Spectrum of the Pests on Cereal Crops and Influence of Soil Fertilisation

Ján GALLO and Monika JELOKOVÁ

Department of Plant Protection, Faculty of Agrobiology and Food Resources, Slovak University of Agriculture in Nitra, Nitra, Slovak Republic

Abstract

Gallo J., Jeloková M. (2008): **Spectrum of the pests on cereal crops and influence of soil fertilisation**. Plant Protect. Sci., **44**: 25–31.

Our research was realised on spring barley and winter wheat in Nitra-Dolná Malanta during 2004–2006. We found that the total occurrence of the pests had decreasing tendency. The flea beetle (Phyllotreta*),* thrips (Thysanoptera) and cereal leaf beetle (*Oulema gallaeciana*) had the highest occurrences. More pests occurred on non-fertilised variants than on fertilised ones in 2004. During 2005 and 2006 there were more pests on the fertilised variants. The effect of fertilisation was the same for spring barley and winter wheat.

Keywords: spring barley; winter wheat; Phyllotreta; Thysanoptera; *Oulema gallaeciana*; fertilisation

Different biotic factors such as predators, parasitoids and different pathogens affect the pests of cereals. Also affecting them are the abiotic factors temperature, rainfall, humidity, wind and sunshine (Sehgal 2006).

There has been only little attention given to research on pests in Slovakia (Gallo & Pekár 1999, 2001). Only a few authors were interested in occurrence and harmfulness of the pests occurring on cereals (Markovec & Gorbundová 1951; Šedivý & Kodys 1985).

Climatically, the slowly rising temperatures are very important for the spectrum of pests. Winters are shorter, temperatures below freezing occur on average on fewer days than before and the soil is frozen to shallower depths. This results in pest species occurring at northern localities, whereas before they had appeared only at lower latitudes (Gallo 2002).

Past research has shown that fertilisation of the soil affects a pest's presence. Fertilisation had a positive effect on the crops, especially on their height and density, leading to a higher presence of pests. Stimulation of plant growth and development is the main goal of fertilisation. Regeneration of the plants is important if the pests damage the plants. Organic fertilisation is very important because it suppresses the plant pathogens and also affects the frequency of pests (Sokolov 1991).

Healthy vital plants are preferred by many pests on cereal species (Price 1991; Breton & Addicott 1992; Preszler & Price 1995).

The variety of a crop can also affect the occurrence of a pest. Ovipositonal behaviour, variability of eggs, growth and survival of the young larvae of the cereal leaf beetle were adversely affected by the trichome density on wheat leaves (Schillinger & Gallun 1968). Eggs per plant and larval survival

Supported by the Scientific Grant Agency (VEGA) of the Ministry of Education of the Slovak Republic and the Slovak Academy of Sciences, Grant No. 1/4421/07.

decreased as the length and density of trichomes increased (Hoxie *et al*. 1975).

Differences in the yields between the varieties and the year's volume in the same level of the damage were detected. Later varieties were better able to compensate for the damage than earlier varieties in years with similar weather (Šedivý 1995).

Influence of a new farming system on pests and their natural enemies has began a few years ago (Khamraev 1990; Pfiffner 1990; Xie *et al*. 1995).

MATERIAL AND METHODS

Our research was conducted at Nitra-Dolná Malanta. The whole area (530 m^2) used in the tree-year experiment (2004–2006) was split into 8 identical plots (each of 60 m^2) separated by a 1 m belt where soil was superficially cultivated. Pests were monitored on spring barley cvs. Jubilant (2004) and Annabell (2005, 2006), and on winter wheat cvs. Samanta (2004) and Solara (2005, 2006). At every sampling date 5 m^2 of winter wheat and spring barley was swept using a standard sweeping net. Collecting began at the shooting phase, ended at wax ripeness of cereal crops and was done every 7–10 days, depending on the weather. The insects collected from each crop were determined. Spiders were removed from samples, and aphids were excluded from the analysis at they were used in another study. We determined the influence of fertilisation and nutrition on the pests in the control variants (0) without fertilisation, and variants fertilised (F) with manure (40 t/ha) + fertilisers (winter wheat for 7 t yield: 70 kg N/ha, 30 kg P/ha, 0 kg K/ha; spring barley for 6 t yield: 30 kg N/ha, 30 kg P/ha, 0 kg K/ha). Climatic data were provided by the meteorological station near the Slovak University of Agriculture at Nitra, Slovak Republic. All results were evaluated with mathematical-statistic analysis Statgraphics.

