Effects of Different Field Managements on the Abundance of Cereal Aphids (*Sternorrhyncha: Aphidoidea*)

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Abstract

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The abundance of cereal aphids on winter wheat tillers and ears was determined in two field managements (integrated and ecological) at Dolná Malanta, Slovakia, over the years 1999–2001. The overall average number of aphids detected per tiller in the integrated field management was 22.73, while in the ecological management that number was 15.67; there were thus 31.06% more aphids in the integrated field management. The average number of aphids detected per ear in the integrated field management was 3.64, and in the ecological field management the number was 2.51; again, there were 31.04% more aphids in the integrated field management.

Keywords: cereal aphids; winter wheat; field managements

Three species of aphids commonly attack wheat: *Metopolophium dirhodum* (Walker 1849), *Sitobion av*enae (Fabricius 1775) and *Rhopalosiphum padi* (Linnaeus 1758) (Carter & Dewar 1980; Šedivý 1982; Lowe 1977, 1978, 1984; Havlíčková 1986; Praslička & Al Dobai 1997). The abundance and reproduction of cereal aphids depends to a certain degree on the growth stage of the plant, the aphid species (Leather & Lehti 1982), climate and weather conditions (Jones 1979; Hanish 1980), the combination of aphid and wheat winter (Havlíčková 1984, 1986) and other factors (Wickerman & Wratten 1979; Havlíčková 1993, 1994). Concerning population dynamics, Honěk and Martinková (2003) state that nutrition and growth stage of the plant may be more significant than the interfamily differences. The abundance of aphids on cereals can be also influenced by the application of agrochemicals. Baran (1971) found that higher doses of nitrogen-based fertilisers promote aphid fertility. Higher nitrogen nutrition creates favorable conditions for aphids because the vegetation period is prolonged and plant tissues are softer. The use of phosphorous and potassium fertilisers had a similar effect (Baran 1972). Šedivý and Kodys (1985) discovered that 2,4D- and MCPA-based herbicides improve the fertility coefficient of aphids on young wheat plants.

MATERIAL AND METHODS

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

Integrated field management (IN): nutrition of the plants was provided by organic and industrial fertilisers. Pesticides were applied to protect the plants against pests, weeds (MCPA agents, cyanozine and betazone) and fungi (tridermorph, fenpropimorph and propiconazole).

Ecological field management (EK): nutrition of the plants was provided only by organic fertilisers and no pesticides were used.

The area of each system was further divided into two plots that alternated between the ecological

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and integrated field management. Each plot measured 10.7 x 10 m; a boundary strip surrounding it was 1 m wide. Each variant had four replicates of 25 m^2, and in each of these 100 tillers were taken at random and 100 ears at growth stage 69 DC (end of bloom). The samples were collected by first cutting whole tillers with ears, followed by cutting only ears from another set of tillers. The gathered material was brought to the laboratory in plastic boxes and stored at 8 ± 2°C. Later, the aphids on individual tillers and ears from each variant and plot were counted. The aphids were killed and stored in sealed and labeled test tubes with AGO conservation agent; the species were identified by using keys and Miller's (Miller 1956) and Taylor's (Taylor 1980) descriptions. Statistical analyses were performed by Tukey's test (Anděl 1985).

RESULTS

The abundance of cereal aphids on wheat in the integrated (IN) and ecological (EK) field managements is shown in Table 1. The abundance of aphids on tillers varied, depending on the year and the field management used. Every year there were more aphids on plants of the integrated field management. In 1999, the average number of aphids per tiller was 26.50 in system IN and 17.40 in EK, thus the count in IN was 34.34% higher. In 2001, the average number of aphids per tiller was 28.30 in IN and 16.80 in EK, which is 40.64% higher in system IN. The largest difference between the number of aphids in IN and EK was in 2001, the smallest difference was in 2000. Over all years of the experiment (1999–2001), the average number of aphids per tiller was 22.73 in IN and 15.67 in EK, i.e. the number was 31.06% higher in the integrated system. Statistical analysis proved the significance of differences between the two field managements (Table 2). In the years 1999 and 2001 the differences between the field managements were highly significant, but they were low in 2000. Within the IN system, highly significant differences were recorded between the years 1999 and 2000, and between 2000 and 2001. The EK sys-

Table 1. Abundance of cereal aphids on winter wheat tillers in the years 1999–2001

Year	Field management	Number of		Average number of aphids per tiller
		affected tillers	aphids	
1999	IN	75	2650	26.50
	EK	60	1740	17.40
2000	IN	58	1340	13.40
	EK	62	1280	12.80
2001	IN	83	2830	28.30
	EK	78	1680	16.80
Total	IN	216	6820	22.73
	EK	200	4700	15.67

IN – Integrated agricultural system; EK – Ecological agricultural system

Table 2. Comparison of aphid abundance of number of aphids per tiller on whole tillers and of number of aphids per ear on ears of winter wheat in two agricultural systems

