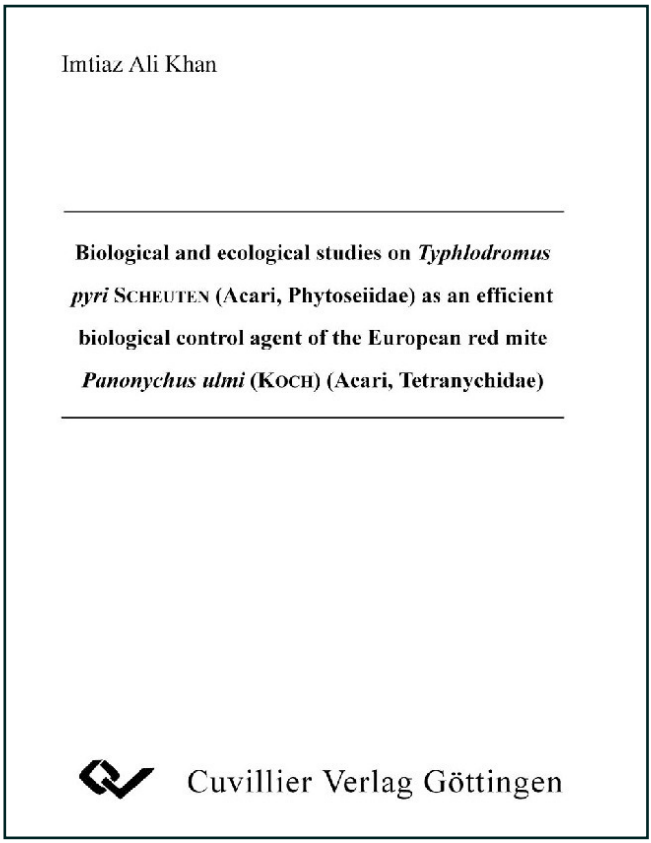
# Biological and ecological studies on Typhlodromus pyri SCHEUTEN (Acari, Phytoseiidae) as an efficient biological control agent of the European red mite Panonychus ulmi (KOCH) (Acari, Tetraychidae)



# 1 INTRODUCTION

The European red mite, *Panonychus ulmi* (KOCH) (Acari, Tetranychidae), is a polyphagous pest of many trees and shrubs worldwide. In Central and Western Europe, it is a major pest especially in apple orchards (ZACHARDA 1989, FITZGERALD and SOLOMON 1991, WALDNER et al. 1991, ROY 1993, SCHAUSBERGER 1998, NAUEN et al. 2001) and vineyards (ENGEL and OHNESORGE 1994, CAMPORESE and DUSO 1996, PAPAIOANNOU et al. 1999, KREITER et al. 2002). *P. ulmi* damages apple by withdrawing juices from leaves and so affects leaf colour and chlorophyll content. High population levels results in substantial reduction in fruit quality as well as quantity and return harvest of apple (PALEVSKY et al. 1996).

Pesticides had been mainly used to control *P. ulmi.* But, in late 80´s the pest showed resistance against the most commonly used acaricides and insecticides (PREE 1987, WELTY et al. 1988). Pesticide application has also resulted in suppression or killing of natural enemies of the pest mite. *P. ulmi* has thus become more serious pest because of the increased pesticide tolerance and destruction of natural enemies (CROSS and BERRIE 1994, GYOERFFYNE and POLGAR 1994). Chemical control of the pest mite species is, therefore, inconsistent and expensive (ROY 1993). Although factors other than destruction of natural enemies have been implicated in inducing *P. ulmi* outbreaks (KARG 1989). Arthropod predators have a key role in regulating *P. ulmi* populations (GENINI and BAILLOD 1987).

*Typhlodromus pyri* SCHEUTEN (Acari, Phytoseiidae) has been known in many European countries as a successful major predator of *P. ulmi* in apple culture (SOLOMON et al. 1993a, SCHAUSBERGER 1998) and vineyards (ENGEL and OHNESORGE 1994, CAMPORESE and DUSO 1996, PAPAIOANNOU et al. 1999). Effectiveness of *T. pyri* as a common predator of the two spotted spider mite *Tetranychus urticae* KOCH (Acari, Tetranychidae) and apple rust mite, *Aculus schlechtendali* NALEPA (Acari, Eriophyidae), has also been documented (DICKE and DEJONG 1988, DICKE et al. 1988, KHAN et al. 2003).

Climatic conditions, mainly temperature and relative humidity, play key roles in the development as well as population dynamics of *P. ulmi* (KARG 1989, KHAN and SENGONCA 2002) and development, reproduction as well as prey consumption by *T. pyri* (SENGONCA and SEIER 1989, SCHAUSBERGER 1998, KHAN and SENGONCA 2001, SENGONCA et al. 2003a).

