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BIOLOGICAL CONTROL OF THE STRAWBERRY MITE BY USING PREDATORY MITES

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In Finland, the first study of biological control of the strawberry mite *Phytonemus pallidus* by *Neoseiulus (Amblyseius) cucumeris* was conducted in 1986. The result was positive but the method was considered too expensive compared to efficient chemical control by endosulfan. Biological control became actual in the middle of 1990's when harmful effects of endosulfan caused restrictions in the use of endosulfan, and problems in strawberry production became obvious. As the price of predatory mites had lowered and organic production increased the chances to extend biocontrol also in open door fields became actual.

Since the middle of 1990's several biocontrol experiments have been conducted in MTT, and already in the very beginning we started in open door fields in farm conditions to get soon practical results. We have found several native phytoseiid species on strawberry in Finland: *Phytoseius macropilis*, *Paraseiulus soleiger*, *P. talbii*, *P. triporus*, *Anthoseius bakeri*, *A. rhenanus*, *Phytoseiulus persimilis* (only introduced), *Proprioseiopsis okanagensis*, *Euseius finlandicus*, *Neoseiulus (Amblyseius) cucumeris* (only introduced), *Amblyseius reductus*, *A. tenuis* and *A. zwölferi*. The most promising native species as natural enemies of the strawberry mite are *A. rhenanus* and *A. reductus*. Studies on the use of *A. rhenanus* reared in laboratory have been conducted in small scale experiments.

In 1996 we tested the effect of introduced *N. cucumeris*, *P. persimilis* and *Amblyseius californicus* on mites in strawberry. Only *N. cucumeris* was effective against *P. pallidus*, and it also spread into plots where other predators were released. In 1998, large scale experiments were conducted at 65 conventional or organic fields. *N. cucumeris* was released in various conditions, ca. 10 specimens/plant. The results were good or satisfactory in 75 % of the fields, and best results were obtained in organic or 'non chemical' fields. The use of insecticides just before flowering was considered as the most critical factor, as it either delayed introduction or increased mortality of predators. In 2000, we compared profitableness of biological control with chemical control or no treatment at all. The costs of biocontrol by *N. cucumeris* and chemical control were almost equal, and compared to untreated plots the yield was 28 % higher meaning the return of 2300 euro/ha.

Effect of fungicides, acaricides and insecticides used on strawberry has been tested in laboratory to *E. finlandicus*, *A. rhenanus* and *N. cucumeris*. Most of the fungicides are not harmful, whereas all insecticides are harmful. The recommended waiting times after insecticide sprays vary from 5 days (pyrethrin) to 5 weeks (pyrethroids). Studies of the effect of mulching materials on biocontrol by *N. cucumeris*, *A. rhenanus* and *E. finlandicus* showed that early and repeated introductions resulted in good control in all mulches whereas later introduction of *N. cucumeris* was less effective in black plastic and straw mulches.

As a conclusion, strawberry mite control by *N. cucumeris* has proven economically feasible. To achieve a better integration of biocontrol with growing techniques and outdoor conditions development of alternative approaches by native phytoseiid species are required.