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POPULATION FLUCTUATIONS OF *AZETA VERSICOLOR* (FABRICIUS) (NOCTUIDAE) ON *GLIRICIDIA SEPIUM* (JACQ.) (FABACEAE) IN NORTHEASTERN COSTA RICA

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ABSTRACT. Counts of early stages, especially caterpillars, of *Azeta versicolor* on the host tree *Gliricidia sepium* planted as shade cover in a vanilla plantation were made intermittently during five years. Based on field observations and rearings, the mature caterpillar and pupa were described, noting two distinct color morphs in the former. Tachinid parasites were also noted. Caterpillar abundance was analyzed and interpreted in relation to monthly rainfall and leaf-flushing in the host tree, since caterpillars feed preferentially on new (flush) leaves. Numbers of caterpillars were highly correlated with monthly rainfall. It is concluded that population cycles of the moth are regulated by seasonal patterns of leaf-flushing in the host.

Additional key words: immature stages, leaf flushing, population dynamics.

Impact of seasonal fluctuations in rainfall on leaf-flushing of semi or fully deciduous host trees is a major environmental factor molding population dynamics of noctuids and other Lepidoptera in the tropics (Vaishampayan & Veda 1980, Blair 1982, Tucker & Pedgley 1983). Fabaceous legume crops in the tropics are especially preferred hosts of noctuid and pyralid defoliators, with seasonal patterns of population outbreaks typical for several of these host species (Bradley & Carter 1982, Panchabhavi & Holihosur 1982). In many species, caterpillars preferentially defoliate immature leaves or other most nutritious tissues of the host, which are often only seasonally available (Futuyma & Wasserman 1980, Bracken 1984). Here I report seasonal abundance pattern of immature stages for the noctuid moth *Azeta versicolor* (Fabricius) on leaves of the fabaceous legume tree *Gliricidia sepium* (Jacq.) planted as shade cover in a vanilla plantation.

METHODS

Counts of life stages of *Azeta versicolor* were obtained on 16 dates between March 1982 and June 1987 at "Finca La Tirimbina," near La Virgen (10°23'N; 84°07"W; 200 m elev.), Sarapiqui District, Heredia Province. Within a ca. 1600 m^2 plot containing about 900 trees of *Gliricidia sepium* planted a few years earlier to shade vanilla plants, 30 arbitrarily selected trees (canopy height ca. 3 m) were censused for *Azeta versicolor* caterpillars at various times. The medium-sized (40 mm wingspan) adults and caterpillars were readily recognizable in field censuses: adult moths are drab greenish brown with striking red ab-

dominal coloration, and yellowish mature caterpillars usually rest close to the base of host trees, typically on stems and leaves of vanilla orchid vines and other epiphytes under the trees.

On a given caterpillar census, as many as 100 samples of both mature or immature leaves and stems on each tree (usually up to height of 1.5 m) were searched for "young" caterpillars (mixed early instars) and eggs. Condition of canopy foliage of *Gliricidia sepium* was also noted (such as presence or absence of flush leaves), providing a qualitative picture of local timing of peak flushing periods in relation to seasonality. A total of 30 caterpillars (later instars) were placed in clear-plastic bags containing fresh cuttings of *G. sepium* and kept tightly shut for rearing. Parasitism of caterpillars and pupae was noted from this sample.

RESULTS

Natural history. In both of two color morphs of the final stage caterpillar, roughly equal in abundance and not sexual dimorphism, the head is pinkish white with black dots. Thoracic and abdominal regions of the mature caterpillar (40 mm long by 5 mm wide) have eight lengthwise narrow bands, which, in the dark form are as follows, dorso medial to latero ventral: (1) deep yellow; (2) faintly yellow edged in black; (3) pale bluish streaked with tiny black lines and a single round black dot on each segment; (4) pale bluish yellow; (5) wide pale blue; (6) lateral (spiracular) stripe pale blue with thin black line medially and reddish spiracle openings, each with a black dot dorsoanteriorly and yellow dot ventroposteriorly; (7) yellow with black edging ventrally; (8) grayish with raised black dot, one per segment. Prolegs pinkish, each with yellow dot laterally, ringed with black. Glossy black elongate setae on profuse raised areas of cuticle. Anal clasper faintly pinkish; true legs reddish. In the light form, there are no black stripes bordering other stripes.

The reddish brown pupa (20–22 mm long by 5–6 mm wide) occurs in a loosely constructed cocoon of host leaves pulled together and anchored with light brown silk. Both caterpillar and pupa thrash about vigorously when picked up. Adults are active throughout the day, and are skittish and difficult to capture with an insect net. The spherical, glossy yellow eggs are placed singly on the undersides of *G. sepium* leaves. Of 257 eggs discovered in the field, ca. 70% were on immature (meristem) leaves. As noted above, mature caterpillars rest on vanilla vines and other epiphytic debris on host trunks during daytime, and are chiefly nocturnal feeders, crawling into the *G. sepium* canopy to feed. Each of 3 pupae (out of 30 reared from collected caterpillars) yielded 1 tachinid parasite.