Knowledge on these parameters in the life cycle of the pest and predatory mite was sufficient below 25°C temperature. However, sufficient knowledge of these important parameters in the life cycle of the predatory mite was still lacking in the literature at higher temperature conditions.

*P. ulmi* and *T. pyri* have continuously been exposed to a variety of pesticides each year in the apple orchards in the North Rhine area. Therefore, it was necessary to find out toxicity of some of the commonly used pesticides against different stages of *P. ulmi* as well as *T. pyri* and resistance levels developed by the two mite species against these pesticides.

The success of a biological control program of a natural enemy depends among other things on adequate information on its seasonal population dynamics, distribution in the trees and on leaves and fecundity on host plant. Such information was available for *T. pyri* in many apple-producing regions of Europe, e.g., in England (FITZGERALD and SOLOMON 1991), Austria (SCHAUSBERGER 1998). But, was lacking for another region, e.g., region Meckenheim in Germany.

The present work aimed, therefore, to study in the laboratory biology and prey consumption by *T. pyri* during development as well as longevity by feeding with *P. ulmi* nymphs as prey at different high temperatures. Prey preference and consumption by *T. pyri* on apple pest mite species was also studied. Investigations were made on production of scars by *T. pyri* adults on apple leaves and fruits under different food regimes. Toxicity of some pesticides against *T. pyri* and resistance developed by the predatory mite against these pesticides was evaluated. Prey preference and consumption by *Chrysoperla carnea* (STEPHENS) (Neur., Chrysopidae) on apple pest mite species was determined. Further experiments were devoted to study biology of *P. ulmi* at the different high temperatures. Efforts were made to find effectiveness of some pesticides against *P. ulmi* and resistance developed by the pest mite against these pesticides. Moreover, field experiments were conducted on *T. pyri* in an apple orchard in the region Meckenheim to study its seasonal population dynamics, within tree- as well as on leaf distribution during vegetation period; within-tree distribution as well as density per twig during winter; fecundity during different generations and mortality during autumn on apple fallen leaves. All these experiments have the goal of comprehensively studying the potential of this promising *T. pyri* at different high temperature conditions and hopefully to complete its successful release against *P. ulmi* in apple orchards.

# 2 MATERIAL AND METHODS

## 2.1 Laboratory experiments

### 2.1.1 Rearing of the test insects

#### 2.1.1.1 Rearing of *Panonychus ulmi*

##### 2.1.1.1.1 Stock culture

Two stock cultures of *P. ulmi* were established on apple leaves (Fig. 1), variety Red Delicious, from few individuals collected from apple orchards region Meckenheim. The leaves were placed upside down on wet cotton in plastic trays (29x36.5 cm). The petioles of the leaves were inserted in wet cotton to keep them fresh longer. The leaves were replaced with fresh ones every two weeks or when showed signs of deterioration. The two cultures were kept separately in climatic chambers at the Institute of Phytopathology, University of Bonn at 25±2°C as well as 30±2°C temperatures, 70±5% RH and a 16:8h (L:D) photoperiod with a light intensity of 4000 lux. The apple plants were grown in small pots in the Glasshouse. Fresh leaves from the plants were excised to maintain the stock cultures as well as use as arena of observation in different experiments on *P. ulmi*.

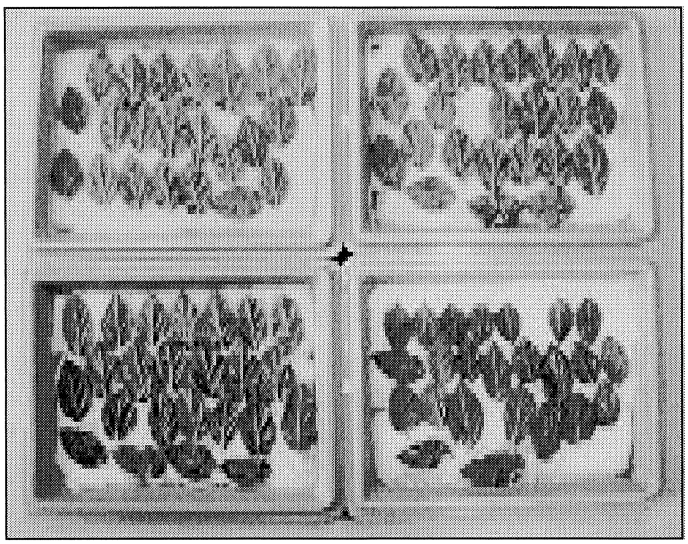


Fig. 1: A stock culture of *Panonychus ulmi* maintained on freshly excised apple leaves in plastic trays at high temperature conditions in a climatic chamber