# Influence of Parasitisation on Cereal Aphids (*Sternorrhyncha*: *Aphidoidea*) in Various Field Management

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**Abstract**

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The level of parasitism of cereal aphids on winter wheat at growth stage 69 DC (end of bloom) differed between two field management used (integrated and ecological) and between individual years of the experiment (1999–2001). Parasitism was always higher in the ecological field management. The average number of parasitised aphids per tiller was 1.84 in the integrated field management but 2.63 in the ecological field management. The average rate of aphid parasitisation was 8.31% in the integrated system, but 16.15% in the ecological field management and thus 94.33% higher.

**Keywords**: parasitoids; cereal aphids; winter wheat

Parasitism of cereal aphids has been analysed by a number of authors (Dean 1974; Starý 1976, 1981; Jones 1980; Chambers *et al*. 1986; Holler 1990; Praslička & Al Dobai 1997; Al Dobai *et al*. 1999). Tamaki *et al*. (1970) state that parasitism of aphids may greatly reduce their populations, but will not prevent their migration. Holler (1990) states that parasitoids were the key factor of aphid mortality on cereals. Latteur (1975) and Rautapää (1976) both consider parasitisation of aphids at a level lower than 5% as non-significant. Pankanin-Franczyk (1994) observed a parasitism of 23.2% of aphids on triticale. Parasitoids usually appear in wheat fields shortly after these are invaded by aphids, but their abundance usually culminates 7 days after the peak of aphid population density (Jones 1972; Rautapää 1976; Starý 1981). Wetzel *et al*. (1981) conclude that parasitoids are an important factor in restricting aphid abundance if 10–20% of aphids are parasitised towards the end of the flowering period. Similarly, Surovenkov (1978) considers parasitoids to be effective regulators of aphid abundance. An important role in parasitisation is also attributed to neighboring crops. For example, cereal aphids and pea aphids have common parasitoids (Starý 1976, 1981). The parasitism of aphids is also affected by the abundance of those parasitoids that may be influenced by various anthropogenous impacts that are parts of wheat production, e.g. the application of agrochemicals (Hsiek & Allen 1986; Sengonca & Kersting 1988; Giller 1995).

## MATERIAL AND METHODS

The experiment was performed during 1999–2001 at Dolná Malanta, Slovakia, using winter wheat grown in two different field management:

(a) Integrated field management – plant nutrition was provided by organic and industrial fertilisers. Pesticides were applied to protect the plants against pests, weeds (MCPA agents, cyanozine and

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betazone) and fungi (tridermorph, fenpropimorph and propiconazole).

(b) Ecological field management – plant nutrition was provided only by organic fertilisers; no pesticides were used.

Each variant was further divided into two plots alternating the ecological and integrated system. Each plots was 10.7 × 10.0 m large, whereby the width of the boundary was 1.0 m. One hundred random tiller samples were taken from each variant (25 × 4), together with the same number of wheat ears in the growth period 69 DC (end of bloom period). The samples were collected by cutting off the tillers and ears. Starý (1981) considers this method of sampling to be the most effective and appropriate. The gathered material was transported to the laboratory in plastic boxes and it was stored in refrigerators with temperatures of 8 ± 2°C. The degree of parasitism was determined by direct counting of parasitised (or mummified and non-parasitised) aphids. The percentage of parasitisation was calculated based on the following formula:

$$\text{Percent of parasitisation} = \frac{b + c}{a + b + c} \times \frac{100}{1}$$

where: $a$ – live non-parasitised aphids
$b$ – live parasitised aphids (between parasitoid egg-laying and mummification)
$c$ – dead mummified aphids (Carter *et al.* 1980)

Parasitoid species were identified based on their contruction, shape, wing nervation color and other taxonomic signs using keys (Starý 1981; Powell 1982). Results were analysed by Tukeys test (Anděl 1985 ).

## RESULTS

The levels of parasitism of cereal aphids on winter wheat grown in integrated (IN) and ecological (EK) field managements at Dolná Malanta, Slovakia, are presented in Table 1. In 1999, the degree of parasitisation in field management IN was just 8.10%, while in system EK it was 127.3% higher, at 18.39%. In 2000, the degree of parasitisation in field management IN was 11.78%, in field management EK 14.33% and thus 22.66% higher in the latter. In 2001, the degree of parasitisation in the integrated field management IN was 6.24%, whereas in the ecological field management EK it was 15%, which is 140.38% higher than in field management IN. Over the period of the experiment (1999–2001), the average level of parasitism in field management IN was 8.31%, but in ecological management EK it was 16.15%, which is 94.33% more than in integrated management IN. Significant differences in parasitisation between the field managements were further backed by statistical analyses (Table 2). Highly significant differences between the field managements were recorded in the years 1999 and 2001, moderate significance in 2000. Significant differences were also found between the results of one field management from different years. Highly significant differences were identified in the integrated field management between years 2000 and 2001. Moderate significance was detected in both field manage-