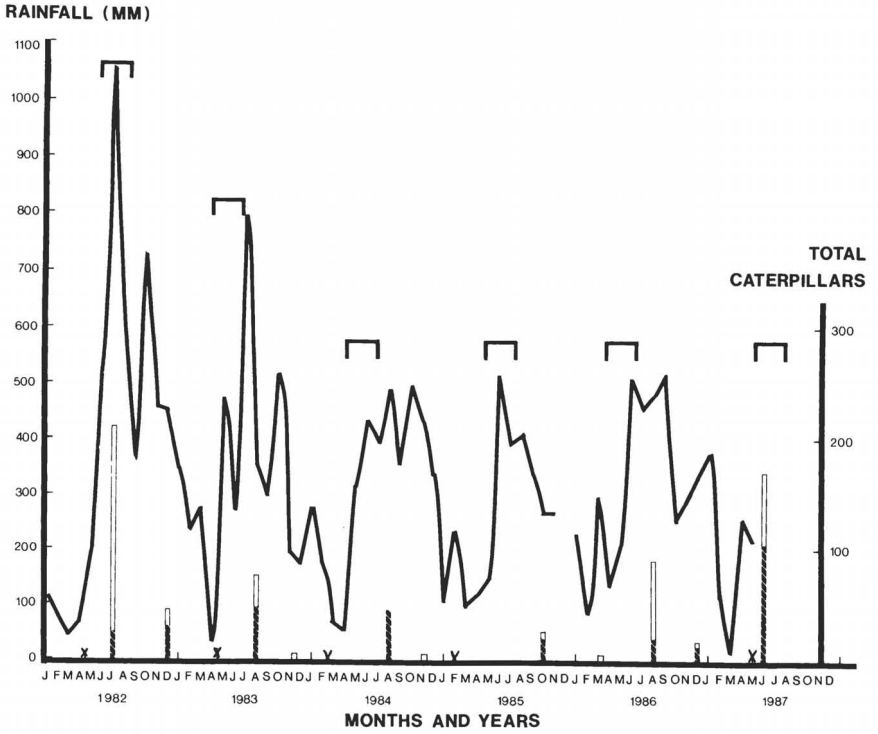

FIG. 1. Monthly total rainfall (line), total numbers of *Azeta versicolor* caterpillars (vertical bars, 5th instars represented by hatching), timing of leaf-flushing (brackets), and periods of caterpillar absenses (x), in the 36-tree subplot of *Gliricidia sepium* at "Finca La Tirimbina." Rainfall data courtesy of Finca La Tirimbina.

Seasonal population fluctuations and leaf-flushing. Abundance of *Azeta versicolor* caterpillars on sampled *Gliridia sepium* trees varied greatly among census dates (Fig. 1). Aside from an occasional hesperiid and limacodid caterpillar, I did not observe other herbivores abundant on these trees. When the data are examined relative to rainy and dry season periods at La Tirimbina, two patterns become apparent: (1) the highest numbers of mature and partly grown caterpillars occurred in the rainy season, especially June–August, approximately during the first half of the lengthy rainy season characteristic of this locality; (2) caterpillars are absent during the dry season (February–March) (Fig. 1). A high positive correlation resulted between numbers of caterpillars and monthly rainfall ($r = 0.81$, $P < 0.01$).

Also during July–August, as many as 500 adults were counted within a 600 m^2 strip of low vegetation bordering one side of the vanilla grove during a 2 morning census (0800–1000 h). As many as 100 eggs were counted within the 36-tree subplot on a single day in July or August,

and none were found in February or March. During dry months, host trees are partly deciduous, and only mature leaves are present. Flowering in *G. sepium* at La Tirimbina is most intense during March and early April. During the first three months of the rainy season, *G. sepium* exhibits intensive leaf flushing (Fig. 1).

The highest population density of *Azeta versicolor* at La Tirimbina follows intense flushing of new leaves on larval host trees. The increased availability of immature (flush) leaves during the beginning of the rainy season provides an abundant food resource for larvae. Population build-up can be so intense in the rainy season as to result in 80–100% defoliation of *G. sepium* on some plots. I conclude that the breeding population of this Neotropical noctuid fluctuates in size throughout the year at La Tirimbina in a consistent manner, and in response to the seasonal leaf-flushing cycle of *G. sepium*.

DISCUSSION

Some tropical legume crops attacked by host-specific noctuids and other moths undergo severe defoliation at certain times of year (Singh & Budhraja 1980). Legume tree species typically planted as a permanent shade over perennial crops in the tropics such as cacao, coffee, and vanilla, including *G. sepium* (Inostrosa & Fournier 1982), and others such as *Erythrina* (Borchert 1980) undergo pronounced seasonal cycles in leaf-flushing in direct response to water-stress and rehydration (Reich & Borchert 1982). The complete absence of *Azeta versicolor* caterpillars on *Gliricidia sepium* in the dry season at La Tirimbina is due to absence of immature (newly flushed) leaves. Thus, availability of edible leaf tissues, a consequence of seasonally regulated hostplant leaf-flushing, determines temporal pattern of population build-up in this noctuid. The degree to which *A. versicolor* exploits other larval host plants at La Tirimbina is unknown.

Skittish behavior of the diurnally active adults, and their vivid red abdominal colors, suggest aposematism, perhaps a consequence of larval feeding on *G. sepium*, a species well known for high concentrations of courmarin compounds in its leaves (Allen & Allen 1981). Marked build-up of the adult population in the first half of the rainy season at La Tirimbina suggests a population structure in which biotic regulation of the herbivore may be minimal.

Gliricidia sepium is capable of producing a new flush of leaves following a period of intense herbivory by (J. R. Hunter & A. M. Young pers. obs.). The ability of *G. sepium* to recover rapidly from intense defoliation may be mediated in large part by the tree's capacity to fix nitrogen in the soil.

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