BIOLOGY AND HOST PLANT RELATIONSHIPS OF *SCAPTOMYZA FLAVA* LEAF MINER

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In the Name of ALLAH the Most Merciful the Most Beneficent

I dedicate this disertation to Imam Khomeini and the blessed my deceased brother Ali Mohammad Seraj

ABSTRACT

Scaptomyza flava Fallén (Diptera: Drosophilidae) is a leaf miner of Cruciferous plants (Brassicaceae). It occurs throughout New Zealand and in many other parts of the world. *S. flava* attacks living plants but also lays eggs on dead leaves and larvae can develop in dead and decaying plant material. However, survival to the adult stage is greater when larvae develop on live leaves. Females are polygamous and mating begins soon after emergence. Female flies start puncturing leaves with their ovipositor ca. 4 h. after emergence and produce peak numbers of punctures within the first 12 h. of their adult lives. It is during this peak time of puncture production that egg laying begins. Oviposition starts on the day following emergence and lasts for about two weeks. After this oviposition rate declines slowly. Eggs are laid mainly between 06.00 and 10.00 h. and between 17.00 and 20.00 h. with a peak between 09.00-10.00 h. and 17.00-18.00 h. The mean number of eggs laid per female per day is dependent on the availability of host plants and ranges from 20.9 to 4.4 eggs per day. Maximum oviposition varies between different host plant species. The total fecundity of some females was as high as 320 eggs (on turnip and in contrast less than 12 eggs on cauliflower) over a lifespan of about 12 days. The larvae destroys the parenchyma of leaves. Although only a small portion of the lamina is damaged by a single larva - approximately 5 cm^2. Most plant injury is caused by feeding by the third-instar larva which lasts about one week. Sex ratios of adults were close to 1:1 with a slight bias in favour of males. Feeding punctures and fecundity of *S. flava* increase greatly when given honey solution. For both sexes, longevity is affected by adult food source. Caged adult female *S. flava* lived significantly longer when provided with honey solution and yeast than when confined on glass plates and starved or allowed access to yeast and water only. Virgin females lived only slightly longer than mated females and unmated males lived significantly longer than all other groups.

S. flava is an oligophagous insect with host plants restricted to the Brassicaceae. When *S. flava* adults were given a simultaneous choice of seven plant species for feeding and oviposition, there was a distinct hierarchical ordering in their ovipositional preference, with turnip, Chinese cabbage, and hedge mustard being preferred over all others. Percentage of punctures with eggs for turnip, Chinese cabbage and cauliflower (three main host plants of *S. flava*) in choice tests were 3.1, 3 and 6.4% and in non-choice tests 6, 5.4 and 28% respectively. In non-choice tests, females laid more eggs on Chinese cabbage and

turnip than other Brassicaceae. Egg production was also different between host plants. Females oviposited means of 255, 165 and 48 eggs during their lifespan when maintained on turnip, Chinese cabbage and cauliflower, respectively. Peak egg production period varied between host plants; on cauliflower, peak production occurred 3-7 days from adult emergence and on Chinese cabbage and turnip between days 7-11 from emergence. There were also significant differences in total developmental times of the insect between three Brassicaceous host plants (cauliflower 41d, Chinese cabbage 33.7d and turnip 31d). There were significant differences in duration of the 3rd larval instar among the host plant species with the longest duration on cauliflower (8d). Fecundity of *S. flava* was positively correlated with female body weight and greater female weights resulted when insects were raised on turnip and Chinese cabbage compared to cauliflower.

Although all leaf sizes and/or ages were accepted by the insects (with the exception of the smallest leaves) for egg laying, the number of feeding punctures and eggs per cm^2 leaf increased with increasing leaf size and/or age. Nitrogen content of leaves did not vary significantly with age. Previous larval feeding experience on turnip and Chinese cabbage appeared to modify adult host plant preference, but previous feeding experience as larvae on a poor host, cauliflower, did not increase egg laying on that host by adult females. Recently eclosed adult *S. flava* may show positive experience effects on turnip (and slightly on Chinese cabbage).

Over a two year period in the Manawatu adults and larvae of *S. flava* were present throughout the year with no evidence of diapause or aestivation. However, there were marked peaks during spring and early summer in numbers of adult flies caught, and again in autumn to early winter with troughs in early autumn and early spring. This pattern, obtained by sampling for adults, was paralleled by sampling for larvae. In a laboratory experiment simulated herbivore injury did not produce the same effect as feeding by *S. flava*. Total fresh-weight accumulation was reduced significantly with increasing levels of injury by *S. flava* feeding but this did not occur with artificial clipping. In another laboratory experiment, where individual plants were caged with 4 mated females for 24 h. reduced growth of Chinese cabbage and turnip occurred from ensuing larval damage.In two separate field experiments turnip tolerated low levels of leaf mining without reduction in weight of bulb but the net yield of Chinese cabbage was significantly reduced.

In the name of Allah the most compassionate the most merciful

By the *Pen* and by the record which men write

(The Holy Qur'ān 68:1)

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