RESULTS AND DISCUSSION

Spring barley

In 2004, insects were first collected in the last decade of April; during next 2 years collecting began in the first decade of May. The beginning of collecting was affected by the weather during the years. The last insects occurred in the first decade of July. The date of the maximum occurrence of the pests changed during the research. Maximum of the insects was recorded between the May and (307 pieces/5 m^2) a June (357 pieces/5 m^2) in 2004. The abundance of the insects decreased at about 45% after this time. The lowest abundance of insects was in May during the low average day temperatures. Maximum occurrence of total insects was in the last decade of May and in the first decade of June. Our results are similar to results of Gallo (2002), who maximum of the insects recorded in the first decade of May and June. Only one maximum of occurrence was recorded

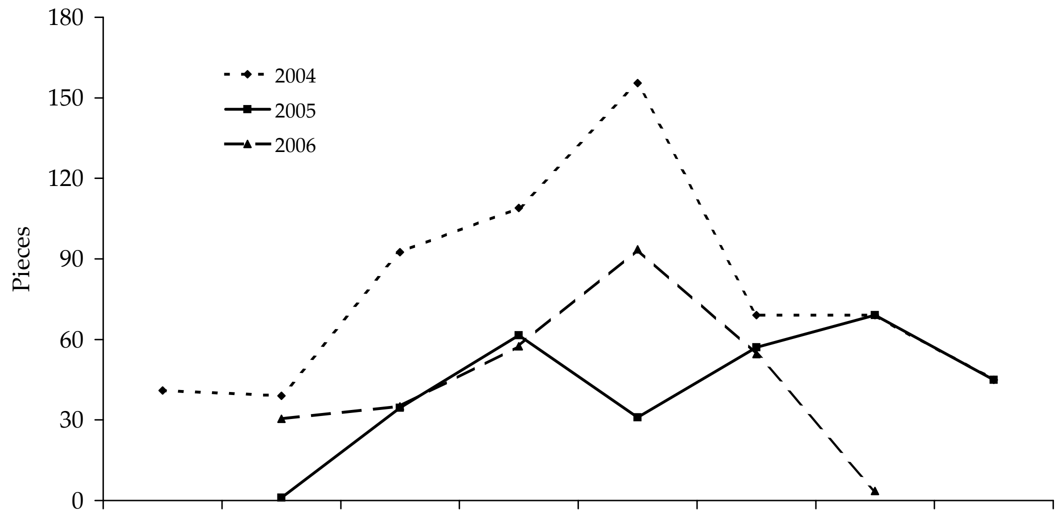

Figure 1. Occurrence of insects on spring barley in 2004–2006 (dec = decade)

