sexual dimorphism in leg scales and interspecific differences in leg spines (Figs. 1-4). *Anticarsia gemmatalis* males had longer scales than females on prothoracic coxae and mesothoracic tibiae (Fig. 1, B and D, e; Fig. 3). These long scales on the males formed large hair pencils. Forbes (1954) reported that each

Fig. 3. Legs of *A. gemmatalis*. Top row, male. Bottom row, female. Left to right: prothoracic, mesothoracic, and metathoracic. Scale bar = 5 mm. Legs are from adults collected 24-IX-1986, East Baton Rouge Parish, LA.

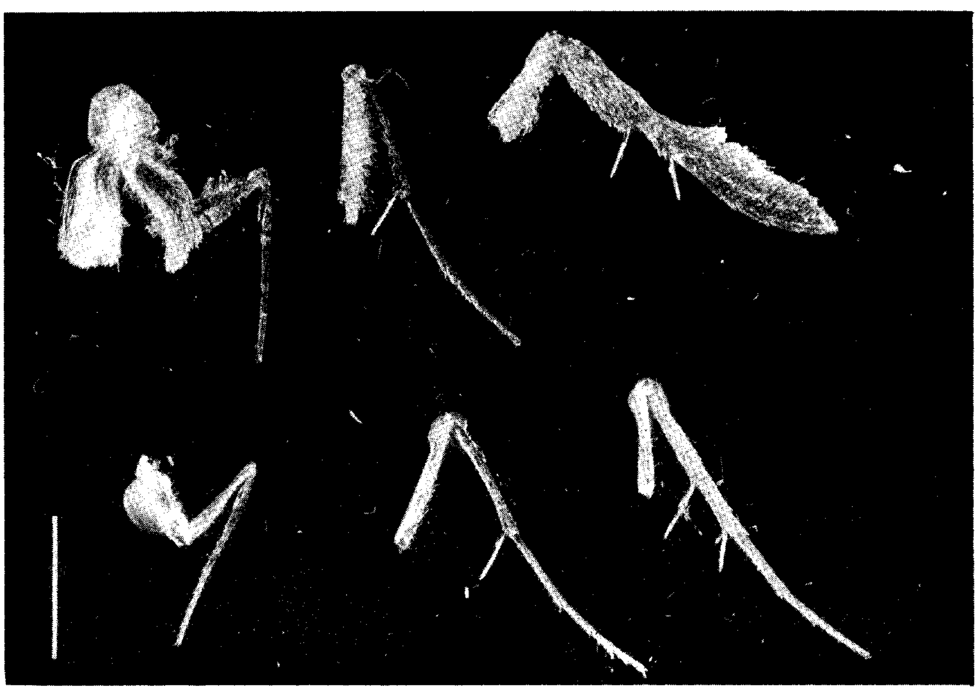

Fig. 4. Legs of *M. latipes*. Top row, male. Bottom row, female. Left to right: prothoracic, mesothoracic, and metathoracic. Scale bar = 5 mm. Legs are from adults collected 24-IX-1986, East Baton Rouge Parish, LA.

