Bionomics of *Acarus siro* L. (Acarina: Acaridae) on Oilseeds

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Abstract

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The bionomics of *Acarus siro* was studied at 18 and 20°C and 70 and 80% R.H. on wheat germs, linseed, rapeseed and sunflowers to obtain data for optimisation of biological control of stored product mites on oilseeds. Wheat germs were used as a control substrate as they were considered optimal for development of *A. siro*. The development of eggs and larvae was longer than that of protonymphs and tritonymphs. Wheat germs appeared to be a better substrate for the development of mites than oilseeds. Generally, the life span of females as well as the oviposition period was shortest on wheat germs while longest on sunflower; also, at the higher temperature the female life span was shorter. The maximum number of eggs laid by a single female (356) was recorded on wheat germs at 20°C and 80% R.H. The development was significantly shorter at 20°C than at 18°C regardless of humidity. There were no significant differences between the effects of the tested oilseeds.

Keywords: *Acarus siro*; bionomics; oilseeds

Acarus siro L. is one of the most common mites on stored oilseeds, can cause substantial damage, and it is thus often necessary to control it. Chemical control is still widely used in spite of being the most expensive and dangerous for people who perform it. That may be because the customer sees the immediate effect – the dead pests. However, the mites are much less sensitive to pesticides than insects. Pest control operators sometimes solve this problem by increasing the doses of conventional pesticides. Mite populations respond by increased resistance. Such an unwanted effect may result in such a high level of pesticide residues in stored oilseeds that sometimes these can hardly be used for production of oil for human consumption. To overcome this problem, a rational approach to the control of mites on oilseeds is necessary. Limited applications of chemicals should be supplemented by means of biological control. The efficacy of biological control will increase if we improve its technology.

Biological control of *A. siro* in stored grain and seeds by means of the predatory mite *Cheyletus eruditus* had been developed (Pulpán & Verner 1965; Žďárková & Horák 1990), and has since been routinely applied in stores in the Czech Republic. However, it has proved that it might not be always successful on oilseeds. In order to improve the efficacy of the technology of biological control on oilseeds we set up life tables of *A. siro* on different food substrates.

MATERIAL AND METHODS

The experiments were carried out on linseed, rapeseed and sunflower seed at temperatures of 18 and 20°C, and 70 and 80% R.H. Wheat germs served as control substrate. The temperatures were chosen to simulate conditions of stored seed, and with regard to the predator *Cheyletus eruditus* which is rather thermophilous and the difference in length of its development at 18 and 20°C is about 5–10 days. The strain of *A. siro* originated from laboratory culture, maintained on wheat germ at 20°C and 85% R.H. for more than 10 years. Small round breeding cells (10 mm in diam., 2 mm deep) drilled into plexiglass blocks (5 × 20 × 50 mm) were used. The bottom of the cells was lined with filter paper sealed with paraffin. Glass covers were clamped onto the chambers with clips. Half a seed or a smaller part of it containing germ and endosperm were put on the bottom together with two tritonymphs. If they appeared to be a pair after moulting, they were left there, otherwise pairs from other freshly ecdysed males and females were formed. The

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length of development, fecundity, number of eggs laid, length of adult life span were determined and the results were treated statistically by *t*-test.

RESULTS AND DISCUSSION

The development of *A. siro* on the three oilseeds and wheat germs was compared. We consider wheat germs to be one of the best foods for *A. siro* (Table 1).

There was little difference in length of development between mites kept on different oilseeds. Generally, at 20°C it was shorter than at 18°C at 70 and 80% R.H. and lasted on average 17 and 25 d, respectively. The development of the egg and larva were 5 and 7 d, respectively. The fecundity, number of eggs laid per female per day and the length of adult life span are presented in Table 2. However, when the development of mites reared on oilseeds were compared with those reared on wheat germs significant differences were recorded. The life span of a female and its oviposition period were shortest on wheat germs, lasting from 23 to 33 and 24 to 29 d at 18 and 20°C, respectively. The longest life span was recorded on sunflower seeds where it lasted from 37 to 46 and 33 to 42 d, respectively. The number of eggs per female on wheat germs was lowest at 18°C and 70% R.H. (100 eggs), and highest at 20°C and 80% R.H. (356 eggs). On oilseeds, the number of eggs laid by one female was lowest on linseed (102 eggs) and highest on rapeseed (247 eggs) under the same conditions. The number of eggs laid per day was highest on wheat germs at 20°C and 80% R.H. (13.4 eggs) and on rapeseed at 20°C and 70%R.H. (8.6 eggs). Generally, the higher the temperature and humidity the higher the number of eggs that were laid per day. The statistical analysis confirms that temperature influences the development of *A. siro* more than the relative humidity, and that the differences in the quality of oilseeds tested as a rearing substrate were not significant (*t*-test, at $P < 0.05$).

