A LABORATORY STUDY ON THE PREDATORY MITE,  
*TYPHLODROMUS PYRI* (ACARINA:PHYTOSEIIDAE). 
II THE EFFECT OF TEMPERATURE AND PREY CONSUMPTION  
ON THE NUMERICAL RESPONSE OF ADULT FEMALES

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INTRODUCTION

The predatory mite, *Typhlodromus pyri* Scheuten (Acarina:Phytoseiidae) is successful in many parts of the world in controlling the European red mite (ERM), *Panonychus ulmi* Koch (Acarina:Tetranychidae) on apples (OVERMEER, 1981; HERBERT, 1956; SOLOMON, 1982; GENINI and BAILLOD, 1987; TETTE, 1972) and on grapevines (BAILLOD and VENTURI, 1980). In New Zealand, integrated mite control (IMC) programmes using *T. pyri* have greatly reduced miticide usage in apple orchards whilst still achieving export quality fruit (WEARING et al., 1978). This has resulted in savings in the cost of spray applications and has delayed the build-up of miticide resistance in ERM (CHAPMAN et al., 1987).

A greater understanding of the predator-prey interaction has been achieved by the development of a *T. pyri/ERM* simulation model (HAYES, 1986). Published data (RABBINGE, 1976) were used to model the dynamics of ERM, but there was little quantitative information on *T. pyri* dynamics. Laboratory experiments were undertaken to determine the effects of temperature and ERM consumption on various life history parameters of *T. pyri*.

The numerical response of a predator is the increase or decrease in predator density in relation to prey density (SOLOMON, 1949; HOLLING, 1965, 1966). Three components of the numerical response have been defined by BEDDINGTON et al. (1976) as; 1) the duration of each instar, 2) the survival rates within each instar, and 3) the fecundity of adults. The duration and survival rates of juvenile stages of *T. pyri* in relation to temperature and prey consumption have already been investigated (HAYES and McARDLE, 1987). The present paper examines the effect of temperature and prey consumption on the fecundity of the adult females, and the duration of the pre-oviposition, oviposition and post-oviposition periods.

METHODS

Adult female *T. pyri* were studied throughout their lifespans at constant
temperatures of 15, 20, 23, 25 and 26.5°C, when supplied with different numbers of ERM larvae as food. (At a temperature of 30°C all the mites died before laying any eggs).

The mites were studied on 2.5 cm diameter discs cut from apple leaves (cv. 'Sturmer Pippin') and placed on moist cotton wool. The experimental design was similar to that of Hayes and Mcardle (1987), but sticky barriers on the leaf discs were not used because of problems encountered when mites ran into them. One T. pyri adult male, and one T. pyri deutonymph female (obtained from a field population, DSIR Research Orchard, Nelson) were placed on each leaf disc, with a plentiful supply of food consisting of all stages of ERM. After the female had moulted to the adult stage, the mites were allowed to remain together for at least 24 h, during which time copulation took place. The male was then removed and the female was placed on a fresh leaf disc and assigned randomly to one of the temperature and food treatments.

Each female predator was supplied with 1, 2, 4, 8 or 12 ERM larvae per day, although not all feeding levels were investigated at each temperature. The feeding levels were chosen to provide a range in consumption rates at each temperature which allowed survival of the mites. ERM larvae were obtained from apple leaves infested with ERM summer eggs, which were held at room temperature.

The leaf discs were examined daily to replenish the ERM larvae, to count the number that had been consumed and to determine the number of eggs that had been laid by the predator. Twice weekly, a T. pyri adult male was placed on each leaf disc for a period of approximately 8 h, to allow subsequent matings. This period is the average duration of the first mating for T. pyri (Overmeer et al., 1982) and was therefore considered to be sufficient time for subsequent matings to take place. Multiple matings are necessary to achieve maximum egg production (Overmeer et al., 1982), and presumably occur in the field, where males are available throughout the lifespan of summer females. All food was removed from the discs during subsequent matings, so that consumption of larvae by males did not interfere with the record of larvae eaten by the female.

At least 8 replicates with their starting times staggered, were carried out at each temperature and food combination. However, a number of mites escaped from the leaf discs and were drowned or lost. Daily consumption of larvae and egg production were recorded from the time of adult female emergence until death.

Statistical analyses were carried out using the Statistical Analysis System (SAS Institute, 1985).

Results

The adult female life-span consisted of a distinct pre-oviposition period, a long oviposition period and a short post-oviposition period. Table 1 shows the mean duration of these periods at each temperature and feeding level.