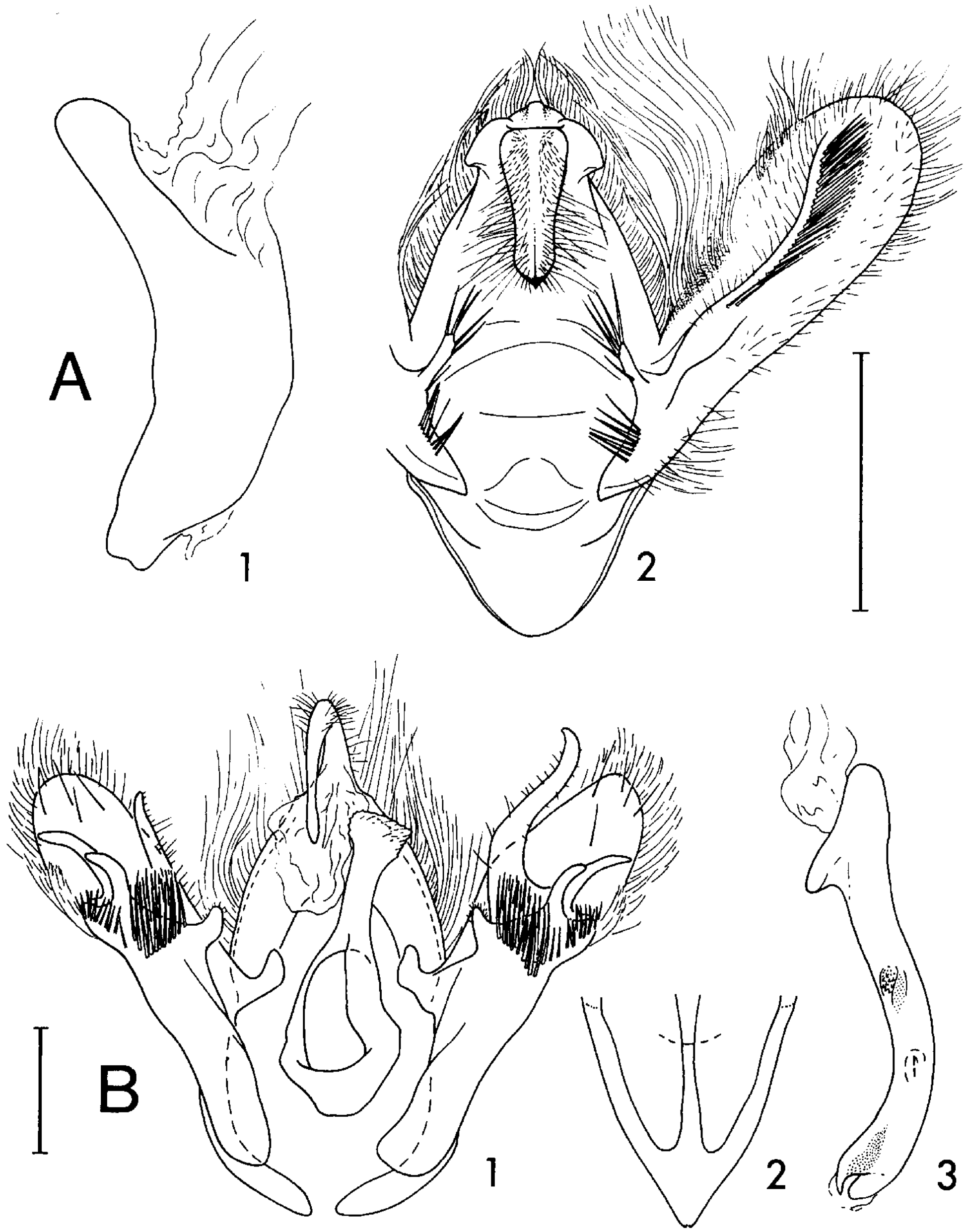

Fig. 5. Male genitalia with aedeagus removed. A. *A. gemmatalis*. 1. aedeagus, lateral view. 2. genitalia with uncus flattened, ventral view. B. *M. latipes*. 1. genitalia (vinculum distorted), ventral view. 2. vinculum in repose, ventral view. 3. aedeagus, lateral view. Scale bars = 1 mm.

mesothoracic tibia had a massive hair pencil but did not mention the coxal hair pencil. Greene (1974) reported incorrectly that long scales were present on the prothoracic femora and metathoracic tibiae. Males of *M. latipes* had longer scales than the females on the prothoracic coxae and on the femur, tibia, and tarsus of each metathoracic leg (Fig. 2, B and D, e; Fig. 4). The long scales on each prothoracic coxa comprised two distinct hair pencils (Fig. 4). The one on the left side of the coxa was attached to a sclerotized extension of the coxa, while the other one was attached to the coxa proper.