CUNNINGTON (1965, 1976, 1985) studied the physical limits of development in the grain mite *A. siro* reared on wheat germs and the effects of physical conditions (temperature and relative humidity) on its length of life span, oviposition and fecundity. He came to the conclusions that duration of adult life and duration of oviposition period are inversely proportional to temperature and are prolonged at low temperatures. Our results corroborate his conclusions.

The development of the predator *Cheyletus eruditus* lasts 41 and 35 d at 18 and 20°C and 75% R.H., respectively (ŽĎÁRKOVÁ, unpublished observations), i.e. almost twice as long as the development of *A. siro* reared under the same or similar conditions. While the female of *A. siro*

Table 1. Length of juvenile stages of *Acarus siro* (in days) on different substrates

Substrate	Stage	*n*	18°C 70%	20°C 70%	18°C 80%	20°C 80%
Wheat germs	Egg	10	6.1 ± 0.4	5.1 ± 0.4	6.6 ± 0.5	5.7 ± 0.4
	Larva	10	4.7 ± 0.7	4.6 ± 0.8	4.4 ± 0.5	3.4 ± 0.5
	Protonymph	10	3.4 ± 0.5	3.7 ± 0.9	3 ± 0	2.7 ± 0.4
	Tritonymph	10	3.7 ± 0.4	3.8 ± 0.3	3.4 ± 0.6	2.7 ± 0.4
Total days			17.9 ± 1.1	17.2 ± 1.2	17.4 ± 0.9	14.5 ± 0.4
Linseed	Egg	10	6.8 ± 1.0	4.2 ± 0.3	5.7 ± 0.8	4.8 ± 0.7
	Larva	10	6.8 ± 1.3	4 ± 0.4	7.7 ± 1.2	3.5 ± 0.5
	Protonymph	10	5.2 ±.2.0	3.4 ± 0.5	5.8 ± 1.5	3.4 ± 1.1
	Tritonymph	10	5.8 ±1.2	4 ± 0.4	6 ± 1.3	4.3 ± 1.1
Total days			24.6 ± 3.7	15.6 ± 1.1	25.2 ± 2.4	16 ± 2.6
Rapeseed	Egg	10	7.4 ± 1.4	6 ± 0.3	7 ± 0.5	5.4 ± 0.5
	Larva	10	7.7 ± 1.8	4.7 ± 0.6	7.7 ± 0.9	5.2 ± 1.4
	Protonymph	10	4.3 ± 0.8	3.3 ± 0.4	5.2 ± 0.6	3.2 ± 0.4
	Tritonymph	10	5.2 ± 0.7	4.6 ± 0.9	5 ± 1.5	3.7 ± 0.6
Total days			24.6 ± 2.3	18.6 ± 1.3	24.9 ± 2.2	17.5 ± 1.9
Sunflower	Egg	10	7 ± 0.4	5 ± 0.3	7.4 ± 0.5	5.3 ± 0.6
	Larva	10	8 ± 1.2	6.7 ± 0.9	7.2 ± 1	4.9 ± 0.5
	Protonymph	10	5.2 ± 0.3	4.2 ± 0.9	4.6 ± 0.6	3.7 ± 0.4
	Tritonymph	10	5.8 ± 1.0	5.5 ± 0.8	4.4 ± 0.7	3.6 ± 0.6
Total days			26 ± 1.6	21.4 ± 2.1	23.6 ± 1.1	17.5 ± 1.2

