Biological Control of Stored Food Mites on Oilseeds using the Mite Predator *Cheyletus eruditus* (Schrank)*

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Abstract

ŽĎÁRKOVÁ E., FEIT R. (1999): **Biological control of stored food mites on oilseeds using the mite predator** *Cheyletus eruditus* (Schrank). Pl. Protect. Sci., **35**: 136–138.

The suppressive biological control of mites on oilseeds can be successful under the circumstances of the ratio of prey and predators being 1 : 20 to 1 : 50 and the original infestation not being higher than 500 specimens per 1 kilogramme. Preventive biological control was carried out in empty oilseed stores after they were cleared. The predators which were released in the stores (2000 specimens being evenly distributed over an area of 100 m^2) were successful and suppress the population of acaroid mites.

Key words: biological control; acarid mites; *Cheyletus eruditus*; oilseeds

Stored product mites cause serious damage to human food and health as well as to animal feed. Chemical control is most efficient and widely used, but mites are much less sensitive to insecticides than insects. Pest control operators sometimes solve this problem by raising the doses of conventional insecticides. Mites respond by increasing their resistance. This unwanted response leads to a high residual level of pesticides in stored commodities. Oilseeds are very attractive for stored product mites which can multiply on them to many millions per kilogramme. This commodity is one in which chemical control is very often applied and the resulting level of pesticide residues is sometimes so high that it can hardly be used as a source of oil for human consumption. A rational approach to stored food mites control is therefore necessary. Limited applications of chemicals should be supplemented with biological means of control.

Biological control of mites was described and tested on stored grain for the first time in former Czechoslovakia (PULPÁN & VERNER 1965). A disadvantage of the method used was the scarcity of predators needed for control. A mass rearing method of the predator was therefore developed by (ŽĎÁRKOVÁ 1986). Predatory mites are now mass reared commercially and sold under the trade name CHEYLETIN. The predator used is *Cheyletus eruditus* (Prostigmata: Cheyletidae), which is commonly found in grain stores where it normally feeds on acarid mites such as *Acarus siro*, *Tyrophagus putrescentiae*, *Lepidoglyphus destructor*, *Glycyphagus domesticus*.

Biological control has certain specific features, which must be taken into consideration. It takes time, sometimes several months, to develop a method suitable for protection of grain destined for long term storage.

The main aim of this work was to prove that biological control of stored product mites feeding on oilseeds is possible. It is very likely that the ratio of the predator to prey, temperature, moisture content of the substrate, duration of the treatment and other circumstances, under which biological control can be carried out, will differ from similar parameters on stored grain, where biological control is commonly used.

MATERIALS AND METHODS

1. Experiments on suppressive biological control were carried out under laboratory conditions of 20°C and 75% R.H. on rapeseed, sunflower and linseed which correspond to 9.7, 10.1 and 9.4% moisture content of the seeds respectively. Plastic bags (30 × 50 cm) each containing 2 kg of oilseeds, were used. After the oilseeds had been conditioned for two weeks, 50 tritonymphs of *A. siro* were added to each bag. When the population had developed to around 500 specimens per one kilogramme, the predator was added at a ratio of 1 : 20 or 1 : 50. Samples of 100 g

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were taken once in 14–20 days and they were analysed by a heat extraction apparatus. The distance of the 25W lamp from the sieve was 25 cm and the time of exposure was 24 hours. The mites were counted individually and preserved in 70% alcohol. The population dynamics of both species were studied over the next 8 months. *A. siro* and *C. eruditus* originated from a culture which had been maintained in the laboratory for more than 10 years.