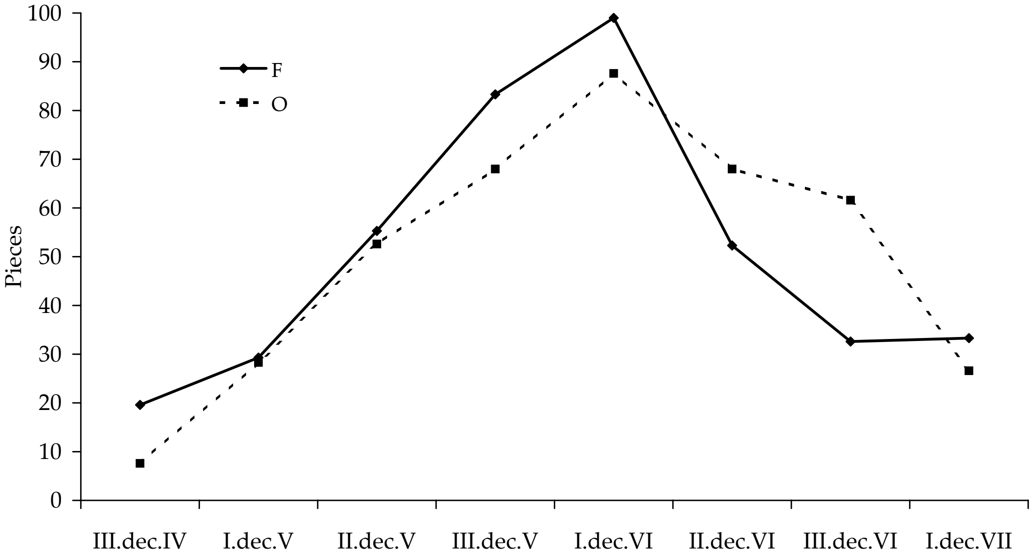

Figure 2. Influence of fertilisation on the insects on spring barley during the study (F – fertilised variants; O – control variants)

in 2004. Only one maximum was recorded in 2006 too. Two maximum of occurrence were recorded in 2005 (Figure 1).

The maximum occurrence of the pests (89 pieces/5 m^2) was recorded on spring barley at the beginning of the June in 2006 (Figure 1). *Phyllotreta* (18 pieces/5 m^2), *Thysanoptera* (21 pieces per 5 m^2) and *Oulema gallaeciana* (12 pieces/5 m^2) were dominant pests. Other authors presented the same spectrum of dominant pests (Gallo & Pekár 1999). There were no insects recorded on spring barley in July. The spring barley was in the

Table 1. Insects on spring barley and winter wheat in 2004–2006 (pieces/5 m^2)

		2004	2005	2006
Spring barley				
Pests	O	104	69	57
	F	100	61	65
Pests summary		204	130	122
Regulators	O	37	30	14
	F	29	20	15
Regulators summary		66	50	29
Insects summary		270*	180	151
Winter wheat				
Pests	O	137	106	70
	F	106	99	72
Pests summary		243	205	142
Regulators	O	43	34	14
	F	42	26	14
Regulators summary		85	60	28
Insects summary		328	265	170*

*denotes a statistically significant difference (O – control variants; F – fertilised variants); regulators = natural enemies

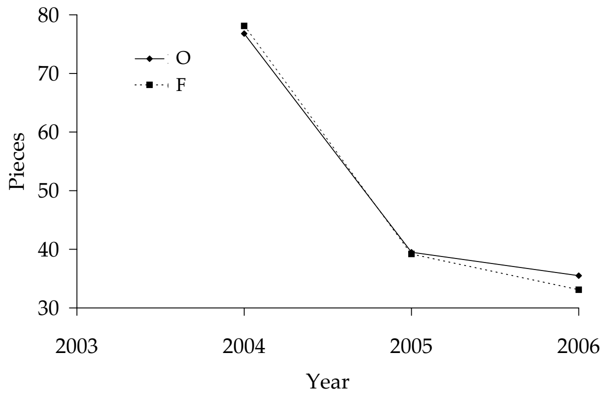

Figure 3. Occurrence of insects on spring barley in 2004 to 2006 (F – fertilised variants; O – control variants)

wax ripeness. Abundance of the natural enemies increased at about 28% in the second decade of June but it decreased compared to the first decade about 80% by the end of month.