	1999			2000			2001		
	IN	EK	difference	IN	EK	difference	IN	EK	difference
Number of aphids per tiller	26.50	17.40	++	13.40	12.80	–	28.30	16.8	++
Number of aphids per ear	3.96	3.08	+	1.75	1.92	–	5.20	2.52	++

– insignificant difference (α = 0.05); + moderately significant difference (α = 0.05); ++ highly significant difference (α = 0.01); IN – Integrated agricultural system; EK – Ecological agricultural system

Table 3. Comparison of aphid abundance of number of aphids per tiller on whole tillers and number of aphids per ear on whole ears of winter wheat in integrated and ecological field managements in the years 1999–2001

Field management	Year	IN			EK		
		1999	2000	2001	1999	2000	2001
Number of aphids per tiller							
	1999	26.50	++	–			
IN	2000		13.40	++			
	2001			28.30			
	1999				17.40	+	–
EK	2000					12.80	+
	2001						16.80
Number of aphids per ear							
	1999	3.96	++	++			
IN	2000		1.75	++			
	2001			5.20			
	1999				3.08	++	+
EK	2000					1.92	+
	2001						2.52

– insignificant difference (α = 0.05); + moderately significant difference (α = 0.05); ++ highly significant difference (α = 0.01); IN – Integrated field management; EK – Ecological field management

tem showed moderately significant differences between the years. The differences between the years 1999 and 2001 were not significant in both field managements (Table 3).

The abundance of cereal aphids on wheat ears is shown in Table 4. Over the years of the experiment and the two field managements, the abundance of aphids on wheat ears varied. In 1999, the average number of aphids per ear was 3.96 in IN and 3.08 in EK, i.e. it was 22.23% higher in IN. In 2000, the average number of aphids per ear was 1.75 in IN and 1.92 in EK, so that there were 8.86% more aphids

Table 4. Aphid abundance on ears of winter wheat in the years 1999–2001

Year	Field management	Number of		Average number of aphids per ear
		affected ears	aphids	
1999	IN	64	396	3.96
	EK	53	308	3.08
2000	IN	42	175	1.75
	EK	50	192	1.92
2001	IN	74	520	5.20
	EK	65	252	2.52
Total	IN	180	1091	3.64
	EK	168	752	2.51

IN – Integrated field management; EK – Ecological field management

in IN. In 2001, the average number of aphids per ear was 5.20 in IN and 2.52 in EK, which showed 51.54% aphids more in IN. Over the whole period observed (1999–2001), the average number of aphids per ear was 3.64 in IN and 2.51 in EK, which made for 31.04% more aphids in IN.

The significant differences of our results was proven by statistical analysis while comparing the abundance of aphids in individual field management (Table 2). Highly significant differences were recorded between individual field managements in the year 2001, moderately significant differences in 1999 and no significant differences in 2000. Significant differences were also found between individual years (Table 3). They were highly significant between 1999 and 2001, and between 2000 and 2001. The abundance of aphids in wheat ears was influenced also by the different frequency of individual species of aphids.

DISCUSSION

Our results showed that there was a higher number of aphids on the better nurtured plants of the integrated field management. Honěk (1994) had demonstrated that better nutrition increased the density of the aphid population. Zelená *et al*. (2003) have proven that mineral nutrition, mainly nitrogen-based fertilisers, promotes the aphid population, whereas potassium has the opposite effect. In our experiments, by fertilising the test fields with nitrogen fertilisers in the IN field management, the overall status of nutrition of the IN plants was better than in the EK. Based on the evidence presented, we may suppose that aphid populations will be higher in the integrated field management of wheat production.

With both field managements, *Metopolophium dirhodum* was the most numerous species on whole tillers, while on ears alone *Sitobion avenae* predominated. There were also limited numbers of *Rhopalosiphum padi* detected. The abundance of these three aphids was also recorded by Dean (1974), Wratten (1975), Carter and Dewar (1980), Havlíčková (1986, 1987) and Honěk (1991).

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Súhrn

Praslička J., Miština T. (2004**): Vplyv rôznych poľnohospodárskych systémov na výskyt obilných vošiek** (*Sternorrhyncha: Aphidoidea*). Plant Protect. Sci., **40**: 82–86.

V rokoch 1999–2001 sme na lokalite Dolná Malanta sledovali výskyt obilných vošiek na odnožiach a klasoch pšenice letnej, formy ozimnej v integrovanom a ekologickom poľnohospodárskom systéme. V sledovanom období bol zaznamenaný priemerný počet vošiek na odnoži pšenice v rámci integrovaného poľnohospodárskeho systému 22,73, čo je o 7,06 vošiek (31,06 %) viac ako v ekologickom poľnohospodárskom systéme (15,67). Priemerný počet vošiek na klase pšenice v integrovanom systéme bol 3,64, t. j. o 1,13 vošiek (31,04 %) viac ako v ekologickom systéme (2,51).

Kľúčové slová: obilné vošky; pšenica ozimná; poľnohospodárske systémy

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