

ATTRACTION OF MALE *FUMIBOTYS FUMALIS*¹ TO FEMALES OF THE SPECIES^{2,3}

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ABSTRACT

Biological and behavioral studies show that female *Fumibotys fumalis* (Guenée) attract males of their species. Males responded to females between 11 p.m. and 3 a.m. and in greatest numbers between 12 p.m. and 1 a.m. Females were attractive 0.5 days after adult emergence and at least to the seventh day after emergence. Females were not attractive to males the evening following the night of mating.

INTRODUCTION

The mint root borer, *Fumibotys fumalis* (Guenée), is widely distributed in North America from Nova Scotia, British Columbia, and Washington in the north to Florida, eastern Texas, and Utah in the south (Munroe 1976). The literature on this insect is limited. Forbes (1923) and Berry (1974, 1977) have reported on the biology, and Pike (1979, 1981) has reported on the chemical and cultural control of the pest. The taxonomy, morphology, and distribution of this moth has been described and reviewed by Munroe (1976).

Before 1971, this insect had not been reported to be a pest of a cultivated crop, however, during that year it was found infesting peppermint in damaging numbers in the Willamette Valley of Oregon (Berry 1974). Since then it has spread to peppermint in other parts of Oregon and into central Washington. The importance of *F. fumalis* in the Pacific Northwest has increased substantially since 1971. Detection, assessment of pest population density, and control have become necessary to the grower.

Based on the vast literature on sex pheromones of Lepidoptera (Klassen *et al.* 1982) we presumed that either the male or female of *F. fumalis* produce a sex pheromone to attract the opposite sex. Because of the proven usefulness of sex pheromones for detection and population monitoring we began an exploratory study of the sex pheromone of this insect. Our first objectives were to provide essential biological and behavioral information prior to chemical studies of the pheromone. Tests were undertaken to determine: (1) whether males or females attract the opposite sex; (2) the time of day when flight activity in response to the sex pheromone occurs; (3) the range in age when call-

ing occurs; and (4) if females are the attractive sex, whether mated females attract males. This paper reports the results of these tests.

MATERIALS AND METHODS

Mint root borer hibernaculæ containing prepupae were collected in soil samples obtained from infested mint fields near Harrah, Washington, March 1982 and 1983. The hibernaculæ were placed in clear plastic shoe boxes on a 5-6 cm layer of moistened peat moss, covered with clear plastic lids and held in a rearing room at a temperature of 21°C, RH of 60%, and a daylength of 16 h. After emergence, adult moths were sexed and maintained in corked glass vials (9.5x2 cm) containing a moistened mint leaf.

Females selected for the field test were placed in wire screen cages (10x8x1.5 cm) which were suspended by a wire from the top of Pherocon IC[®] sticky traps equidistant between the top and bottom of the trap. The traps were suspended from a moveable metal arm attached to an iron rod stake. Each trap was positioned directly above the mint foliage, 45-60 cm above ground in the same field from which the hibernaculæ were collected.

In tests to determine which sex was attractive, males or females (one male or female/trap) were placed in three traps per sex with three non-baited traps during 1983 on 7/21, 7/26, 7/27, 8/13 and 8/14. Each insect was used for one night (9 p.m. to 9 a.m.). To determine the time of moth flight activity, caged females (one female/cage) were placed in each of four traps on July 6, 8, and in each of three traps on July 9, 1982 for 12 h. (9 p.m. to 9 a.m.), and the catches were counted hourly from 10 p.m. to 7 a.m. The temperature was recorded during the test period on a hygrothermograph (Belfort Instrument Co.; Baltimore, MD) in a louvered shelter in the mint field. For the experiment to determine the number of days after adult emergence that females will call and attract males, all females were carefully segregated according to age after emergence.

¹Lepidoptera: Pyralidae.

²Mention of a commercial product in this paper does not constitute an endorsement by the USDA. Received for publication 11 July, 1984.

