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METHYL PALMITATE AND METHYL MYRISTATE REPEL FLIES

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We tested the effectiveness of methyl palmitate ($C_{17}H_{34}O_2$) (MP) (Eastman Kodak Co., Rochester, New York), an active ant repellent product of van der Vecht's gland in *Polistes fuscatus* (Post et al. 1984), and methyl myristate ($C_{15}H_{30}O_2$) (MM) (Aldrich Co., Milwaukee), a homolog, also known to be an effective ant deterrent (Post & Jeanne 1981, Post et al. 1984, Henderson & Jeanne 1989), as repellents against two species of flies.

Although ants are the most important predators, they are not the only arthropod enemies of *Polistes* spp. Nelson (1968) provided an extensive list of symbionts and

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parasites from *Polistes* nests in or near the U. S. He included two *Sarcophaga* spp. (*S. polistensis* Hall and *S.* sp. near *bullata* Park) as parasites of *Polistes* larvae. Chemical protection against opportunistic flies like *Musca domestica* L. may also be of selective value since the nectar and honeydew stored in exposed wasp nest combs (Strassmann 1979, Hunt et al. 1987, Henderson personal observations) are attractive carbohydrate sources for flies (Downes & Dahlem 1987). Our pupose was to determine if *M. domestica* and *S. bullata* are repelled by the "ant" repellents.

Tests with *Musca domestica*:

Field tests were conducted 8-14 August 1988 on a farm with a high density of house flies in Cross Plains, Wisconsin (Dane Co.). A 500 ml erlenmeyer flask containing a 50:50 honey/water mixture was placed upside down onto a small petri dish that fit snuggly around the flask mouth. Only a small amount of "honeywater" was accessible to flies between the dish half and flask mouth (ca. 1 mm exposure). The food dispenser was supported 0.75 m from the ground using clamps and a chemistry ring stand. Placed directly under and in contact with the petri dish half was a 20 cm by 30 cm glass plate. Flies were highly attracted to the honeywater and they invariably landed on the glass plate (rather than the dish or flask) and walked across the plate to get to the food source.

Six trials were conducted, each consisting of three treatments; MM, MP and a control (untreated plate), presented sequentially in random order. Each treatment consisted of 8 ml of a 1% solution in hexane (containing 80 mg of MP, MM, or hexane alone) poured into the center of the plate where it dried to a thin film having a 6 cm radius. The plate was then placed under the dish. The number of flies that flew away upon tarsal contact with the chemical surface (repelled) and the number that continued toward the food source (not repelled), was recorded for five minute intervals between the hours of 12:00 and 4:00 PM over the seven day study period. Temperature was approximately 30°C.

We found no significant differences between the repellency of MM or MP to *Musca domestica* adults (total not repelled = 4 and 4, total repelled = 47 and 56, respectively; chi-square = 0.048, $p > 0.25$). Only 7.8% of the flies were not repelled by the treatments. We pooled these data for comparison against the control (untreated plate (hexane only); not repelled = 70, repelled = 2). *M. domestica* adults were repelled significantly by the treatments (chi-square = 144; $p < 0.001$).

Tests with *Sarcophaga bullata*:

Four petri dish halves (9 cm diam.), each with 50 g putrid ground beef mixed with 0 ml, 0.25 ml, 0.5 ml, or 1 ml of undiluted MM, were exposed to a colony (> 300 individuals) of *S. bullata*. MP was not used here because it remained a solid at the tested temperatures (22-24°C) and methyl esters do not appear repellent to insects when in a solid state (Henderson and Jeanne, personal observations). The four dishes (treatments) were arranged at random around the center inside of a large (0.6 m on a side) screened cage (BioQuip Products, Gardena, CA) containing adult *S. bullata* of mixed sexes. A 150 W flood bulb was placed 2 cm above the outside center of the cage to help maintain room temperature at ca. 24°C and increase fly activity (they often "sunned" themselves). The number of adult flies on each dish was recorded every 15 min for the next 1.5 h and the mean number per dish was calculated for each of five separate test days. Each test was separated by one week. The degree of MM repellency for each treatment was expressed by the percentage ratio method (Laake et al. 1931). In addition, the number of larvae (*S. bullata* larviposits) in each dish was counted after 48 h. The mean number of adults landed, as well as the number of larvae from each dish, were analyzed using a two-factor ANOVA.

