

**BIOLOGY OF *SUMITROSIS ROSEA*
(COLEOPTERA: CHRYSOMELIDAE), A LEAFMINER OF
BLACK LOCUST, *ROBINIA PSEUDOACACIA* (LEGUMINOSAE)**

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Abstract.—Data are presented on life history of the chrysomelid *Sumitrosis rosea* (Weber), a univoltine leafminer of black locust, *Robinia pseudoacacia* L. (Leguminosae). Its distribution, host range, and habits are compared and contrasted with those of the well-known locust leafminer, *Odontota dorsalis* (Thunberg), a co-occurring member of the same tribe (Chalepini). Although the scorched appearance and premature defoliation of black locust can be attributed to feeding by *O. dorsalis*, the often overlooked *S. rosea* may intensify the damage.

The genus *Sumitrosis* Butte belongs to the chrysomelid subfamily Hispinae and contains 55 mainly Neotropical species. Only six are known from America north of Mexico, with *S. inaequalis* (Weber) and *S. rosea* (Weber) the most common and widely distributed. Both hispines, though varying in color and sometimes occurring in the same habitat (Ruesink, 1984; McPherson, 1985), are readily separable by characters given in Butte's (1969) key: pale yellow antennae and angulate posterolateral elytral angles in *rosea*, contrasted with piceous antennae and rounded elytral angles in *inaequalis*. Their principal host plants, however, have been misassigned. Wilcox (1954) reported *S. inaequalis* as a legume feeder and *S. rosea* as associated with composites. Following Wilcox (1954), Balsbaugh and Hays (1972) stated that larvae of *inaequalis* mine leaves of plants in the Leguminosae. The actual host preferences of the two species are just the reverse, as Ford and Cavey (1985) pointed out; they suspected that Butte's (1969) report of *Chenopodium album* L. (Chenopodiaceae) as a larval host was based on a misidentification of the plant. The host range is also said to include Urticaceae, especially wood nettle, *Laportea canadensis* (L.) Wedd. (Hicks, 1965; Riley and Enns, 1979; McPherson, 1985), and we also have observed a hispine species developing on this plant. Although the forms reared from various legumes and wood nettle may indeed be conspecific, it is unusual for a North American hispine to mine the leaves of plants in such distantly related families.

On black locust, *Robinia pseudoacacia* L. (Leguminosae), mines of *S. rosea* often co-exist with those of another hispine, *Odontota dorsalis* (Thunberg), the locust leafminer. In contrast to this well-studied tree pest (e.g. Chittenden, 1902; Dominick, 1938; Haviland, 1943; Fritz, 1983; Kirkendall, 1984), the habits of *S. rosea* are poorly known. It was not mentioned in Chambers' (1880) account of insects occurring on black locust in Kentucky, Schwarz' (1891) list of Coleoptera

associated with *R. pseudoacacia* in the Washington, D.C., area, or in Weaver and Dorsey's (1965) study of the natural enemies of leafmining insects on this tree in West Virginia. When this hispine has been treated, most authors merely have noted its collection from black locust. Butte (1969) gave a list of synonyms for *S. rosea* but did not record misidentifications appearing in certain faunal lists and in the economic literature. Thus, some of the few papers containing notes on *S. rosea* have been overlooked owing to the confusing usage of the name *nervosus*.

Baliosus nervosus (Panzer) apparently is the correct name for the basswood leafminer (see Uhmann, 1957; Ruesink, 1984). This name assignment, however, has not generally been followed by North American workers. *Baliosus nervosus* of authors has been variously applied. Chittenden's (1902) observations refer to *S. inaequalis* and *S. rosea*, with his record of a "pale variety or race" on *Robinia neomexicana* A. Gray in Arizona referring to *rosea* [see Butte (1969: 17); Needham et al. (1928) incorrectly cited this tree as a host of *inaequalis*]. Based on host data cited (composites or legumes), other economic workers have used *nervosa* for *inaequalis* (e.g. Beutenmüller, 1890; Ouellet, 1919) or for *rosea*. Observations in the following papers apparently refer to adults of *rosea* (cited in *Chalepus* or *Odontota*): West Virginia: "quite plentiful" or "very common" on black locust, feeding on upper surface of leaves (Hopkins, 1891, 1893); Ohio: common on locust foliage (Cotton, 1906) and occasionally "fairly abundant"; sometimes found on dogwood (Houser, 1918); New Jersey: common on locust throughout state (Smith, 1910); New York: occurring with *O. dorsalis* on locust on Long Island, termed the "rosy hispa" (Felt, 1912); and Kentucky: common on locust (Garman, 1916).

