METHYL ANTHRANILATE: IDENTIFICATION AND POSSIBLE FUNCTION IN *APHAENOGASTER FULVA* AND *XENOMYRMEX FLORIDANUS*[1]

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ABSTRACT

Mandibular gland secretions of the ants *Aphaenogaster fulva* Roger and *Xenomyrmex floridanus* Emery contain methyl anthranilate. Behavioral tests demonstrate that it initiates escape behavior in the workers of each species. The evolutionary significance of methyl anthranilate in myrmicine species is discussed.

Exocrine secretions of ants contain different classes of compounds. The same exocrine constituents often are found in many genera and/or subfamilies. Typical examples are undecane and tridecane, found in the Dufour's glands of a number of formicine genera, and 4-methyl-3-heptanone, a common mandibular gland alarm pheromone found in 7 genera and 5 subfamilies of the Formicidae (Blum and Hermann 1978a). On the other hand, some compounds appear to be genus and/or subfamily specific. Iridodial and dolichodial are common only to members of the subfamily Dolichoderinae (Blum and Hermann 1978b). Two sulfur-containing exocrine products, dimethyl disulfide and dimethyl trisulfide, have been identified only in the mandibular gland secretions of the ponerine ant, *Paltothyreus tarsatus* (Fabr.) (Casnati et al. 1967). Similarly, methyl anthranilate, a compound easily recognized in the field by its pungent grape-like odor, appears to be restricted to the formicine genus *Camponotus* (Brand et al. 1973a, Brand et al. 1973b) and, more specifically to males of the subgenus *Myrmentoma* (Duffield 1976).

Here we report the presence of methyl anthranilate in 2 myrmicine genera, *Aphaenogaster* and *Xenomyrmex*, and discuss its occurrence and function in the Myrmicinae.

MATERIALS AND METHODS

Colonies of *Xenomyrmex floridanus* Emery were collected from dead limbs of mangrove trees in the Florida Keys during April, 1978. A pungent grape-like odor was readily detected when the heads of workers and female reproductives were crushed. Worker heads were extracted with methylene chloride for chemical analysis.

Colonies of *Aphaenogaster fulva* Roger were collected in Beltsville, MD. When colonies were disturbed *in situ* or when a worker's head was crushed, a faint grape-like odor could be detected. Heads of workers were extracted with methylene chloride for chemical analysis.

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Extracts were analyzed on a computerized Finnigan 3200 gas chromatograph—mass spectrometer (GC-MS) equipped with a 1 m x 1 mm (ID) glass column utilizing 3% OV-17 as a stationary phase. The column was programmed at 10°C/min from 60°-200°C.

Behavioral reactions were determined for each species by exposing individuals from laboratory colonies to crushed worker heads of the same species or to synthetic methyl anthranilate. Tests were conducted along a foraging trail of *X. floridanus* and near the nest entrance of *A. fulva*. Crushed heads were held with forceps 1 cm from the trail or nest entrance. Reactions to methyl anthranilate were tested in the same situations by applying 10 μl methyl anthranilate to 8 mm filter paper discs held with insect pins 1 cm above and beside the test individuals.

Results and Discussion

The *A. fulva* extract contains a minor component with a mass spectrum and GC retention time identical to that of methyl anthranilate. More than 95% of the observed volatiles in the *X. floridanus* extract were a single compound. The mass spectrum and GC retention time of this compound were identical to those of methyl anthranilate.

Analyses of excised mandibular glands of *A. fulva* workers demonstrated that these structures were the source of the pheromone. Because *Xenomyrmex* workers are small, dissections were difficult and the anatomical source of the ester was not established.

When crushed heads of workers were placed near the nest entrance of an *A. fulva* colony, workers in the vicinity initially were attracted to the pheromonal source and then avoided the area. *Xenomyrmex* workers hesitated when they passed a crushed worker head placed beside a foraging trail. Synthetic methyl anthranilate on an elevated paper disc caused more pronounced responses in both species. Upon detecting the methyl anthranilate, *Aphaenogaster* workers quickly moved away from the source; *Xenomyrmex* traveling along a foraging trail stopped when exposed to this volatile compound, investigated the source, and then moved quickly on, sometimes moving off the trail to avoid the site.