Different occurrence of the insects was in 20. The maximum of the collected insects (102 pieces per 5 m^2) was at the end of June (Figure 1). The total number of insects 114 pieces/5 m^2 was recorded in the first decade of June and from which there were 84 pieces/5m^2 pests. There was recorded maximum amount of natural enemies (14 pieces/5 m^2). The second maximum of total insects (262 pieces/5 m^2) and also pests (177 pieces/5 m^2) was recorded in the last decade of May. The collecting was realised in the first decade of July in 2005. The amount of the pests decreased at about 34% and natural enemies at about 63% in 2005.

During the three years study the effect of fertilisation was monitored in the spring barley (Figure 2). According the results, more pests were recorded on fertilised variants. The more pests were recorded on the non-fertilised variants only in 2004. Our results are different from results of Samsonova (1991), according which the fertilisation had no effect on the occurrence of the pests. Levine (1993) results are similar to ours.

The occurrence of the insects had the similar character on fertilised and non-fertilised variants. The relation between fertilised and non-fertilised variants had not statistically significant difference (Table 1).

Total amount of collected insects on spring barley had increasing tendency during the all years (Figure 3). Total amount of the pests was 1630 pieces per 5 m^2 collected during the entire period in 2004. This number decreased at about 55% in 2006. The amount of natural enemies had also decreasing tendency. While 66 pieces/5 m^2 of natural enemies were collected in 2004, this amount decreased at about 67% in 2006 (Table 1). This drop could be caused by higher temperature during the year 2006. According to Honěk (2003), McAvoy and Kok (2004), the temperature influenced occurrence and development of the pests in crops.

Difference between the year 2004 and the other years 2005 and 2006 was statistically evident (Figure 4).

Winter wheat

The beginning of collecting was realised in the second decade of April and the last collections were realised in the first decade of July during the years 2004–2006. The last collection was realised at the end of June in 2006 (Figure 5). The beginning was affected by the weather during the years.

The first maximum of the pests was recorded in the last decade of April (247 pieces/5 m^2) in 2004. The second maximum was recorded at the end of May (350 pieces/5 m^2) and at the beginning of June (285 pieces/5 m^2). Thrips (44 pieces/5 m^2) had the highest occurrence. The cereal leaf beetle was recorded at most in April. It was found occasionally in the crops in the next time. Aphids (58 pieces/5 m^2) were recorded in the crops in June. Maximum occurrence of the pests was recorded in the last decade of May (284 pieces/5 m^2), the second one in the second decade of June (314 pieces/5 m^2) in 2005. There were trips (26 pieces/5 m^2) and flea beetle (38 pieces/5 m^2) and also cereal leaf beetle (15 pieces/5 m^2). The aphids were not recorded in this year. During the terms with the highest level of the pests, there were also recorded the highest occurrence of the natural enemies (53 pieces/5 m^2).

