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Population dynamics of the thrips predators *Amblyseius mckenziei* and *Amblyseius cucumeris* (Acarina: Phytoseiidae) on sweet pepper

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Abstract

On greenhouse-grown sweet peppers (*Capsicum annuum*), the thrips predator *Amblyseius cucumeris* established easier and reached higher population densities than the related species *A. mckenziei* (*A. barkeri*). Mixed populations of both predators were observed during several generations, but eventually *A. mckenziei* was superseded. *A. cucumeris* is considered the better predator for thrips control on this crop.

Introduction

Amblyseius spp. are found associated with thrips in greenhouses (Woets, 1973) and are studied as potential control agents (Ramakers, 1978). *A. cucumeris* (Oud.) has been described under the name *Typhlodromus thripsi* MacGill (Evans, 1952), recognized as a predator of *Thrips tabaci* Lind by MacGill. *A. mckenziei* Sch. & Pr., which some taxonomists consider synonymous to the earlier described *A. barkeri* (Hughes), was not known to be a thrips predator previously.

Amblyseius spp. have been introduced artificially in experimental plots since 1977 and in commercial greenhouses since 1980 (Ramakers & van Lieburg, 1982). Today these predators are mass-reared for commercial use in the Netherlands (de Klerk & Ramakers, 1986), Denmark (Hansen, 1988), Canada (Steiner & Elliott, 1987) and England.

This paper deals with the performance of mixed as well as separate populations of both predators on greenhouse-grown sweet pepper. The experiments were part of a wider study to determine the suitability of the different species for thrips control in protected crops.

Materials and methods

Five experiments with artificial introductions of thrips predators were carried out between 1980 en 1983. For Experiments 1-4 a heated glasshouse of about 70 m^2 was used. About 190 sweet pepper plants (*Capsicum annuum* L. cv. Tisana), arranged in six rows, were grown in the natural soil, which was steam-desinfected before, and were trimmed so that two main stems per plant were retained. The date of planting varied between February 13 and April 10, and the growing period between 8 and 11 months. The setpoint for heating was 18 °C and for ventilation 25 °C. From mid-September onwards an artifical photoperiod of 14 hours was created (to prevent diapause of the aphid predators used) in Experiments 1, 2 and 4. Exp. 5, with two separate predator populations and a control plot, was carried out in three smaller glasshouses with 40 plants each under similar conditions.

No synthetic fungicides were used, and the application of insecticides was reduced to a minimum. The phytoseiid predator *Phytoseiulus persimilis* A.-H. was introduced against spider mites, and aphids were controlled with the braconid parasite *Aphidius matricariae* Hal., the cecidomyiid predator *Aphidoletes aphidimyza* Rond., and occasionally by fumigating pirimicarb. Noctuid larvae were controlled with *Bacillus thuringiensis* Berliner or removed by hand. Only in Exp. 2, sulphur powder was dusted to control tarsonemid mites.

Thrips populations, predominantly *T. tabaci*, developed spontaneously. Thrips predators were mass-reared and introduced as described by Ramakers & van Lieburg (1982). In Exp. 1 (1980), *A. mckenziei* was introduced on 2 May and *A. cucumeris* on 7 July; all plants were treated both times. In Exp. 2 (1981), both species were introduced during the first days of May at a rate of 15 predators per plant, but in different parts of the glasshouse (see Fig. 1). In Exp. 3 (1982), each plant was treated on 3 June with about 100 predators, using both predator species alternately (see Fig. 1). In Exp. 4 (1983), *A. cucumeris* was introduced on 27 June after spontaneous occurrence of *A. mckenziei*, observed since 19 May. Competition between predator species was excluded in Exp. 5 (1980) by introducing equal numbers of the species in separate glasshouses. Both species were introduced during the first days of May. Since *A. mckenziei* was hardly detectable during the first months, an additional introduction of only *A. mckenziei* was done in mid-July.

Predators were observed on leaf and/or fruit samples during fortnightly countings of arthropods with a stereomicroscope at magnification 10. A leaf was inspected at the underside only, with special attention to the hairs around the vein pits, on which these predators prefer to oviposit. The fruit calyx was removed to inspect its underside and the corresponding part of the fruit skin. To some extent, species can be identified at this low magnification by colour, since *A. mckenziei* becomes dark red if well-fed. For quantitative evaluation, however, this method is not reliable, since only adults and not all individuals of *A. mckenziei* are coloured, adults are difficult to tell apart from deutonymphs in both species and contamination with other species would be overlooked easily. Therefore, the composition of the predator complex at the end of the season (in Exp. 4 also during the season) was confirmed by mounting specimens on microscope slides. For this purpose, preda-

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Experiment 2

M M M M M M M M M M M M M M ...

M o o o o M o o o o M o o o ...
o o o o o o o o o o o o o o ...

o o o o o o o o o o o o o o ...
C o o o o C o o o o C o o o ...

C C C C C C C C C C C C C C ...

Experiment 3

M C M C M C ...

C M C M C M ...
C M C M C M ...

M C M C M C ...
M C M C M C ...

C M C M C M ...
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Fig. 1. Predator introduction schemes in Experiments 2 and 3. M = plant with *Amblyseius mckenziei*; C = plant with *Amblyseius cucumeris*; o = plant without predators.

tors were collected directly from leaves or fruits, or (in Experiments 3 and 4) by hanging leaves vertically in a Berlese funnel.