Table 1. Parasitisation of cereal aphids on winter wheat in two field management in the years 1999–2001

| Year | Field management | Number of aphids | | | Parasitised (%) |
|---|---|---|---|---|---|
| | | total | parasitised | non-parasitised | |
| 1999 | IN | 2730.00 | 221.00 | 2509 | 8.10 |
| | EK | 1920.00 | 353.00 | 1567 | 18.39 |
| 2000 | IN | 1570.00 | 185.00 | 1385 | 11.78 |
| | EK | 1340.00 | 192.00 | 1148 | 14.33 |
| 2001 | IN | 2340.00 | 146.00 | 2194 | 6.24 |
| | EK | 1620.00 | 243.00 | 1377 | 15.00 |
| Average | IN | 2213.33 | 184.00 | 2029.33 | 8.31 |
| | EK | 1626.67 | 262.67 | 1364.00 | 16.15 |

IN – integrated field management; EK – ecological field management

Table 2. Levels of parasitisation of aphids on winter wheat in two field managements, 1999-2001

| Field management | 1999 | | | 2000 | | | 2001 | | |
|---|---|---|---|---|---|---|---|---|---|
| | IN | EK | difference | IN | EK | difference | IN | EK | difference |
| Parasitisation (%) | 8.10 | 18.39 | ++ | 11.78 | 14.33 | + | 6.241 | 15.00 | ++ |

– difference not significant ($\alpha$ = 0.05); + significant difference ($\alpha$ = 0.05); ++ highly significant difference ($\alpha$ = 0.01)

Table 3. Percent parasitisation of aphids on winter wheat in integrated and ecological field managements, 1999–2001

| Field management | Year | IN | | | EK | | |
|---|---|---|---|---|---|---|---|
| | | 1999 | 2000 | 2001 | 1999 | 2000 | 2001 |
| IN | 1999 | 8.10 | + | | | | |
| | 2000 | | 11.78 | ++ | | | |
| | 2001 | | | 6.24 | | | |
| EK | 1999 | | | | 18.39 | + | – |
| | 2000 | | | | | 14.33 | – |
| | 2001 | | | | | | 16.15 |

IN – integrated field management; EK – ecological field management; – difference not significant ($\alpha$ = 0.05); + significant difference ($\alpha$ = 0.05); ++ highly significant difference ($\alpha$ = 0.01)

ments for the differences between the years 1999 and 2000 (Table 3).

## DISCUSSION

In each year of the experiment more aphids were found in the integrated system – an average of 22.13 aphids per tiller. Three species of aphids were identified: *Metopolophium dirhodum* (Walker 1849), *Sitobion avenae* (Fabricius 1775) and *Rhopalosiphum padi* (Linnaeus 1775). The abundance of these aphid species was recorded also by Carter and Dewar (1980), Havlíčková (1986, 1987), Honěk (1991) and others. However, the average number of parasitised aphids was higher in the ecological system, averaging 2.63 aphids more per tiller, while in the integrated system the number of parasitised aphids averaged 1.84. Helenius (1991) determined that the number of parasitised aphids ranged from 0% to 43.1%. In our experiments, the degree of aphid parasitisation varied from year to year and by the production system used. Differences in the degree of parasitisation over time were also identified by Dean (1974). The degree of parasitisation was higher in the ecological field management throughout the experimental period. The lower degree of aphid parasitisation in the integrated field management was probably brought about by the application of pesticides. This fact is commented on by Hsiek and Allen (1986) and Sengonca and Kersting (1988).

By performing a detailed count of the aphids in the mid-development stage (75 DC) of wheat it can be concluded that parasitisation has significantly lowered the population density of aphids in both production field managements. The population decrease was particularly noticeable in the ecological field management. Similar results are presented by Wetzel *et al*. (1981). Praslička and Al Dobai (1997) also recorded a substantial decrease in aphid populations (with 10% parasitisation) towards the end of the bloom period and beginning of the ripening period. In contrast, Borgemiester (1992) did not find any decrease in the aphid population even with 20% parasitisation. This indicates that the decrease

in population density may also be influenced by other factors. *Aphidius uzbekistanicus* (Luzhetski 1960), *A. ervi* (Haliday 1843) and *A. rhopalosiphi* (De Stefani-Perez 1902) were the most abundant species recorded. Similar results of cereal aphids is presented by Barabás (1985), Cameron *et al*. (1984), Al Dobai *et al*. (1999) and others.

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## Súhrn

Praslička J., Miština T. (2004): **Parazitácia obilných vošiek** (*Sternorrhyncha*: *Aphidoidea*) **na rôznych poľnohospodárskych systémoch**. Plant Protect. Sci., **40**: 49–53.

Parazitácia obilných vošiek na pšenici letnej, formy ozimnej v rastovej fáze koniec kvitnutia (69 DC) bola rozdielna medzi jednotlivými poľnohospodárskymi systémami (integrovaný a ekologický), ako aj medzi jednotlivými rokmi (1999–2001). Parazitácia vošiek bola v každom roku vyššia na ekologickom poľnohospodárskom systéme. Priemerný počet parazitujúcich vošiek na jednej odnoži bol v rámci ekologického systému 2,63 a na integrovanom systéme 1,84. Priemerná parazitácia obilných vošiek bola na ekologickom systéme 16,15 % a na integrovanom 8,31 %, teda vyššia o 94,33 %.

**Kľúčové slová**: parazitoidy; obilné vošky; pšenica ozimná

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