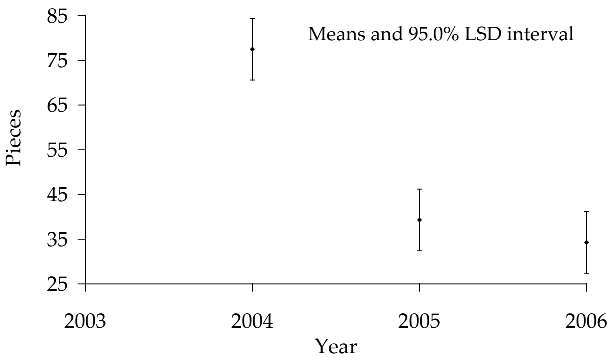

Figure 4. Relation between the years 2004, 2005 and 2006 on spring barley

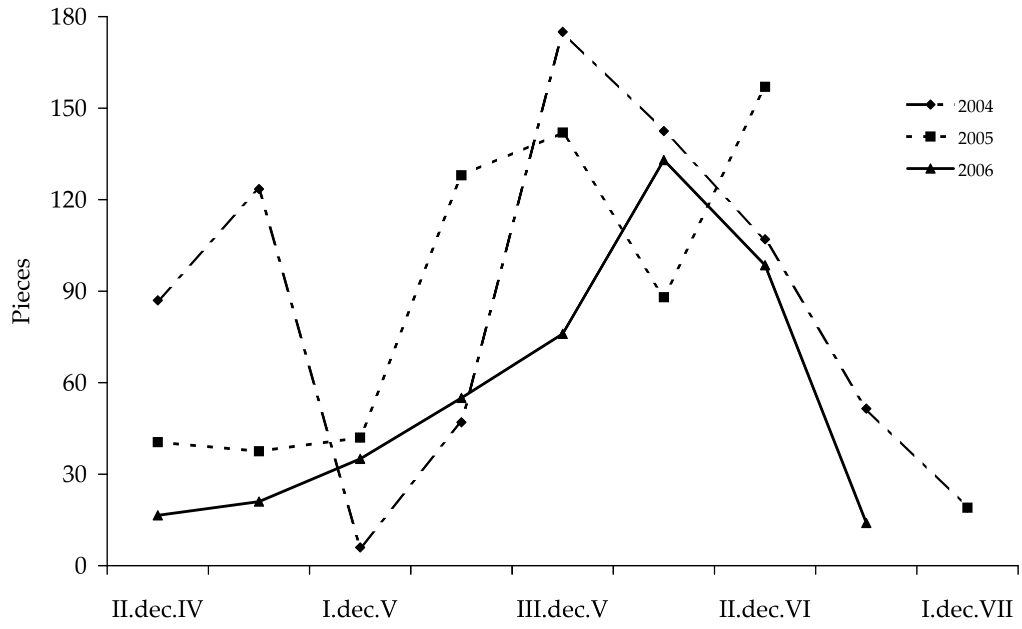

Figure 5. The occurrence of insects on winter wheat in 2004–2007

Our results were similar to the results of Gallo and Pekár (1999, 2001), which presented the same spectrum of the pests.

The high occurrence of the pests was recorded also in the first (266 pieces/5 m^2) and in the second (197 pieces/5 m^2) decade of June (Figure 5). The highest occurrence had again thrips (18 pieces per 5 m^2), flea beetle (24 pieces/5 m^2) and cereal leaf beetle (10 pieces/5 m^2). Fritt fly *Oscinella fritt* was recorded (6 pieces/5 m^2) during the entire year. The higher occurrence of the pests could be caused by higher temperature during the year. According to Petr *et al.* (1987), and McAvoy and Kok (2004), the temperature influenced occurrence and development of the pests in the crops.

The influence of the fertilisation was study during three years research on winter wheat (Figure 6).

According to our results, the higher occurrence of the pests was recorded on fertilised variants. The higher occurrence of the pests was recorded on the non-fertilised variants only in the year 2004. Our results are different from the results