Table 2. Bionomic parameters of *Acarus siro* on different substrates

Substrate	Parameters	*n*	18°C 70%	*n*	20°C 70%	*n*	18°C 80%	*n*	20°C 80%
Wheat germs	female life span (days)	8	23.1 ± 1.2	7	24.1 ± 11	7	33.3 ± 12.3		29.4 ± 5.7
Linseed		17	31.9 ± 12.2	15	36.6 ± 12.0	18	31.2 ± 11.118		33.4 ± 8.7
Rapeseed		9	35.6 ± 15.4	10	22.9 ± 9.7	10	29.5 ± 12.710		35.9 ± 5.7
Sunflower		10	46.1 ± 12.9	10	42.2 ± 12.0	10	37.2 ± 10.410		33.9 ± 5.1
Wheat germs	oviposition (days)	8	22.0 ± 11.0	7	20.4 ± 10.2	7	22.0 ± 9.710		26.3 ± 4.9
Linseed		17	29.4 ± 12.3	15	32.5 ± 10.4	18	27.9 ± 11.418		28.9 ± 9.0
Rapeseed		9	33.3 ± 13.4	10	21.9 ± 10.1	10	27.1 ± 10.510		32.7 ± 7.7
Sunflower		10	41.2 ± 12.6	10	38.4 ± 12.4	10	33.3 ± 10.610		27.5 ± 4.3
Wheat germs	number of eggs/female life	8	100.5 ± 42.1	7	140.6 ± 88.9	7	233.9 ± 136.7	10	356.8 ± 103.4
Linseed		17	102.5 ± 53.7	15	159.5 ± 66.3	18	152.8 ± 72.018		148.7 ± 61.2
Rapeseed		9	177.8 ± 87.7	10	114.7 ± 41.2	10	188.1± 56.110		247.1 ± 58.7
Sunflower		10	162.6 ± 50.8	10	178.5 ± 61.4	10	178 ± 43.010		185.7 ± 41.4
Wheat germs	number of eggs/day	8	4.8 ± 0.8	7	6.8 ± 2.0	7	10 ± 2.2	10	13.4 ± 2.2
Linseed		17	3.5 ± 1.0	15	4.7 ± 1.4	18	5.4 ± 1.2	18	5.1 ± 1.2
Rapeseed		9	5.1 ± 0.8	10	8.6 ± 0.9	10	7.4 ± 1.3	10	7.6 ± 1.4
Sunflower		10	4.1 ± 0.6	10	4.7 ± 0.6	10	5.7 ± 1.0	10	6.8 ± 1.2

lays 100 to 250 eggs on oilseeds during her lifetime, the female of *C. eruditus* produces only 70–90 viable eggs (Boczek 1959). It could be erroneously concluded that *C. eruditus* does not have a chance to control *A. siro* on oilseeds. However, our small scale trials showed that *C. eruditus* can control acaroid mites even on oilseeds, provided that the original infestation was not higher than 50 specimens per one kg of the oilseed substrate. In other words, the biological agent must be applied more or less preventively, at a time when the infestation of the acaroid mites is just beginning.

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Souhrn

Fejt r., Žďárková e. (2001): **Bionomie** *Acarus siro* L. (Acarina: Acaridae) **na olejninách**. Plant Protect. Sci., **37**: 111–114.

Byla studována bionomie druhu *Acarus siro* L. při teplotě 18 a 20 °C a při 70 a 80% relativní vlhkosti vzduchu na pšeničných klíčkách, semenech lnu, řepky a slunečnice, aby byla získána data pro optimalizaci biologického boje proti skladištním roztočům na olejninách. Pšeničné klíčky byly použity jako kontrola, neboť bylo potvrzeno, že jsou pro vývoj *A. siro* optimální. Stadium vajíčka a larvy trvalo více dní než stadium protonymfy a tritonymfy. Délka života samic i ovipoziční období byly nejkratší na klíčkách a nejdelší na slunečnici. Čím byla teplota vyšší, tím kratší byla délka života samic. Nejvíce vajíček nakladených jednou samici (356) bylo zaznamenáno na klíčkách při 20 °C a vlhkosti 80 %. Vývoj *A. siro* byl prokazatelně kratší při 20 °C než při 18 °C, bez ohledu na vlhkost. Mezi testovanými olejninami nebyly signifikantní rozdíly.

Klíčová slova: *Acarus siro;* bionomie; olejniny

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