2. Experiments on preventive biological control were carried out in empty oilseed stores after they were cleared. The methods used for grain stores (ŽĎÁRKOVÁ & HORÁK 1990) were applied. Three per cent of the total area was divided into 1 metre squares and sampled later. The sample squares demarcated by chalk lines on the floor, were spaced far enough apart to cover representatively all types of the floor. These included uniformly cleaned areas, spots with residues of oilseeds, dust corners, etc. For sampling, the areas of the squares were vacuum cleaned. The vacuum samples were analysed by heat extraction apparatus (25W bulb, 25 cm above the sieve, exposure 24 hours). The weight of samples varied from 300 to 1600 g. After sampling, the predator *C. eruditus* was released in the stores, one bag (2000 specimens) being evenly distributed over an area of 100 m^2. After one or two months the sampling was repeated, but this time the samples were taken from squares adjacent to the original ones. They too were analysed by heat extraction. Six stores where the oilseeds had been held during the previous year and which were already empty (total area of 1,150 m^2) were investigated for the presence of mites. The mites were found in two of them (650 m^2). These two stores were then preventively treated with CHEYLETIN.

RESULTS AND DISCUSSION

1. The results are outlined in Fig. 1–3. Biological control of mites on rapeseed was successful. Two months after the introduction of *Cheyletus*, the population of *A. siro* started to decline in comparison with the control. There was no difference between the ratios of 1 : 20 and 1 : 50.