With the exception of Chittenden (1902), who reared *S. rosea* from mines on black locust leaves, early writers did not provide data on immature stages. This is hardly surprising because its mines are indistinguishable from those of the locust leafminer, whose mines usually "swamp" those of the less numerous *S. rosea*. We note that one of the six undetermined larval forms that Hopkins (1891) observed in blisterlike mines on black locust leaflets in West Virginia may have been that of *S. rosea*. But larvae were unknown when Butte (1969) revised the genus, though the mature (third-stage) larva has now been described and illustrated (Ford and Cavey, 1985). The inconspicuous, singly deposited eggs have not been described and perhaps have gone unnoticed.

Recent authors have added several legumes as larval hosts, e.g. *Desmodium* sp. and *Lespedeza intermedia* (S. Watts.) Britt. (Ford and Cavey, 1985) and measured adult foliage consumption and area occupied by mines on soybean, *Glycine max* (L.) Merrill (Buntin and Pedigo, 1982; cited as *Baliosus nervosus*, see Ruesink, 1984). The seasonal history and habits of *S. rosea* have not been elucidated. Here, we summarize our observations on its seasonal history and host plants in Pennsylvania and its behavior on black locust in the greenhouse. We also observed *Odontota dorsalis* in the field and greenhouse. The distribution, host range, habits, and natural enemies of these two hispines are compared and contrasted.

MATERIALS AND METHODS

During 1982–85, black locusts in the Harrisburg, Pennsylvania, area were examined every 1–3 days once leaf flush had begun (late April–early May) to detect emergence of overwintered adults of *S. rosea* and *O. dorsalis*. Once beetles had

begun to emerge, two small groves of shrubby trees were monitored for 15–20 minutes at 7- to 10-day intervals to record the relative numbers of adults present and to make behavioral observations. After oviposition began, the life stages observed on black locust leaflets were noted, though actual numbers of eggs, larvae, and pupae were not recorded. The periodic censuses continued through August to determine whether either species produced a second generation. In December 1985, leaf litter taken beneath black locust was examined for the presence of overwintering beetles. Supplemental field observations were made on populations of *S. rosea* occurring on locust and other hosts in southcentral Pennsylvania; Ithaca, New York; and several localities in the southern Appalachians.

The laboratory rearings were carried out in a greenhouse under natural photoperiod. In 1984, overwintered adults of *S. rosea* were placed on 3 black locust saplings in a small cage at temperatures ranging from 22–33°C and relative humidity of 50–90%; locust leafminer adults were placed on black locust in an adjoining cage under similar conditions. The habits of both species were observed twice daily. In 1985, mating pairs of *S. rosea* were collected on 3 June and a pair placed on each of 14 black locust seedlings. Clear plastic (Mylar) cylinders covered at the top with nylon mesh were placed over the plants; the plants were then put in a small cage. Humidity inside the cylinders was not measured, but the condensation forming on the inner surface suggested it was higher than the 50–90% in the cage. Fecundity of each of 11 females was determined by examining seedlings twice daily for eggs and placing small, numbered adhesive disks adjacent to each egg. To determine stadia without disrupting the larvae, mines were illuminated from the underside with a handheld, concentrated light source (pen light). To verify our determination of larval instars, the roof of a mine was pulled back periodically with forceps to detect cast skins. Data on fecundity, longevity, incubation period, egg size, and first and second stadia are given as means \pm SE.

BIOLOGY

Distribution and host plants.—*Sumitrosis rosea* is known from Ontario south to Florida and west to Manitoba, Kansas, and Arizona (Butte, 1969). Our collecting in eastern United States suggests that this hispine is common in the Mid-Atlantic region and southern Appalachians but infrequent and patchily distributed north of Pennsylvania where black locust, its principal host, is not native but widely naturalized (Li, 1963; Little, 1971). Butte (1968) gave a similar eastern range for *O. dorsalis*—Ontario to Georgia—but examined material only from as far west as Illinois. Records for the locust leafminer now are available for all states east of the Mississippi and from Arkansas, Louisiana, and Missouri (Cannon, 1970; USDA, 1977).