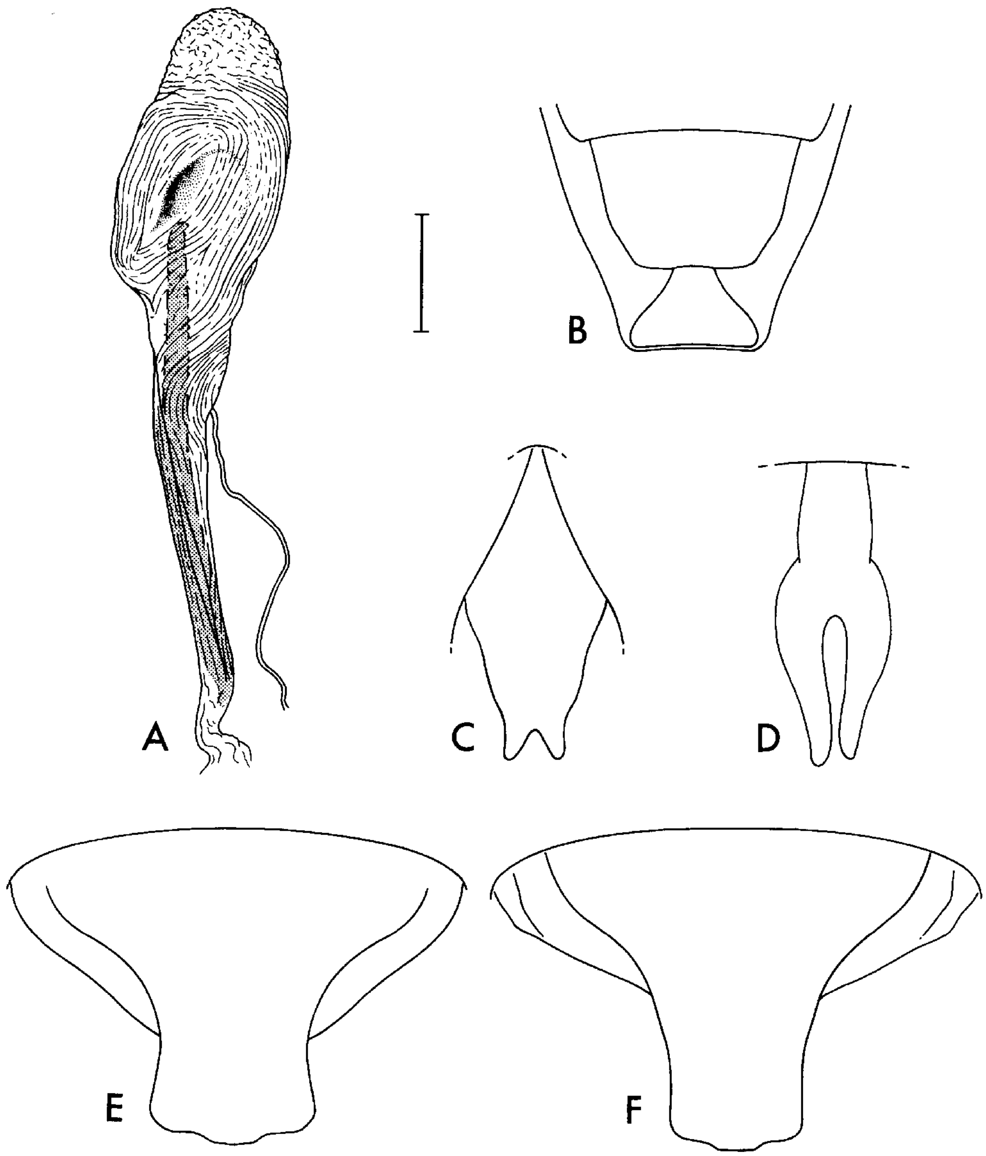

Fig. 6. Female genitalia. A, B. *A. gemmatalis*. A. bursa copulatrix, unmated. B. sixth visible abdominal segment (ventral view without ovipositor). C-F. *Mocis* spp., sixth visible ventral abdominal segment. C. *M. latipes*. D. *M. disserverans*. E. *M. texana*. F. *M. marcida*. Scale bar = 1 mm.

These two hair pencils appeared as one when the leg was held close to the body. The long scales on each metathoracic leg formed a dense fringe. Bethune (1869) noted that the metathoracic tarsi of SGL males were densely fringed, and Forbes (1954) reported the same for the tarsi and tibiae of *Mocis* spp., but neither mentioned hair pencils on the prothoracic coxae. Each mesothoracic tibiae of the *Mocis* spp. has a row of spines on the anterior face. Forbes (1954) reported that this character was present in the Catocalinae but absent in the Erebinae, in which he placed *Anticarsia.*

The dorsal postmedial line, ventral subterminal spots, reniform spot, and leg scale characteristics are useful for distinguishing VBC and SGL adults. On worn specimens, wing maculation usually fades before leg scale characteristics or the metathoracic tibial spines are lost. Genitalia dissections may be necessary on severely worn specimens. The male genitalia of VBC and SGL are shown in Fig. 5. The male genitalia of *M. latipes* cannot be flattened without distortion of the vinculum which is shown in repose in Fig. 5, B, 2. The appearance of the heavily sclerotized, asymmetrical processes on the valves will vary depending upon how much the valves are flattened. Similar processes distinguish the other three *Mocis* spp. from VBC. Both *M. latipes* and *M. disserverans* have a similar needle-shaped structure surrounding the aedeagus, but it is longer, sinuate, and pointed apically in *M. disserverans. Mocis marcida* and *M. texana* lack the needle-shaped structure but have a more heavily sclerotized area on each side of the aedeagus that is spined distally.