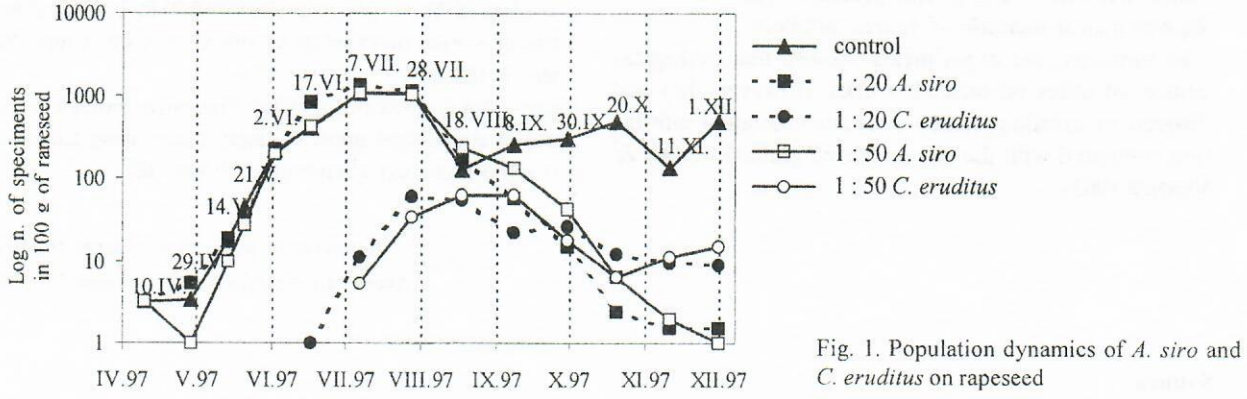

Fig. 1. Population dynamics of *A. siro* and *C. eruditus* on rapeseed

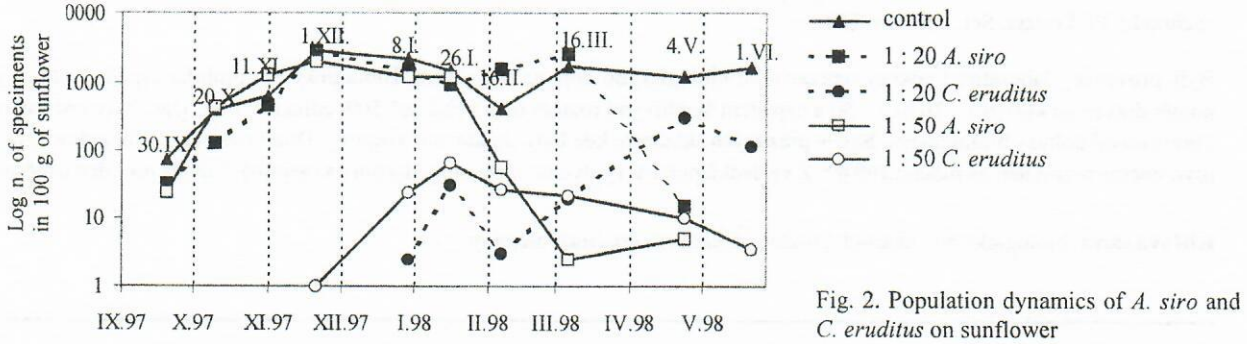

Fig. 2. Population dynamics of *A. siro* and *C. eruditus* on sunflower

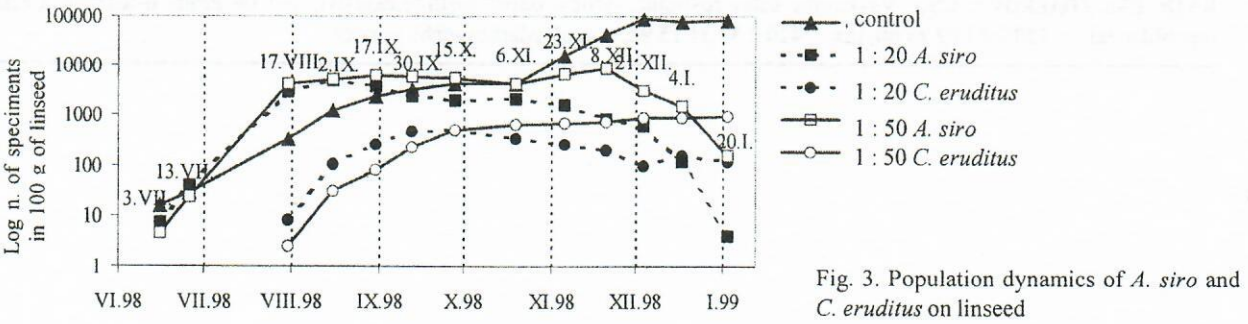

Fig. 3. Population dynamics of *A. siro* and *C. eruditus* on linseed

Biological control of mites on sunflower was also successful. Again two months after introduction of the predator, the population of *A. siro* started to decline. There was a difference in the rate of decline between the ratios of 1 : 20 and 1 : 50.

The population dynamics on linseed was similar to the one on rapeseed. Biological control was effective, the population of *A. siro* started to decline two months after introduction of *Cheyletus*. There was no difference between the ratios of 1 : 20 and 1 : 50.

In summary, the suppressive biological control of mites on oilseeds can be successful under the circumstances of the ratio of prey and predators being 1 : 20 to 1 : 50 and the original infestation not being higher than 500 specimens per 1 kilogramme.

2. The results are outlined in Fig. 4. After one month the population of *Acarus* started to decline, whereas the population of *Cheyletus* increased. Increase in the *Cheyletus* population was very slow, since the temperature in the store was below 20°C. However, the parts of the stores which were not treated with predators (control areas) showed a clear increase of *Acarus* numbers.

In summary, the experiments showed that biological control of mites on oilseeds works. However, they are differences in ratio predator : prey and in original infestation compared with the one on stored grain (PULPÁN & VERNER 1965).

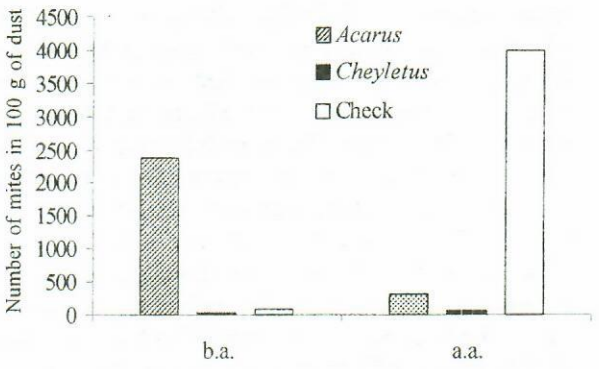

Fig. 4. The mites found before and after application of CHEYLETIN

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Souhrn

ŽĎÁRKOVÁ E., FEJT R. (1999): **Biologický boj proti roztočům na olejninách pomocí dravého roztoče** *Cheyletus eruditus* (Schrank). Pl. Protect. Sci., **35**: 136–138.

