

**Aspects of the Biology of the Ladybird Beetle *Stethorus vagans*
(Blackburn) (Coleoptera: Coccinellidae)**

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PLEASE NOTE

The greatest amount of care has been taken while scanning this thesis,
and the best possible result has been obtained.

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Thesis Summary

This thesis reports laboratory and field investigations on the aspects of biology of the *Stethorus vagans* predator of two-spotted mite *Tetranychus urticae* (Acarina: Tetranychidae).

Stethorus vagans (Coleoptera: Coccinellidae) is an indigenous Australian ladybird, which mostly occurs in the coastal regions and to a lesser extent inland. Adults and larvae are both voracious predators, feeding on all stages of two-spotted mite, *T.urticae*. Aspects of the biology of *S. vagans* were studied in the laboratory at constant and fluctuating temperatures, and regularly fed on all stages of *T.urticae*.. For field studies potted French bean plants infested *T. urticae* were exposed in the field.

The lower developmental threshold temperature for egg, 1st, 2nd, 3rd, 4th larval instars, and pupal stage was estimated to be 10.1, 9.5, 9.5, 9.1, 8.2, and 8.0°C respectively, and for all stages combined it was 9.1°C. The degree-days (DD) required for development were calculated for each stage of *S. vagans* from the developmental data and the mean threshold temperature. Total mean DD for the development of all stages combined was from 189.9 to 207.8 (calculated at constant temperatures of between 12-30°C respectively), and 189.1 at fluctuating temperatures (12.7-32.1°C).

There was no significant difference in male and female longevity with mean survival of 33.21 days at 25°C. The mean number of eggs laid per female was 190 in a mean reproductive period of 28 days at the same temperature. The mean generation time (including pre-oviposition

period) was 15.5 days, while the total life cycle from egg to adult death was 41.9 days. No diapause nor any overwintering stage was recorded in either laboratory or field investigations.

Adult *S. vagans* was found to consume a range of alternative prey for survival if the primary host was not available. However, none of the alternative hosts tested had the potential to support reproduction, except for broad mite *Polyphagotarsonemus latus* although this treatment resulted in significantly lower fecundity and egg hatchability than their primary host *T. urticae*. Adults survived for 4-5 days without food and water, while their longevity increased up to 6, 7, 8, 18, 21, 23, and 26 days on whitefly *Trialeurodes vaporariorum* eggs, predatory mite *Phytoseiulus persimilis* eggs, water, honey & water, pollen & water, rust mite *Aucolops lycopersi* and broad mite *Polyphagotarsonemus latus* respectively. There was no significant difference in male and female longevity of *S. vagans* with any of the alternative hosts tested.

Time partitioning behaviour was assessed for newly emerged, satiated and 24 & 48 hour starved adults *S. vagans* as well as 4th larval instars. Adults & 4th instar larvae spent most of their time searching and feeding if they were starved, but satiated and newly emerged predators spent a greater proportion of time resting and walking..

Prey consumption rates were assessed for both immature and adult *S. vagans*. For functional and numerical responses, all motile stages of *S. vagans* were exposed to prey densities varying between 0, and 200 *T. urticae* eggs per day per individual. All stages of *S. vagans* were voracious feeders and fed on all stages of two-spotted mite, but preference was for eggs. The mean rate of consumption increased from 1st instar to 4th instar larvae (i.e. 27.9, 50.1, 71.6, and 152.4 mite eggs per day respectively), while adult males, pre-ovipositing, ovipositing, and post-ovipositing females consumed 63.5, 94.3, 57.1 and 142.7 mite eggs per day respectively.

All stages of *S. vagans* showed strong positive functional responses to *T. urticae*. None of the larval instars completed development of the stadium at the lowest prey density (2 mite eggs/day), except for a few 1st instar larvae. Prey consumption increased linearly from low prey density to high prey density until it reached a plateau for each stage. Adults and larvae also showed a significant numerical response to prey density. Starved adults survived up to 5 days, and no mortality was recorded for up to 7 days at very low prey density (i.e. 2 mite eggs/day). However high mortality occurred with prey densities less than 2, 8, 15, and 31 mite eggs for 1st, 2nd, 3rd and 4th instar larvae respectively.. Fecundity (both mean daily and total) increased from lower to higher prey densities. Cannibalism was observed with all stages of *S. vagans* at low prey density and adult females fed on their own eggs. Cannibalism ceased when prey density exceeded 42 mite eggs per female /day.

In investigations to determine how *S. vagans* located their prey, they were unable to locate prey in a Y-tube olfactometer but were readily able to reach prey on potted bean plants in a room.. Satiated adults took longer to locate their prey than did starved ones, and found high prey populations in a shorter time medium or low prey populations. This latter result was also observed in field investigations, when significantly more predators were collected from the high prey density treatment, while none were found on mite free plants

S. vagans exhibited many of the attributes of an effective biological control agent such as high reproductive potential, location of prey at low levels, reproduction at low densities, and ability to feed on alternative hosts if the primary host was not available.

It is concluded from this study that *S. vagans* has a number of characteristics which are likely to be much useful natural enemy of two-spotted mite *T. urticae*.

DECLARATION

I declare that this work has not been submitted for a higher degree at any other University or
Institute

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