With help of the stereomicroscope, *Amblyseius* specimens were separated from other predatory mites (*P. persimilis, Lasioseius sp.*). They were macerated in hot KOH, cleared in hot chloralphenol and mounted in Faure's fluid. Results as shown in Table 1 are based on examination of adults only.

Results

In Exp. 1, *A. mckenziei* was well established before *A. cucumeris* was introduced. Both species were found on all plants, often on the same fruit, during July and August. In September, *A. cucumeris* became dominant, and *A. mckenziei* was not found anymore in October. Since the beginning of September, another predator was observed, identified as 'similar to *A. potentillae* (Garman)'. It became the most abundant species on leaves, possibly preying on spider mites; on the fruits, *A. cucumeris* maintained its dominant position (Table 1).

In Exp. 2, both predators established and colonized the untreated plants (Fig. 1) in May and June. Dominance of *A. cucumeris* became apparent in August; at the end of the season, *A. mckenziei* was rare on the *A. mckenziei*-plot and not found on the *A. cucumeris*-plot. Figures in Table 1 refer to samples taken from both plots equally.

Table 1. Microscopic identification of predatory mites. D = number of predators, incl. eggs, present per leaf c.q. fruit; n = number of adult predators identified; M = *Amblyseius mckenziei*; C = *Amblyseius cucumeris*; P = *Amblyseius potentillae*.

Exp.	Predator introduction	Sampling period	Plant parts	D	n	Composition of predator complex (%)			
						M	C	P	other
1	M 2 May	26 Nov.-	leaves	1.5	61	0	20	80	0
	C 7 July	21 Jan.	fruits	0.4	69	0	93	7	0
2	M+C 4 May	1 Oct.-	leaves		79	3	97	0	0
		5 Nov.	fruits	1.0	74	3	97	0	0
3	M+C 3 June	10 Sep.-	leaves	1.8	145	0	96	0	4
		15 Nov.	fruits	0.5	15	0	100	0	0
4	C 27 June	30 June-	leaves	1.1	78	23	77	0	0
		1 July	fruits	1.9					
		25 July	leaves	1.5	74	18	82	0	0
		28 Nov.-	leaves		177	0	57	43	0
		1 Dec.	fruits	1.2	62	0	81	19	0

Table 2. Dynamics of separate populations of *Amblyseius mckenziei* and *A. cucumeris* (Experiment 5). Average number of predators (including eggs) per leaf or per fruit. + = predator(s) present in sample of 30 fruits c.q. 50 leaves.

Date of sampling	Control		*Amblyseius mckenziei* (introduction 2 May, 15 July)		*Amblyseius cucumeris* (introduction 1 May)	
	leaf	fruit	leaf	fruit	leaf	fruit
19 May	0	0	0	0	0	+
28	0	0	0	+	0	0.1
4 Jun.	0		0		0	
12	0	0	0	0	+	0.1
18	0	0	0	0	+	0.7
24	0	0	0	0	0.6	0.4
3 Jul.	0	0	0	+	0.2	0.3
10	0	0	0	0	0.2	1.0
16	0	0	0	0	0.5	1.4
24	0	0	+	0.2	0.3	1.0
31	0	0	+	0.2	0.3	1.4
7 Aug.	0	0	0.1	0.3	0.5	1.8
13	0	0	+	0.1	0.5	2.4
20	0	0	+	0.7	0.2	3.8
27	0	0	0	0.5	0.1	4.9
3 Sep.	0	0	0	0.2	0.3	4.0
10	0	0	0	0.2	0.6	4.5
17	0	0	0	0.5	0.3	1.5
26	0	0	0.2	0.5	0.7	3.4
4 Oct.	0	0.1	0.3	1.1	0.9	1.4
16	0.1	0.1	0.3	0.5	0.4	2.3

The thrips population was reduced to a very low level in Exp. 3, after which the populations of both predators decreased as well. When a slight revival of the thrips occurred in late autumn, only *A. cucumeris* was left to deal with it (Table 1).

The final situation in Exp. 4 was similar to Exp. 1, with mixed populations of *A. cucumeris* and *A. potentillae*, whereas *A. mckenziei* was virtually absent (Table 1).

In Exp. 5, separate populations of both predator species survived until the end of the season, though *A. cucumeris* became more abundant than *A. mckenziei* even after a second introduction of the latter (Table 2).

Conclusions and discussion

On sweet peppers grown in greenhouses, *A. cucumeris* tended to establish easier and reach higher densities than *A. mckenziei* (Experiments 1-4), even when an advantage was given to *A. mckenziei* (Experiments 1 and 4). The near absence of *A. mckenziei* in late season, observed in Experiments 1-4, might be caused by the presence of a competing predator, as is suggested by a comparison with the *A. mckenziei-plot* in Exp. 5. However, even as a separate population, *A. cucumeris* was far more abundant throughout the season (Exp. 5). It is therefore expected that *A. cucumeris* is the more suitable predator for thrips control, which should be confirmed by further trials.

The results seem to be contradicted by the observation, that in commercial sweet pepper holdings *A. mckenziei* is quite common, especially in late season, whereas *A. cucumeris* seldom occurs spontaneously. It should be noticed that in the experiments described, chemical pesticides were hardly used. For a number of current insecticides tested, *A. mckenziei* was found to be more tolerant than *A. cucumeris*, which might explain the dominance of the former in commercial crops.

As several other phytoseiids (McMurtry et al., 1970), *A. cucumeris* is known to be a pollen feeder. Immediate host plant effects might thus be involved, so the conclusion is not necessarily valid for other crops.

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