Adults of *S. rosea* have long been known to occur on black locust trees, and larvae have been reared from mines on locust leaflets (see introduction). Thus, the statement that no species of the genus is known to use a tree as a larval host (Ruesink, 1984) is incorrect. In addition to the other leguminous hosts noted, goldenchain, *Laburnum* sp., appears to serve as a host plant. In early September 1981 a population estimated at several hundred adults was observed on an isolated goldenchain tree in Northumberland Co., Pennsylvania. Adult feeding, so severe that nearly every leaflet showed injury, had rendered the tree unaesthetic in appearance. A few old eggs of *O. dorsalis* were present, but most empty mines were

probably those of *S. rosea*. At a nursery in the same county, adults were present on goldenchain trees during June and July.

Black locust is thought to represent the prime and original host of *O. dorsalis* (Chittenden, 1902). Locust leafminer also develops on false indigo, *Amorpha fruticosa* L. (Chittenden, 1902), and bristly locust, *Robinia hispida* L. (Ford and Cavey, 1985). The host range also includes several exotic legumes: soybean (Poos, 1940; McPherson and Ravlin, 1983); Japanese pagodatree, *Sophora japonica* L.; and goldenchain, *Laburnum* × *waterei* (Wheeler, 1980). A new host record is yellowwood, *Cladrastis lutea* L. We observed eggs, larvae, and adults on this leguminous tree in York Co., Pennsylvania and at Ithaca, New York.

Seasonal history and habits.—We collected an adult of *S. rosea* (and one of *O. dorsalis*) overwintering in locust leaves beneath host trees. In Virginia, locust leafminer adults are known to hibernate in thick masses of loosely matted leaves, the beetles clinging to lower leaf surfaces of oak, maple, and those of other deciduous tree species. Winter survival of *O. dorsalis* in three wire screen cages containing 50, 90, and 201 beetles ranged from 88–92% (Haviland, 1943). In the Harrisburg area we swept an overwintering *S. rosea* from weeds beneath black locust on 18 April, but adults did not appear on host trees until late April or early to mid-May, typically on small trees within 7–10 days of leaf flush and a few days to a week after the first locust leafminer adults were present. When disturbed on their host, adults quickly dropped to the ground, a behavior displayed by *O. dorsalis* (Hopkins, 1891) and *S. inaequalis* (Ouellet, 1919). After several days of warm weather, adults became more numerous on black locust and began to feed on the upper and lower surfaces of host foliage. The characteristic feeding posture, abdomen elevated 30–45° above the leaflet surface, is shown in Fig. 1; occasionally a beetle's abdomen was nearly perpendicular or parallel to the surface during feeding. *Sumitrosis rosea* fed by scraping the epidermis and sometimes cutting tiny holes in a leaflet. In the laboratory a beetle fed briefly on the stem of a locust sapling. We also observed an adult feeding on a leaflet of *Robinia hispida* but did not observe a general dispersal to nonhost plants. In Iowa, adults have been reported to feed on foliage of lima and field bean (Buntin and Pedigo, 1982). Locust leafminer adults fed similarly on black locust, though the elevated-abdomen posture was only rarely seen. They imparted a netted or skeletonized look to the foliage and usually made larger and more numerous holes in leaflets and used a wider range of plant species for adult feeding. *Odontota dorsalis* attacks various herbaceous and woody plants, sometimes injuring the foliage of apple and other fruit trees (Hopkins, 1896; Chittenden, 1897, 1902; Dominick, 1938; Haviland, 1943). We observed adults of both hispines feeding on black locust petals and collected adults in inflorescences where they may have been feeding on nectar and pollen. *Odontota dorsalis* is known to visit flowers of black locust (Lovell, 1915) and to exploit nectar in inflorescences of fly-poison, *Amianthium muscaetoxicum* (Walter) Gray, and is one of the main pollinators of this liliaceous plant (Travis, 1984).

In nature we first observed mating pairs of *S. rosea* from 3 days to 2 weeks after overwintered beetles appeared on host trees. Our earliest record of copulation was 7 May. There was no elaborate courtship ritual observed under laboratory conditions. The male approached a potential mate, then pounced on her dorsum.