In the female genitalia of VBC, the ductus bursa is membranous with an elongate sclerotized rod-shaped structure extending into the bursa copulatrix (Fig. 6, A). In *Mocis* spp., the ductus bursa is a heavily sclerotized tube and only the bursa copulatrix is membranous. On VBC the last (i.e., sixth) visible ventral abdominal segment, excluding the ovipositor, is roughly rectangular in shape after the scales are removed (Fig. 6, B). In SGL, this sclerite is diamond-shaped and apically emarginate (Fig. 6, C), deeply cleft in *M. disserverans* (Fig. 6, D), and broad basally, narrowed distally, and apically sinuate in *M. texana* and *M. marcida* (Fig. 6, E and F, respectively).

Other moth species may be confused with VBC and SGL; therfore familiarity with the external and internal morphological characteristics of VBC and SGL can be useful for species identification and segregation of blacklight and pheromone trap catches. Both VBC and SGL have similar pheromones (Heath et al. 1983, Descoins et al. 1986) and are captured in VBC pheromone traps (Gregory, unpublished data).

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References Cited

BETHUNE, REV. C. J. S. 1869. Notes on Canadian Lepidoptera. Part III. Canadian Entomol. 1: 85-9.

CHAPIN, J. B., AND P. S. CALLAHAN. 1967. A list of the Noctuidae (Lepidoptera, Insecta) collected in the vicinity of Baton Rouge, Louisiana. Proc. Louisiana Acad. Sci. 30: 39-48.

DEAN, T. W. 1985. Behavioral biology of the striped grass looper, *Mocis latipes* (Guenée), in north-central Florida. Ph.D. Dissertation, Univ. Florida, Gainesville.

DESCOINS, C., B. LALANNE-CASSOU, C. MALOSSE, AND M. L. MILAT. 1986. Analyse de la phéromone sexuelle émise par la femelle vierge de *Mocis latipes* (Guénée) (Noctuidae, Catocalinae de Guadeloupe, Antilles Francaises). C. R. Acad. Sc. Paris, t. 302, Série III, n° 13: 509-12.

FORBES, W. T. M. 1954. Lepidoptera of New York and neighboring states. Noctuidae. Part III. Cornell Univ. Agric. Exp. Stn. Memoir. 329: 1-433.

GREENE, G. L. 1974. Sexual dimorphism of *Anticarsia gemmatalis* leg scales—(Note). Florida Entomol. 57: 280.

GREGORY, JR., B. 1986. A model of adult and egg populations of *Anticarsia gemmatalis* Hübner (Lepidoptera: Noctuidae) in soybean. Ph.D. Dissertation, Univ. Florida, Gainesville.

HAMPSON, G. F. 1913. Catalogue of the Lepidoptera Phalaenae in the British Museum. 13: 1-609. British Museum (Natural History), London.

HEATH, R. R., J. H. TUMLINSON, N. C. LEPPLA, J. R. MCLAUGHLIN, B. DUEBEN, E. DUNDULIS, AND R. H. GUY. 1983. Identification of a sex pheromone produced by female velvetbean caterpillar moth. J. Chem. Ecol. 9: 645-56.

HERZOG, D. C., AND J. W. TODD. 1980. Sampling velvetbean caterpillar on soybean. pp. 107-140 *In* M. Kogan and D. C. Herzog, eds. Sampling methods in soybean entomology. Springer-Verlag, New York.

HODGES, R. W. 1971. The moths of America north of Mexico, including Greenland. Sphingoidea, hawkmoths. Fascicle 21. E. W. Classey Limited and R. B. D. Publications Inc., London.

HODGES, R. W., T. DOMINICK, D. R. DAVIS, D. C. FERGUSON, J. G. FRANCLEMONT, E. G. MUNROE, AND J. A. POWELL, eds. 1983. Check list of the Lepidoptera of America north of Mexico, including Greenland. University Press, Cambridge. 284 pp.