Byly provedeny laboratorní pokusy represivního biologického boje na olejninách. Biologický boj probíhá úspěšně, pokud je poměr dravce ku kořisti 1 : 20 až 1 : 50 a napadení škodlivými roztoči není vyšší než 500 jedinců v 1 kg. Dále byly provedeny i preventivní pokusy biologického boje v prázdných skladech, kde byly skladovány olejniny. Draví roztoči (2 000 jedinců) byli rovnoměrně rozptýleni na plochu 100 m^2. Z výsledků pokusů vyplynulo, že biologický boj na olejninách může probíhat úspěšně.

Klíčová slova: biologický boj; akaroidní roztoči; *Cheyletus eruditus*; olejniny

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Geographic Distribution of the Field Vole (*Microtus arvalis*) in the Czech Republic

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Abstract

ZAPLETAL M., OBDRŽÁLKOVÁ D., PIKULA J., PIKULA J. JR., BEKLOVÁ M. (1999): **Geographic distribution of the field vole (*Microtus arvalis*) in the Czech Republic.** Pl. Protect. Sci., **35**: 139–146.

The ecological distribution and requirements of the field vole (*Microtus arvalis*) were studied, using data on its population density in individual districts of the Czech Republic from 1955 to 1990. The field vole was found to be distributed from lowlands to the sub-alpine level, i.e., from 150 to 1600 metres above sea-level. It inhabits continuously and reproduces regularly in nine different biotopes of the Czech Republic. Geographic areas of regular overcrowding of field voles correspond with areas of most suitable living conditions. Of climatic conditions the field vole prefers mainly moderately warm climatic regions, and these are inhabited by 79.52% of its population. The analysis of quantitative requirements of the field vole indicates that there is a correlation between the distribution of this species and medium values of ecological factors. High and extremely high field vole densities are regularly encountered in areas amounting to 10 057 km^2, of which the field biotopes cover 5 072 km^2.

Key words: field vole; geographic distribution; ecology; Czech Republic

The field vole (*Microtus arvalis* Pallas 1788) is one of the most serious pests of agricultural production in the Czech Republic. When the field vole population reaches overcrowding densities, it causes considerable damage to vast agricultural areas.

Despite this fact, not much attention has been paid so far to defining the areas of regular and frequent overcrowding by field voles and consequent damage to agricultural production.

Such a definition of calamitous overcrowding areas of the field vole on the territory of the Czech Republic has been attempted by FARSKÝ (1925) on the basis of data from the years 1920 to 1925. However, the methods used to create the maps were not quite exact. There have been no further attempts in this respect.

The reasons for population overcrowding of the field vole, as well as of other microtine rodents, have not yet been satisfactorily and clearly explained. Nevertheless, knowledge on the areas of regular overcrowding may be used in plant protection against this serious pest. For a compilation of theories on population fluctuations see, for example, publications by ODUM (1971), SCHWERDTFEGER (1968, 1975) and VLASÁK (1986) and recent works such as BEGON *et al.* (1996).

In the scientific literature there is a lack of geographic data maps on the quantitative distribution of the field vole in the Czech Republic, including a longer time series. Data on its quantitative distribution in relation to the elevation above sea-level and other ecological conditions are also lacking. Such data have not been published by KRATOCHVÍL *et al.* (1959) and other authors. It was the study of field vole habitats by PELIKÁN (1955), apart from other sources, that we used to classify habitats inhabited by the field vole in the Czech Republic.

It was our aim to:

1. use quantitative data on the field vole in the Czech Republic for the purpose of plotting a map of its geographic distribution and defining areas of regular overcrowding;
2. use those quantitative data to prepare a chart of its distribution in biotopes in relation to the elevation above sea-level;
3. evaluate the ecological requirements of the field vole using a geographic database of ecological factors.