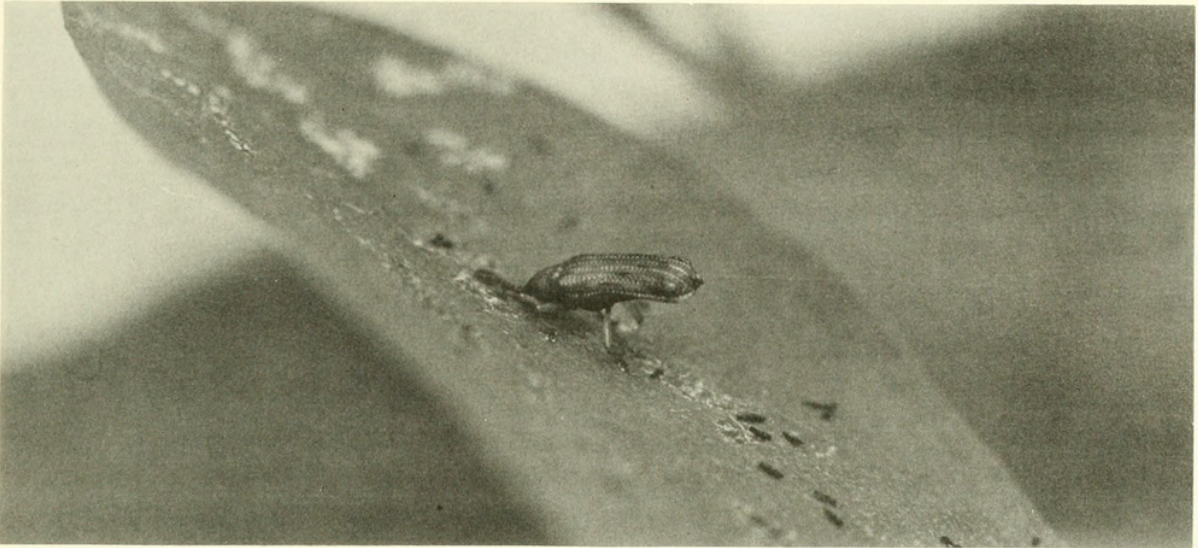
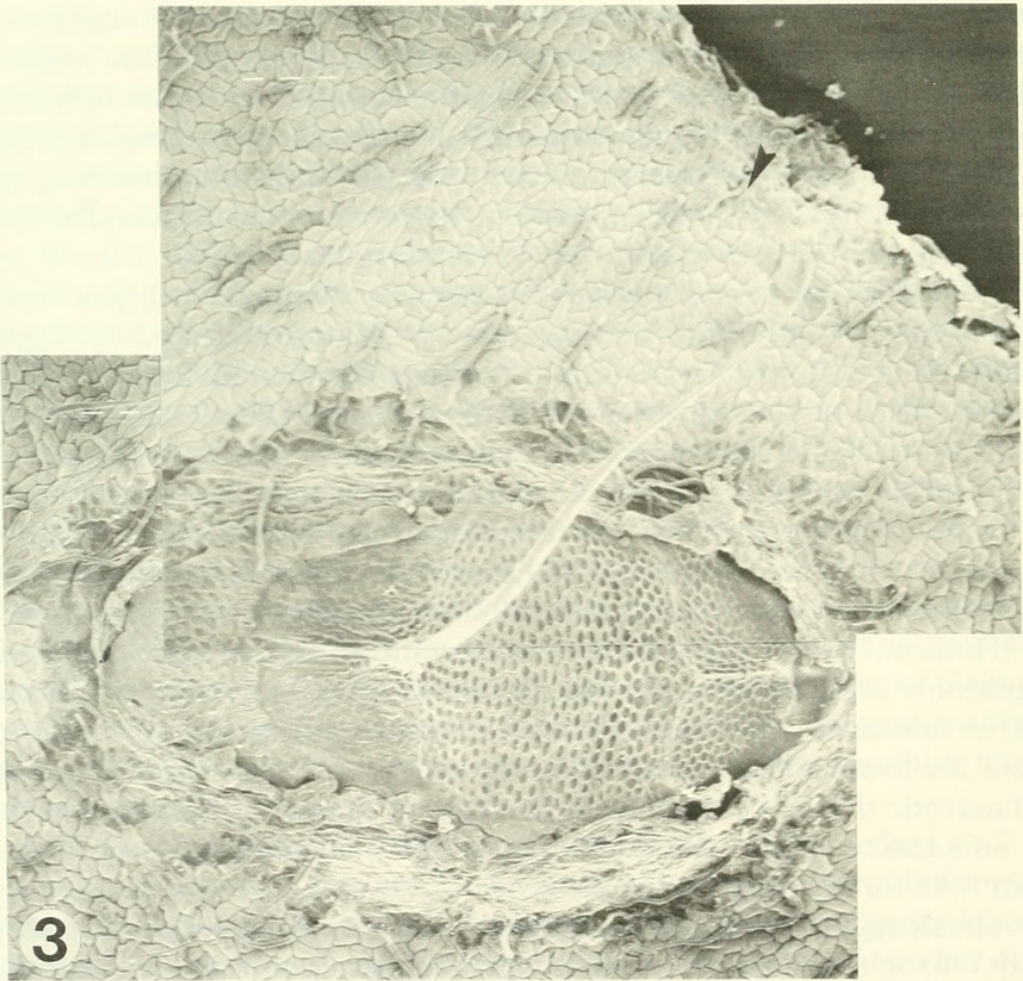
