

Thèse EPFZ No 8385

**ECOSYSTEME VERGER DE POMMIER:
POSSIBILITES D'IMPLANTATION DES PHYTOSEIIDES ET
MODELISATION DU SYSTEME "VERGER-*PANONYCHUS ULMI*
(KOCH)-*TYPHLODROMUS PYRI* (SCHEUTEN)"**

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**Contribution to the analysis of the ecosystem 'apple orchard':
Possibilities for introducing phytoseiids and
modelling the system 'orchard - *Panonychus ulmi* (KOCH) -
Typhlodromus pyri (SCHEUTEN)'
(abstract)**

First a faunistic survey was carried out in Swiss apple orchards and the phytoseiid complex was defined in relation to four pest management programs influencing the various species. These programs are partially responsible for the reduced diversity observed for prey species in intensively managed systems. Certain species appear related to each other (e.g. *Galenodromus longipilus* and *Kampimodromus aberrans*) or are associated with prey species (*Amblyseius finlandicus* with *Aculus schlechtendali*), while other species such as *T. pyri* don't appear to have any particular relationship to other orchard inhabiting mite species. Competition between predatory mite species is high, particularly between *A. finlandicus* et *T. pyri* under a selective spraying program. The survey enabled furthermore to carry out quantitative studies leading to a two stage sampling plan for *T. pyri*.

In the second chapter the developmental biology for *Amblyseius andersoni*, *Amblyseius fallacis*, *G. longipilus* and *T. pyri* was studied in the laboratory to compute developmental thresholds (10.6, 11.4, 10.3, and 9.8°C respectively), and intrinsic rates of increase (0.151, 0.189, 0.211, and 0.103 respectively) when reared on *Tetranychus urticae*. The age specific fecundity was also studied for the four species fed either *T. urticae* or *P. ulmi*. The latter species proved to be a better food source for *A. andersoni* and *T. pyri*, while the opposite was true for the other two predator species. *P. ulmi* was clearly a suboptimal prey species for *G. longipilus*. The females of all four predatory species were able to adjust daily fecundity rates and total fecundity to the amount of prey available. This enabled to keep a constant potential fecundity even under conditions of limited food. Hibernating females have biological characteristics similar to summer generations. For all four species elements of the functional response were estimated.

In the third chapter a small scale field release experiment with *T. pyri* is described and within-plant movements are followed. The efficacy of this species was demonstrated based on releases in an orchard that had also a predator free control plot. At the end of the second year, *T. pyri* had almost eradicated *P. ulmi* in the release plot. A high number of predators were collected there for releases in other orchards without jeopardizing the success of biological control in the orchard under study. The releases were carried out with shelter traps. This method proved to be very

satisfactory for distributing phytoseiids without requiring mass production. In addition the shelter traps enabled to estimate the number of overwintering females.

In the last chapter a population model for *T. pyri* is constructed and combined with existing models on apple tree growth and *P. ulmi* population dynamics. This tritrophic system model was validated with field data from three growing seasons. The model was appropriate to describe the dynamics of *T. pyri* and *P. ulmi* in spring, while it was satisfactory for two years out of three during the summer. The model identified gaps in the actual knowledge on *T. pyri*, particularly with respect to cannibalism and the importance of alternative food supply. Furthermore the model enabled to formulate hypotheses on the influence of those factors on the mite population dynamics in apple orchards.