Limenitis arthemis astyanax (Fabricius) (Nymphalidae) Sipping Cercopid-Spittle on Tall Goldenrod, Solidago altissima L. (Asteraceae)

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Source: The Journal of the Lepidopterists' Society, 64(4) : 217-218

Published By: The Lepidopterists' Society

URL: https://doi.org/10.18473/lepi.v64i4.a8

Journal of the Lepidopterists' Society
64(4), 2010, 217–218

LIMENITIS ARTHEMIS ASTYANAX (FABRICIUS) (NYMPHALIDAE) SIPPING CERCOPID-SPITTLE ON TALL GOLDENROD, *SOLIDAGO ALTISSIMA* L. (ASTERACEAE)

Scores of insects use the resources provided by goldenrod plants (*Solidago* spp.). In the Finger Lakes Region of New York alone, Root & Cappuccino (1992) documented 138 species of insects that feed on leaves, stems, or sap of tall goldenrod, *Solidago altissima* L. With its prodigious flowering display in late summer and early autumn, *S. altissima* is also visited by numerous species of pollen-, nectar-, flower-, and seed-feeding insects (Gross and Werner 1983; Sholes 1984). Therefore, I was not surprised during my studies of goldenrod in Virginia to see adults of the red-spotted purple, *Limenitis arthemis astyanax*, making repeated visits to *S. altissima* in early September—until I realized that the plants had yet to open any flowers. A closer examination of the interaction revealed a very unusual behavior: The butterflies were imbibing spittle excreted by the nymphs of spittlebugs (Cercopidae) that were abundant on *S. altissima* (Fig. 1).

Adults of the genus *Limenitis* are known to have rather eclectic feeding habits. In addition to nectar, they also feed on rotting fruit, dung, and carrion (Downes 1973). They have also been reported to feed on sap exuding from woodpecker holes in trees and on honeydew excreted by aphids (Rosenberg 1989). However, there are apparently no previous reports of *L. a. astyanax* or any other species of butterfly, utilizing the excretions of spittlebugs. It is quite possible that this behavior has not been officially documented for any insect.

It might seem like a small step from feeding on aphid honeydew to spittlebug excretions, as both aphids and spittlebugs tap into the flow of plant sap and excrete copious amounts of liquid waste. However, the similarities end there. Aphids feed on phloem sap, which is rich in sugars manufactured by the plant through photosynthesis. Because aphids obtain more carbohydrates than they need from phloem sap, their excretions (honeydew) are rich in sugars. Many insects, most notably ants, are able to take advantage of this honeydew as a source of sugar.

In contrast to aphids, spittlebugs ingest xylem sap, which is relatively dilute, with small amounts of inorganic nutrients and amino acids and smaller amounts of sugar (Wiegert 1964a; Horsfield 1977). Spittlebug nymphs introduce bubbles into their liquid excrement and cover their bodies with the foamy spittle, which may serve as protection from predation or desiccation (Guilbeau 1908; Weaver and King 1954; Wiegert 1964a; Whittaker 1970; Turner 1994). Spittlebugs extract most of the sugars and other nutrients from the xylem sap, such that spittle is expected to be of little nutritional benefit to other insects (Wiegert 1964b). It has been suggested that the spittle may be toxic to other insects due to the presence of ammonia (Turner 2000).

The fact that *L. a. astyanax* repeatedly returned to spittle masses raises several questions. For instance, do the butterflies sip spittle to their own detriment, or do they gain a net benefit from it? If the latter, then what is the nature of the benefit? Are there undigested amino acids from the xylem or nutrients from decaying exuviae and small organisms trapped in the spittle, or do the butterflies simply use the spittle as a source of moisture? Would the costs and benefits of sipping spittle differ depending on the species of cercopid producing the spittle?

The most abundant spittlebug nymph on *S. altissima* in Virginia in September is the sunflower spittlebug (*Clastoptera xanthocephala* Germar), a rather polyphagous species that is best known for feeding on plants in the Asteraceae. Nymphs of two other cercopid species, *Philaenus spumarius* (L.) and *Lepyronia quadrangularis* (Say), are common on *S. altissima* during the late spring and early summer, but I have not observed

FIG. 1. Adult *L. a. astyanax* sipping spittle produced by the spittlebug *C. xanthocephala* on its host plant *S. altissima* (Photograph by M. J. Wise on 2 September 2009 at Blandy Experimental Farm in Clarke County, Virginia.).