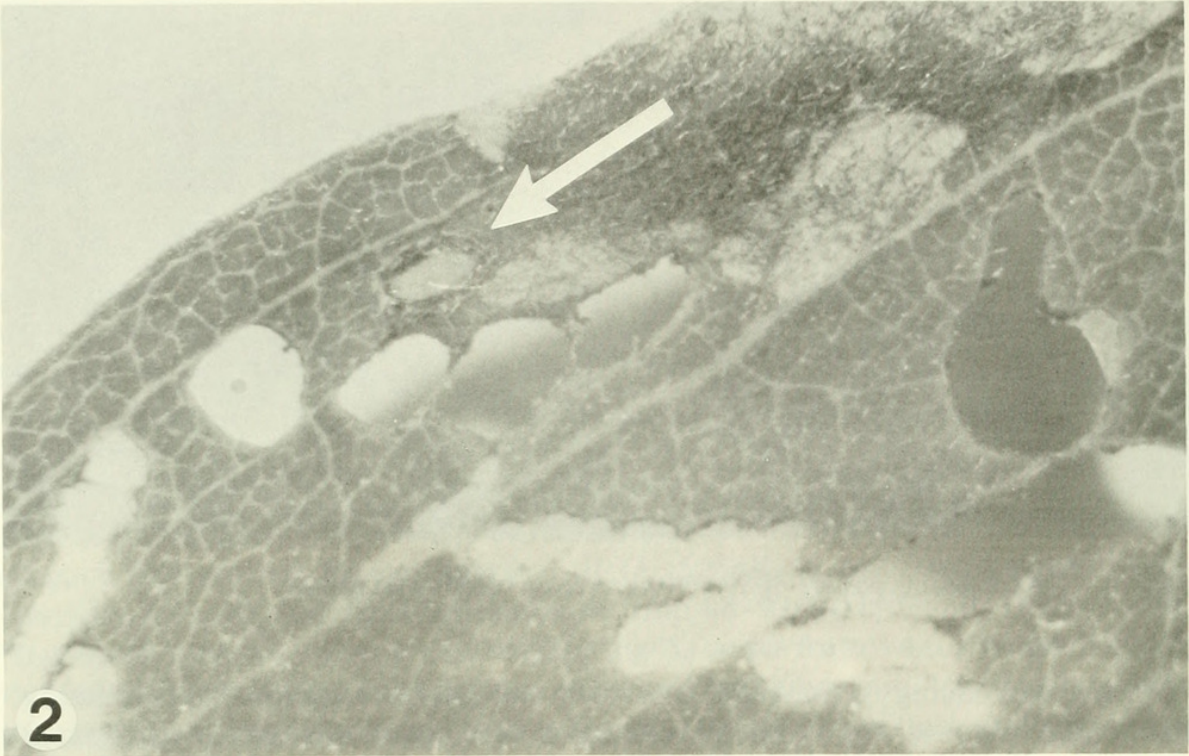