These results suggest that in the myrmicine ants, methyl anthranilate is an alarm pheromone. This is not true, however, in other subfamilies where it is associated with different behaviors. Hölldobler and Maschwitz (1965) demonstrated that swarming in the European species *Camponotus herculeanus* L. is dependent upon season, temperature, and time of day, as well as the release of an exocrine secretion from males which synchronizes the departure of both sexes. It is plausible that methyl anthranilate, 1 of the compounds in the male mandibular gland of most *Myrmentoma* species, may function in this swarming phenomenon. Behavioral tests employing workers of several species of *Myrmentoma* whose males produce methyl anthranilate, however, clearly indicate that methyl anthranilate does not function as an alarm pheromone in these formicines (Brand et al. 1973a, Brand et al. 1973b).

While investigating the occurrence and source of a sex pheromone in *X. floridanus*, Hölldobler (1971) observed that winged females and workers produce a highly odoriferous substance in their mandibular glands. Crushed worker heads released escape behavior in males rather than attraction. This alarm behavior of males coincides with our observations on the alarm behavior of workers to either crushed heads or methyl anthranilate.

These results are consistent with observed phenomena in formicid evolution. Although species representing divergent phyletic lines may have exocrine blends containing some of the same compounds, similar taxa will frequently exhibit different behavioral responses to those compounds. In addition they will exhibit sex and caste differences in the occurrence and concentration of these compounds. One can frequently predict that the more divergent the taxa, the greater the chemical differences will be. However, in some cases, phyletic differences are not apparent in the exocrine chemistry, but in the behaviors elicited by these compounds, thus "chemobehavioral" differences.

Data from the literature and our unpublished results on over 20 Nearctic myrmicine genera indicate that *Aphaenogaster* and *Xenomyrmex* are the only 2 genera in which species have mandibular gland secretions containing methyl anthranilate. In comparison, the mandibular gland alarm pheromone, 3-octanone, has been identified in over 30 species representing 6 myrmicine genera (Blum and Hermann 1978a). It may be concluded that methyl anthranilate is a relatively uncommon alarm pheromone.

The evolution of the chemobehavioral responses of social Hymenoptera can be studied but a clear picture of such behavior must await the study of the chemicals controlling such behaviors. It is highly desirable in comparing different alarm behaviors to know what compounds cause these responses. The results of this investigation clearly demonstrate this point because methyl anthranilate is an alarm pheromone in *Xenomyrmex* and *Aphaenogaster* whereas in *Camponotus* it does not function in this way.

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LANGURIA ERYTHROCEPHALUS: HOST PLANTS, IMMATURE STAGES, PARASITES, AND HABITS (COLEOPTERA: LANGURIIDAE)[1]

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ABSTRACT

Languria erythrocephalus Blatchley has been little known since it was described in 1924. Larval hosts are maidencane, *Panicum hemitomon*, a native southeastern range grass and to a lesser extent paragrass, *P. purpurascens*, an introduced pasture species. Immature stages of *L. erythrocephalus* are described and the habits, natural enemies, and damage are discussed. The most important of several parasites were a braconid, *Heterospilus languriae* Ashmead, and a eupelmid, *Eupelmus cyaniceps* Ashmead.

Languria erythrocephalus Blatchley was described from 8 specimens swept from weeds along margins of a ditch at Moore Haven, FL (Blatchley 1924). Vaurie (1948) treated the species in her revision but presented only morphological information. She saw only 33 specimens collected between March and August. Otherwise, there appears to be no literature on this species except a catalogue listing (Leng and Mutchler 1927). Nothing was known about the habits, host plants, immature stages, or parasites until this study was undertaken.

HOST RELATIONS

In April, 1972, beetles were observed abundantly in the leaf whorls of maidencane, *Panicum hemitomon* Schult., most of these buds contained from 1 to 5 adults (apparently resting). Inspection of older canes showed that 98% had from 1 to 7 emergence holes of the approximate size to permit passage of the adult beetles (Fig. 1). When mature canes were split, no

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