L. a. astyanax visiting goldenrods when these spittlebugs were present. This difference in *L. a. astyanax* behavior may be caused by differences in the physical or chemical properties of the spittle created by the different species, or it may simply be a result of changing needs of the butterflies from spring to fall. Notably, the weather in the period in which I observed the spittle sipping was particular warm and dry. Changes in plant size or chemical constituents of xylem as the season progresses could also affect the attractiveness of cercopid spittle to *L. a. astyanax*. It would be interesting to determine if the butterflies feed on spittle derived from plants other than goldenrods.

Finally, in order to characterize the ecological interaction among the butterflies, spittlebugs, and goldenrod, it would be necessary to know whether spittle sipping by butterflies affects the fitness of the spittlebug nymphs. My observations suggest that *L. a. astyanax* only takes a small proportion of available spittle per feeding bout from any given spittle mass, and thus a single visit is likely to have only a minor effect on the nymphs. If the butterflies were to return frequently, then they might shrink a spittle mass faster than the nymphs can replace it. In addition, a butterfly's proboscis might disturb a nymph's feeding, causing it to leave the spittle mass to relocate elsewhere on the plant. During the time period needed to re-establish its spittle mass, the nymph would be vulnerable to desiccation and predation (Wise *et al*. 2006). Clearly, the observation of spittle sipping by *L. a. astyanax* introduces a number of interesting physiological and ecological questions that will require further study to resolve.

ACKNOWLEDGEMENTS

I thank the University of Virginia's Blandy Experimental Farm for providing housing and access to field sites. I also thank Netta Dorchin of the Museum Koenig in Bonn, Germany and the community of entomologists on the ENTOMO-L Listserv for anecdotes and leads to information regarding spittle feeding in insects.

LITERATURE CITED

DOWNES, J. A. 1973. Lepidoptera feeding at puddle-margins, dung, and carrion. J. Lepid. Soc. 27: 89-99.

GROSS, R. S. & P. A. WERNER. 1983. Relationships among flowering phenology, insect visitors, and seed-set of individuals: experimental studies on four co-occurring species of goldenrod (*Solidago*: Compositae). Ecol. Monogr. 53: 95-117.

GUILBEAU, B. H. 1908. The origin and formation of the froth in spittle-insects. Am. Nat. 42: 792-798.

HORSFIELD, D. 1977. Relationships between feeding of *Philaenus spumarius* (L.) and the amino acid concentration in the xylem sap. Ecol. Entomol. 2: 259-266.

ROOT, R. B. & N. CAPPUCCINO. 1992. Patterns in population change and the organization of the insect community associated with goldenrod. Ecol. Monogr. 62: 393-420.

ROSENBERG, R. H. 1989. Behavior of the territorial species *Limenitis weidemeyerii* (Nymphalidae) within temporary feeding areas. J. Lepid. Soc. 43: 102-107.

SHOLES, O. D. V. 1984. Responses of arthropods to the development of goldenrod inflorescences (*Solidago*: Asteraceae). Am. Midl. Nat. 112: 1-14.

TURNER, J. S. 1994. Anomalous water loss rates from spittle nests of spittlebugs *Aphrophora saratoga* (Homoptera: Cercopidae). Comp. Biochem. Phys. A. 170: 679-683.

———. 2000. The extended organism: the physiology of animal-built structures. Harvard University Press, Cambridge, Mass. 235 pp.

WEAVER, C. R. & D. R. KING. 1954. Meadow spittlebug *Philaenus leucophthalmus* (L.). Ohio Agricultural Experiment Station, Technical Report 174. Wooster, OH.

WHITTAKER, J. B. 1970. Cercopid spittle as a microhabitat. Oikos 21: 59-64.

WIEGERT, R. G. 1964a. The ingestion of xylem sap by meadow spittlebugs, *Philaenus spumarius* (L.). Am. Midl. Nat. 71: 422-428.

———. 1964b. Population energetics of meadow spittlebugs (*Philaenus spumarius* L.) as affected by migration and habitat. Ecol. Monogr. 34: 217-241.

WISE, M. J., D. L. KIEFFER, & W. G. ABRAHAMSON. 2006. Costs and benefits of gregarious feeding in the meadow spittlebug, *Philaenus spumarius*. Ecol. Entomol. 31: 548-555.

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Received for publication 28 December 2009, revised and accepted 18 May 2010