TABLE 1. TWO-FACTOR ANOVA ON THE REPELLENCY OF METHYL MYRISTATE TO *SARCOPHAGA BULLATA*. TESTS ARE BLOCKED ON TIME.

Source	Degrees of Freedom	Sum of Squares	Mean Square	F	P
Treatments	3	716.19	238.73	4.64	< 0.05
Blocks	4	680.90	170.22	3.31	< 0.05
Error	12	616.91	51.40	–	–
Total	19	—	—	–	–

A significant difference in repellency of MM to *S. bullata* was found between treatments and between blocks (Table 1). The block (time) effect may be the result of changes in the physiological age (and thus readiness to larviposit) of the flies being tested. Only the 1.0 ml MM treatment was significantly different from the untreated control (Tukey's procedure at alpha = 0.5). However, the treatment effect reflected the correlation between increased repellency with increased treatment dose. Using the percentage ratio method developed by Laake et al. (1931), the highest treatment dose (1.0 ml), had a rating of 3.8, indicating the strongest repellency, while the lowest treatment doses (0.25 and 0.50 ml) had the highest values (ca. 43) and indicated a low degree of repellency (Table 2).

The number of larvae per dish, however, was not affected by MM (two-factor ANOVA, treatments $F_{3,12} = 2.42$, $p > 0.05$, blocks $F_{4,12} = 2.97$, $p > 0.05$). It is possible that MM is not as effective in repelling the flies 48 h after application and that larvae are deposited at that time. Previous studies have shown MM to have a short lifetime (< 24 h) (Henderson and Jeanne, 1989).

In conclusion, we found that the house fly is repelled by MP and MM and that a parasitic fly is repelled by MM. These repellents may have wider application in controlling pestiferous insects than was previously thought. Tests of MM and MP show repellency to yellowjackets and honey bees as well (Henderson and Jeanne, unpublished).

Chemical protection at the wasp nest may involve a fly repellent in addition to its known function as an ant barrier; in the field, paper wasps often rub parts of their nest other than the petiole with their gasters. However, it is not known if a repellent is applied to areas outside of the nest petiole.

TABLE 2. NUMBER OF *SARCOPHAGA BULLATA* ADULTS LANDING ON METHYL MYRISTATE (MM) TREATED BAITS COMPARED WITH THE NUMBER LANDING ON UNTREATED BAIT. THE RESULTS ARE EXPRESSED AS THE PERCENTAGE RATIO OR COEFFICIENT OF EFFICACY (SENSU LAAKE ET AL. 1931). A PERCENT RATIO OF 0 INDICATES PERFECT REPELLENT ACTION, A RATIO EQUAL TO 100 INDICATES NO REPELLENT EFFECT.

Treatment	No. dishes	Total No. landed	Percentage ratio
Control (untreated)	5	567	*
0.25 ml MM	5	243	42.8
0.5 ml MM	5	247	43.6
1.0 ml MM	5	22	3.8

*Percentage ratio is determined by dividing the total number of flies in treated dish by the number in the control dish X 100.

Support for this work was provided by the College of Agriculture and Life Sciences, University of Wisconsin, Madison, and by Hatch Grant (# 2588) to RLJ. Several anonymous reviewers provided useful comments on this manuscript. We thank Susan Henderson for numerous retypings of the manuscript.

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POLYGYNOUS COLONIES OF *SOLENOPSIS GEMINATA* (HYMENOPTERA: FORMICIDAE) IN THE GALAPAGOS ISLANDS

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The tropical fire ant, *Solenopsis geminata* (F.), introduced into the Galapagos Islands over 100 years ago (Wheeler 1919) is presently widespread in the islands of the archipelago (Lubin 1984). They are especially abundant in improved pastures, parks, residential yards and gardens, and along National Park trails. These ants sting humans and also can be serious pests on young and weak Galapagos tortoises, and land iguanas (M. H. Wilson, Terrestial Ecologist, Charles Darwin Research Station, Galapagos Islands, unpublished data). Heavy populations exist on the island of Santa Cruz, particularly in the small village of Bellavista (Figure 1), on several of the surrounding farms,