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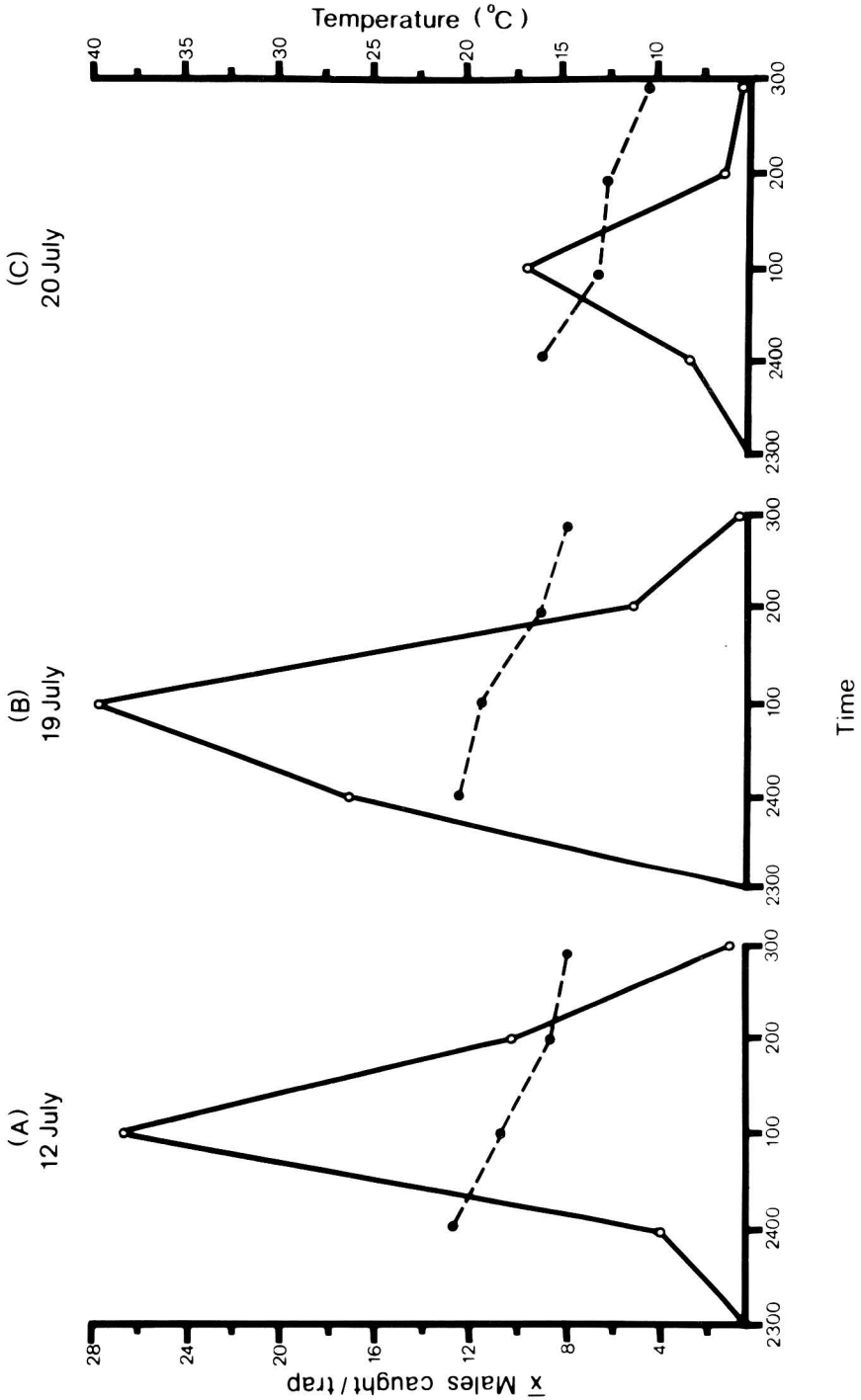


Fig. 1. Flight activity as a function time of day when *F. fumalis* (Guenée) were attracted to caged virgin females. O, mean number of moths captured per trap. There were 3, 4, and 5 replications for July 12, 19 and 22, respectively. Maximum trap captures were significantly different ($P = 0.05$, by Duncan's multiple range test) from adjacent lower values which were also significantly different from the next lower values, temperature variation. Harrah, WA, 1982.

TABLE 1. Variation in trap catch of male *F. fumalis* when unmated females used as attractants were of different ages in a mint field near Harrah, Washington, July 1982.

Age after emergence in days	No. traps	♂ catch/trap
0.5	1	13
2	7	28
3	6	38
4	5	32
5	1	9
6	3	38
7	1	23

When the relative attractiveness of mated and unmated females was compared, the mated females were obtained by placing them in cages with males. After the field tests, all females were dissected and checked for the presence of spermatophores.