Fig. 1. Typical feeding posture of *Sumitrosis rosea* on black locust leaflets.

With the pair facing in the same direction, he quickly attempted intromission. In one pair, we observed a violent antennal quivering in both sexes, with the male mounted on the female prior to intromission. Antennal quivering may be part of the female's acceptance behavior. Pairs often remained *in copula* for 1–4 hours, with the abdomen of the female sometimes elevated. Males usually remained atop the female after copulation. She was observed to dislodge the male by a side-to-side wriggling, a behavior displayed by locust leafminer females. In *S. rosea*, multiple matings were frequent, with one pair mating seven times in nine days. Mating in *O. dorsalis* also is characterized by an absence of prolonged courtship. This species exhibits rapid pair formation with the male often inserting his aedeagus within 30 seconds, long copulations followed by postcopulatory "escort" behavior, and multiple matings (Fritz, 1983; Kirkendall, 1984).

The preoviposition period was not determined. Oviposition began in nature during late May or early June, and eggs were present until early July. Eggs were laid singly on the adaxial surface, almost always near the leaflet edge and camouflaged by prior or subsequent adult feeding damage (Fig. 2). In preparing an oviposition site, the female apparently gnaws the upper surface, then deposits an egg in the slight wound thus made. In the laboratory nearly all eggs were laid at night. The brownish egg, 0.74–0.96 mm long ($\bar{x} = 0.87 \pm 0.02$) and 0.46–0.60 mm wide ($\bar{x} = 0.53 \pm 0.01$) ($n = 10$), is not covered with excrement as in *O. dorsalis* (Chittenden, 1902; Dominick, 1938) and *Baliosus nervosus* (cited as *B. ruber*) (Hodson, 1942), but partially coated with a thin cementlike material so that chorionic sculpturing is visible. In withdrawing her ovipositor from this protective substance, the female leaves a distinct spine on the egg surface (Fig. 3). From the lower surface of a leaflet, the oviposition site is marked by a tiny spot of necrotic tissue. The statement that eggs of *Sumitrosis* "are laid in clusters of 3–7 on a leaf or leaflet" (Ford and Cavey, 1985) is inaccurate for *S. rosea* and may not hold for any member of the genus.

In contrast, eggs of the locust leafminer usually are deposited in masses of 3–5 (rarely 1–6) on abaxial surfaces of black locust leaflets, with clutch size averaging



Figs. 2, 3. *Sumitrosis rosea*. 2, Egg on upper surface of black locust leaflet near adult feeding injury. 3, Scanning electron micrograph of egg showing spine (black arrow denotes tip of spine).

4.10 in nature and 3.70 under laboratory conditions (Fritz, 1983). An egg mass is visible on the adaxial surface as a brown spot that superficially resembles an egg of *S. rosea*.

In the field, mating pairs of *S. rosea* were observed until mid-June. The fecundity of 11 field-collected females averaged 72.8 ± 22.44 (range = 16–224). Fritz (1983) reported a mean fecundity of 110.6 for *O. dorsalis*. The mean incubation period was 8.3 days ± 0.57 ($n = 200$), which compares with an average of 10 days for locust leafminer ($n = 110$ egg masses) (Dominick, 1938). Newly hatched larvae initiated mines on the upper leaflet surface rather than lower surface as in *O. dorsalis*. Mines containing first instars were observed in the field by 12 June 1985 when some second instars of *O. dorsalis* were found; one week later first instars still were the only larval stages of *S. rosea* present. First-instar larvae were found until early to mid-July. In the laboratory the first stadium averaged 5.3 days ± 0.45 (range = 5–7, $n = 14$). Mines of *S. rosea*, which closely resemble those of *O. dorsalis*, are roughened, blisterlike or parched, and visible from both surfaces. They usually were restricted to one longitudinal half of a leaflet, with both halves sometimes mined toward the apex. Because eggs are laid singly (occasionally there was more than one under laboratory conditions), larval migration was not observed as frequently as in *O. dorsalis* in which 3–5 larvae occupy an initial mine. Larvae of all stages, however, may vacate a mine, especially on a tiny leaflet. Migrant larvae of both species began mining new leaflets on the adaxial surface.

Second instars were present from about late June to mid-July 1985. Based on the rearing of 3 individuals, the second stadium averaged 6.0 days (range 5–7). A few third instars were observed by early July when summer (current) generation adults of locust leafminer were numerous. By mid-July the *S. rosea* population consisted mainly of third instars and pupae, overwintering adults having died between 8 and 18 July; in the laboratory, mean longevity of 9 overwintered adults was 23.4 days ± 5.29 (range = 1–42). As in *O. dorsalis*, pupation occurred in the larval mine, and pupae, when disturbed, are capable of wriggling. In the laboratory the third stadium and pupal period were each estimated at 5–7 days. Teneral adults remained in mines for 1–2 days before chewing through the brittle epidermis covering the mine and, in the laboratory, fed on unmined areas of the leaflet from which they emerged. Based on averages for the incubation period and first and second stadia, and on approximations for the third stadium and pupal period, the life cycle of *S. rosea* required about 32 days under laboratory conditions, which was slightly less than for *O. dorsalis*. It appeared that 2–3 leaflets were used during larval development compared to 3 or 4 for locust leafminer.