LEPPLA, N. C., T. R. ASHLEY, R. H. GUY, AND G. D. BUTLER. 1977. Laboratory life history of the velvetbean caterpillar. Ann. Entomol. Soc. America. 70: 217-20.

WATSON, J. R. 1916. Life-history of the velvet bean caterpillar (*Anticarsia gemmatalis* Hübner). J. Econ. Entomol. 9: 521-28.

COMPARISONS OF CAT FLEA (SPHONAPTERA: PULICIDAE) ADULT AND LARVAL INSECTICIDE SUSCEPTIBILITY

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ABSTRACT

The resistance levels of a Florida strain of cat fleas, *Ctenocephalides felis* (Bouche), were evaluated using nine chemicals after colonization for approximately one (1984) and

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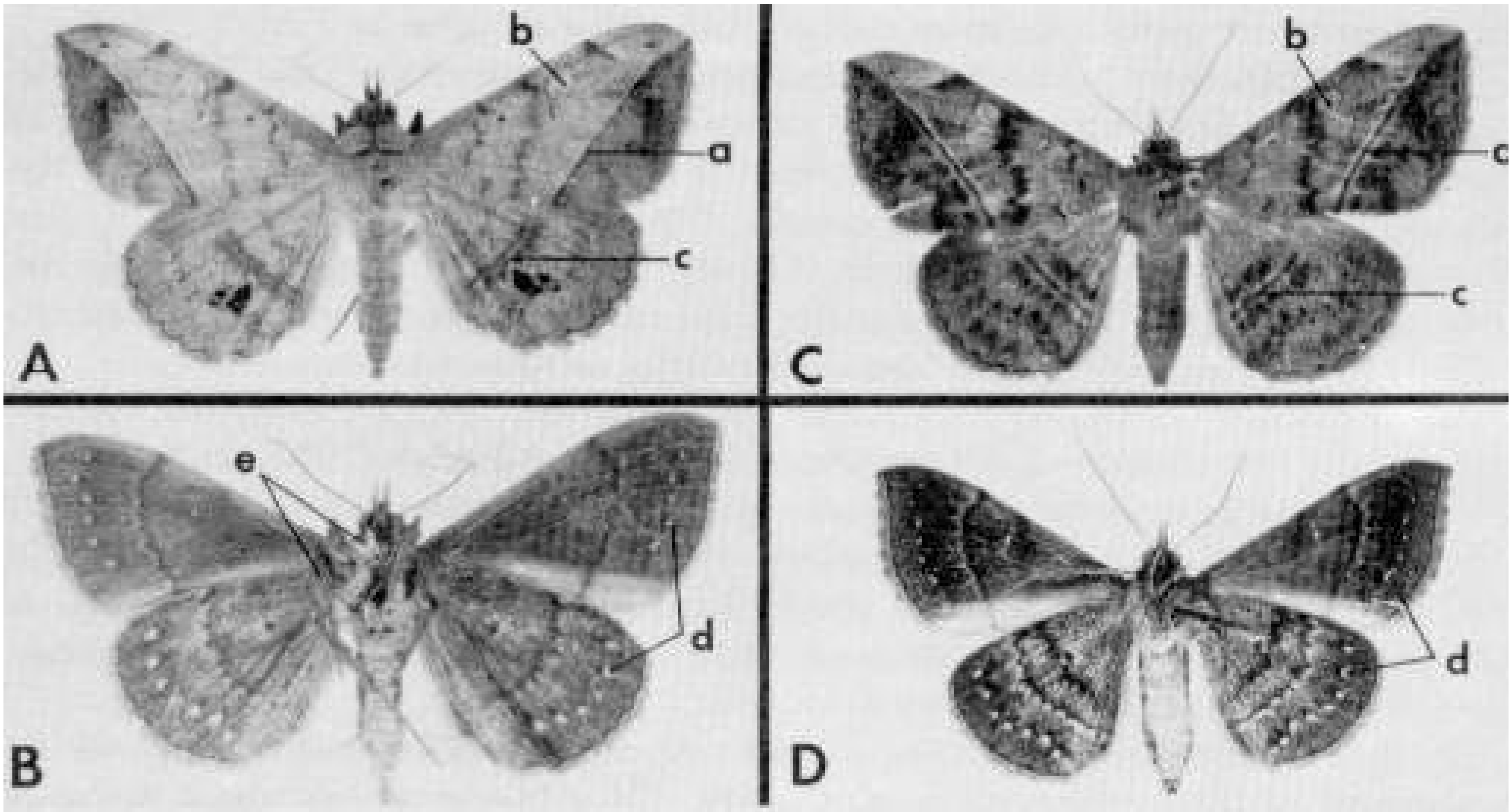
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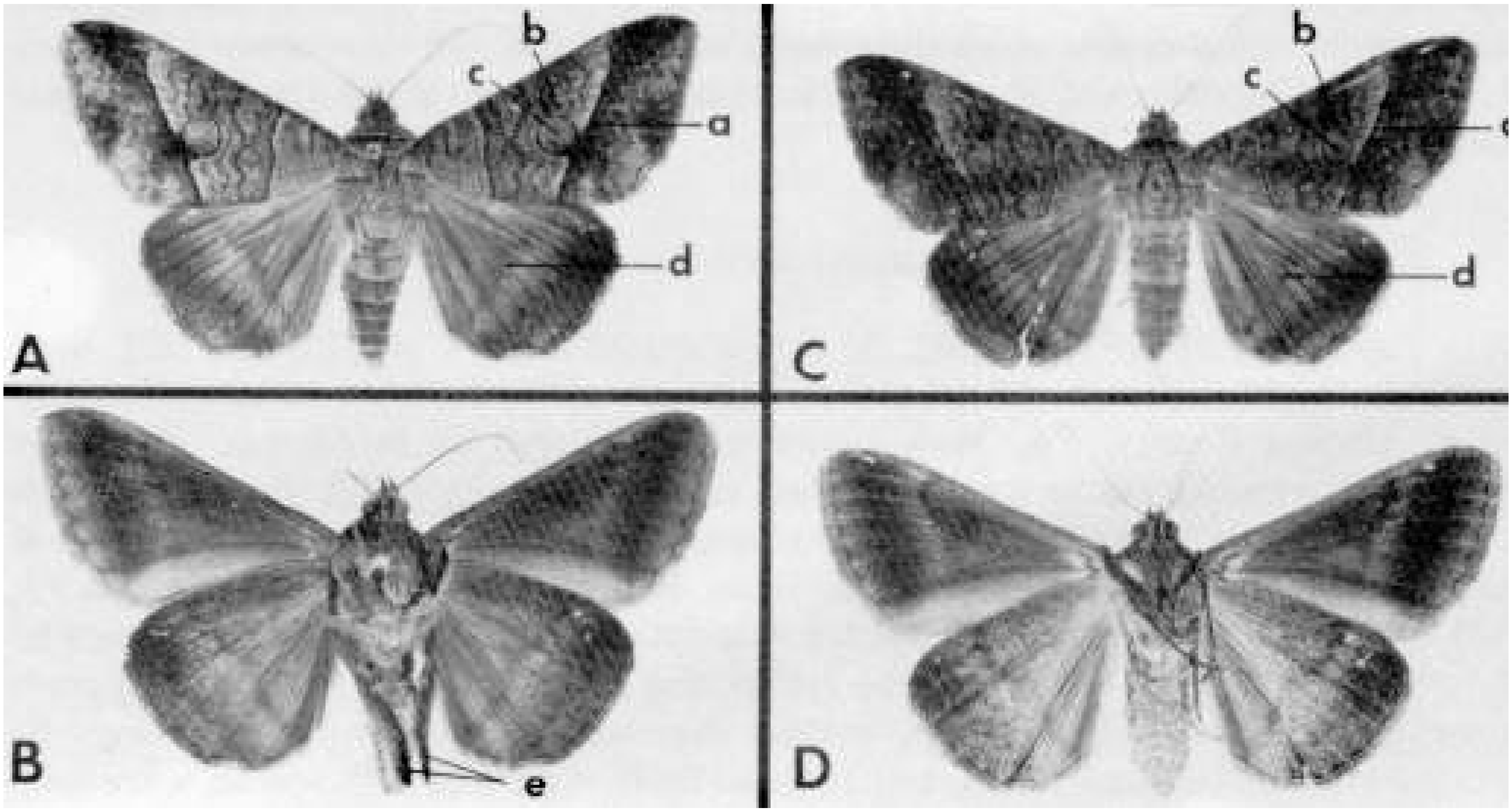
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