RESULTS AND DISCUSSION

Traps baited with virgin females captured an average of 21.3, 34.0, 23.3, 26.0, and 31.3 males/trap and no females during five separate 12 h periods, while none of the male baited traps captured males or females; unbaited traps caught no males in the three of the 12 h periods and 0.3 male/trap in each of the two other periods of 12 h. Consequently, the sex pheromone is produced by females to attract males.

In tests to determine the time of day of flight activity (Fig. 1), moths were captured between 11 p.m. and 3 a.m. with significantly greater captures occurring between 12 p.m. and 1 a.m. The temperatures during the time of flight activity for the three nights ranged from 11-21°C. On the third night, 20 July, temperatures were lower during the flight period than on the first two nights, and flight activity was considerably less than on the previous evenings (Fig. 1C).

Traps baited with females caught males when the

females ages varied from 0.5 to 7 days after emergence (Table 1). Females appear to be about constant in attractiveness during these ages, but our tests are not definitive in this respect because we could not obtain enough females from our small colony for adequate replication for ages 0.5, 5 and 7 days.

Only unmated females attracted males. During the day following mating, none of the traps (a total of nine in three separate tests) baited with mated females caught males while the nine traps with unmated females caught a total of 21, 48, and 74, males respectively.

The biological and behavioral data presented here establish; (1) that females attract only males into traps while males do not attract either sex into traps; (2) that males respond optimally to females between 12 midnight and 1 a.m. (2400 and 100 h); (3) that females are attractive at least from 0.5 to 7 days after adult emergence and; (4) that mated females do not attract males during the day following mating. This information should be useful in the development of a monitoring system based on traps baited with the sex pheromone of *F. fumalis*. Such traps would be an asset to scientists and growers in detecting and assessing infestations of *F. fumalis* particularly in new peppermint plantings and in areas not now infested.

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BIOLOGICAL CONTROL OF THE EUROPEAN FRUIT LECANIUM, *LECANIUM TILIAE* (HOMOPTERA: COCCIDAE), IN BRITISH COLUMBIA

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In 1928 and 1929 Glendenning (e.g., 1934) released specimens of the parasitic encyrtid *Blastothrix sericea* (Dalm.) from England in an intense and long-lasting outbreak of *Lecanium tiliae* (L.) in the Vancouver district of British Columbia. The infestation then collapsed: scale populations decreased from an average of 57 per 50 cm of branch in 1930 to virtually none in 1931. Parasitism of the scale increased from 25 per cent in 1930 to 99 per cent in 1983. This was later quoted widely as a classic example of successful biological control.

However, the subsequent appearance of long-lasting outbreak of *L. tiliae* in the Vancouver district showed that it was not in fact an economic success. Flanders (1970) concluded that the numbers of specimens of *B. sericea* that were released were too small to have had any influence in controlling the 1920's infestation, leading Rubin and Beirne (1975) to conclude that the increased percentage parasitism in the early 1930's was a consequence rather than a cause of the dramatic decrease in the scale population.

The natural enemies of *L. tiliae* were studied by Rubin and Beirne (1975) in 1969-72 in an infestation in the Vancouver district that began about 1964. The dominant parasite was the only species of

Blastothrix found. It was identified by E. S. Sugonjaev as *B. longipennis* (Howard), a native North American species that had earlier been regarded as a synonym of the European *B. sericea*. Rubin and Beirne deduced from this that *B. sericea* had not become established in the original biological control attempt which therefore was a technical failure as well as an economic one.

Sugonjaev (1983) recently reviewed the genus *Blastothrix* in North America and stated that the species from British Columbia that was earlier identified as *B. longipennis* is neither that species nor *B. sericea* but is *B. britannica* Girault, a parasite of several species of lecanium scales in Europe and not previously known from North America. Sugonjaev suggested that it had been introduced originally by Glendenning as *B. sericea*, became established, and subsequently spread into Washington and Oregon.

Rubin and Beirne (1975) suggested that *L. tiliae* was still a potential subject for successful biological control in Southern British Columbia and Sugonjaev (1983) now suggested that the true *B. sericea* would be suitable for introduction, since in Europe it is known to parasitize *L. tiliae* only and it has not been found in North America. This might now be done, some 60 years after it was first proposed by Glendenning.

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