Summer generation adults were observed by 24 July; they were more numerous on 29 July, with emergence continuing into mid-August. A few adults were present on host trees as late as mid-September.

In 1984 and 1985 we did not observe mating or oviposition in the current generation. Under laboratory conditions in 1984, there also was no evidence of a second generation. In 1985 when development of laboratory populations was 3–4 weeks ahead of that in the field, females deposited viable eggs during late July. Although *S. rosea* appears to have a univoltine life cycle, the possibility of a second generation being produced in certain years cannot be discounted.

Our field observations indicated that locust leafminer populations were univoltine in both years, and this species produced a single generation in the laboratory in 1984. Several authors have reported a second brood for *O. dorsalis*, but

Table 1. Comparative life history data for two hispine leafminers of black locust.

Character	<i>Sumitrosis rosea</i>	<i>Odontota dorsalis</i>
Overwintering stage	Adult	Adult
Appearance on host	Late Apr. to mid-May	Late Apr. to early May
Adult feeding	Few plant species	Many spp., including oak, fruit trees
Larval hosts	Leguminosae, mainly black locust, also soybean; Urticaceae	Leguminosae, mainly black locust, also soybean
Oviposition habits	Eggs laid singly on adaxial surface	Eggs in clusters of 3–5 on abaxial surface
Fecundity	$\bar{x} = 72.8$	$\bar{x} = 110.6$ (Fritz, 1983)
Incubation period	$\bar{x} = 8.3$ days	$\bar{x} = 10$ days (Dominick, 1938)
Larval period	ca. 17 days	$\bar{x} = 17.6$ days (Dominick, 1938)
Pupal period	ca. 6 days	$\bar{x} = 9.6$ days (Dominick, 1938)
Generations/year	1	Probably 1

we agree with Ford and Cavey (1985) that the locust leafminer (as well as other eastern hispines) probably is univoltine throughout its range. The delayed emergence of some adults from overwintering sites, with oviposition spread over several weeks, leads to varying rates of development among individuals in a population. In Rhode Island, for example, *O. dorsalis* deposited eggs from early June to early July (Kerr, 1951). An observation of emergence occurring a month after the first appearance of summer adults would suggest a bivoltine life cycle.

The only natural enemies we observed of either hispine species were the mirid *Lopidea robiniae* Knight and a chrysopid, *Chrysopa* sp. On four or five occasions nymphs of *L. robiniae* pierced the epidermis of a mine and appeared to attack larvae of *O. dorsalis* or *S. rosea*; once we observed a nymph with its stylets inserted in an egg mass of *O. dorsalis*. Twice we observed chrysopid larvae preying on *S. rosea* pupae. Weaver and Dorsey (1965) listed predators and parasites of *O. dorsalis* in West Virginia; in Illinois, McPherson (1985) reared three parasitic species (Hymenoptera: Chalcididae and Eulophidae) from *S. rosea* larvae or pupae.

DISCUSSION

Odontota dorsalis and *Sumitrosis rosea* produce similar, blisterlike mines on leaflets of their preferred host, black locust. These chrysomelids of the tribe Chalpinini also share a similar, univoltine life cycle, though overwintered adults of the former emerge slightly earlier; thus throughout the season locust leafminer development is advanced 1–2 weeks compared to that in *S. rosea*. The species differ notably in their oviposition habits and egg structure; Table 1 compares and contrasts selected biological traits.

These species commonly co-occur on small black locust trees, with numbers of the locust leafminer usually outnumbering those of *S. rosea*. Their mines are indistinguishable in the field, and the second, less abundant hispine on black locust is often undetected. On most severely mined trees, the scorched appearance of foliage and premature leaflet drop can be attributed to attack by *O. dorsalis*. Because on some trees adults of *S. rosea* are nearly as abundant as those of the locust leafminer, this species also may cause significant injury. Typically, however,

its colonization of black locust only intensifies damage inflicted by this tree's primary pest, *O. dorsalis*.

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