STUDIES ON THE BASIC COMPONENTS OF THE PREDATION OF *PHYTOSEIULUS PERSIMILIS* ATHIAS-HENRIOT

(ACARINA : PHYTOSEIIDAE)

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INTRODUCTION

The functional and numerical response of a predator to its prey densities (Solomon, 1949) are important factors in predator-prey system dynamics (Holling, 1959). The responses, in turn, are the results of combinations of the actions and interactions of their components such as prey density, searching ability and searching behaviour of a predator, and mutual interaction between individuals. Therefore, the responses should be studied under conditions which will insure that all components can play their role.

The functional response of *Phytoseiulus persimilis* Athias-Henriot to its tetranychid mites has been studied by several authors (Mori and Chant, 1974; Pruszynski, 1973; Laing and Osborn, 1974; Takafuji and Chant, 1976; Everson, 1979; Fernando and Hassell, 1980). The numerical response of the predaceous mite was extensively studied by Takafuji and Chant (1976). Also, searching behaviour of *P. persimilis* in relation to webbing produced by tetranychid mites (Schmidt, 1976; Takafuji and Chant, 1976; Sabelis, 1981) and the mutual interaction between individuals of the mite (Fernando and Hassell, 1980) were reported.

However, few workers observed the responses in open systems. The purpose of this study was to examine the responses in a system where the predator could disperse freely and to compare the results with those in closed systems.

MATERIALS AND METHODS

*P. persimilis* was obtained from the culture of the Institut für biologische Schädlingbekämpfung in Darmstadt, Germany. *Tetranychus urticae* Koch, which originated from the glasshouse at the Institut für Pflanzenpathologie und Pflanzenschutz of the University of Göttingen, was maintained for years on bush lima bean plant (*Phaseolus vulgaris* L.) in our laboratory.

*T. urticae* used in the present study were reared on bush lima bean plant at 25°C ± 1°C.

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and 50–60% R.H. under 16 h photoperiod in a growth chamber. *P. persimilis* (hereafter referred to as *PM*) was maintained on plants infested with *T. urticae* (hereafter referred to as *TM*) under the same conditions.

A glass-cylinder (diameter 2 cm, height 2 cm) with a plastic cover with a hole, was placed in a petri-dish (9 cm in diameter) filled with water. An excised leaf disk (4 cm in diameter) with stem from a bush lima bean plant was inserted into the glass-cylinder (Fig. 1). In this arena, the *PM* female could readily emigrate from the leaf disk.

In order to investigate the searching behaviour of *PM*, 0, 1, 5, 10 or 20 *TM* females were placed on a leaf disk and one day later, all the females and the eggs laid during the day were cautiously removed with a fine brush. Thereby, five different web densities were obtained on the leaf disk. The positive correlation between the web density and the number of infesting females was enough to study the influence of web density. Next, different numbers of eggs of *TM*, 0, 20, 40 and 80, were placed with a fine brush on each leaf disk with a different web density. A *PM* female, 4–8 days old, was introduced on each leaf disk. Every hour up to 8 h and then after 24, 30 and 48 h, the *PM* females still remaining on the leaf disks were recorded. Each treatment was replicated 10 times.

For testing the functional and numerical response, a sufficient number of *TM* females was placed on the leaf disk and the following day, all the females and undesired eggs were removed. The densities of *TM* eggs thus obtained were 5, 10, 20, 30, 40, 50, 60, 70, 80, 90 and 100 per leaf disk. A *PM* female, 4–8 days old, was then introduced on the leaf disk. After 24 h, the number of prey eaten, the number of eggs laid by the *PM* and presence or absence of the *PM* on the leaf disk were recorded. Each treatment was replicated 10 times.

The mutual interaction between individuals of the *PM* was examined as follows. On each leaf disk, 20, 40 and 80 females of *TM* were placed depending on the prey density desired. One day later, all the females and undesired eggs were removed. The prey densities thus obtained were 100, 200 and 400 per leaf disk. The densities of the *PM* females tested in this study were 1, 2, 4, 8 and 16 per leaf disk. After 24 h, the number of prey eaten, the emigration rate of *PM* females and the number of eggs laid by the females were counted. Each treatment was replicated 5 times except the treatments of the predator-prey ratio of 8: 200 and 16 : 400 which were repeated three times.