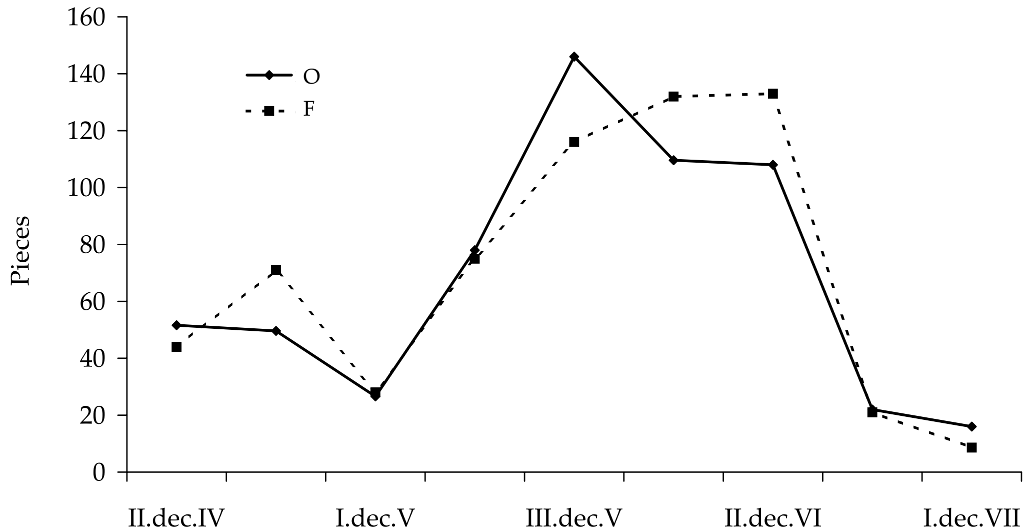

Figure 6. The influence of fertilisation on the insects during the study on winter wheat (F – fertilised variants; O – control variants)

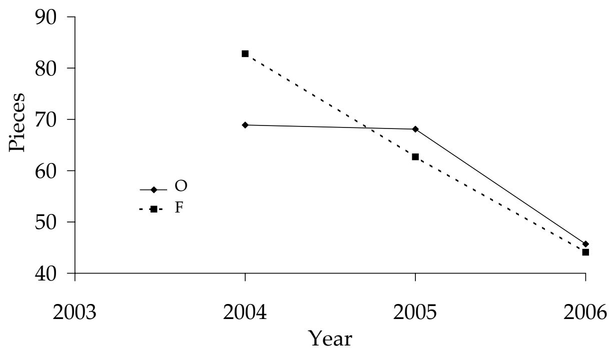

Figure 7. The occurrence of insects on winter wheat in 2004–2006 winter wheat (F – fertilised variants; O – control variants)

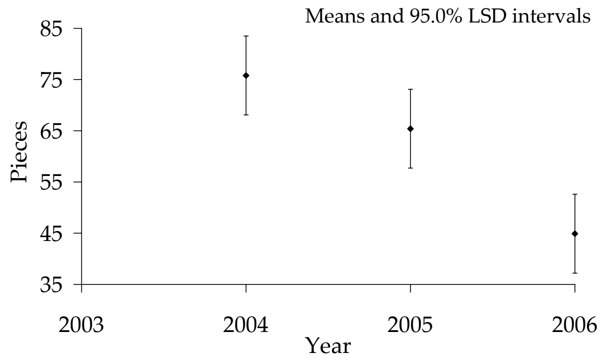

Figure 8. Relation between the years 2004, 2005 and 2006 on winter wheat

of the other author according which the fertilisation had no influence at the pests (Samsonova 1991). The similar results reached Levine (1993) and Gallo and Pekár (1999). The occurrence of the insects had the similar character on fertilised and non-fertilised variants. Maximum amount of the pests was recorded one decade sooner on the fertilised variants than on the non-fertilised variants (Figure 6). Relation between fertilised and non-fertilised variants had not statistically significant difference (Table 1).

The total number of insects had a decreasing tendency during the three years (Figure 7) and in both variants of fertilisation. While 3259/5 m^2 of insects were collected in 2004, this number decreased by about 51% in 2006. This decrease was expressive on the non-fertilised variants in 2006, it began on the fertilised variants after the first year.

The same decreasing tendency had also pests and their natural enemies. Their occurrence decreased at about 59% during the study. Difference between the year 2006 and the other years 2005 and 2004 was statistically evident (Figure 8).

References

Breton L.M., Addicott J.F. (1992): Does host-plant quality mediate aphidant mutualism. Oikos, **63**: 253–259.

Gallo J. (2002): Spektrum živočíšnych škodcov na obilninách v závislosti od pestovateľských spôsobov. In: Zborník referátov: Pestovanie a využitie obilnín v treťom tisícročí. Agroinštitút, Nitra: 213–216.

Gallo J., Pekár S. (1999): Winter wheat pests and their natural enemies under organic farming system in Slovakia: Effect of ploughing and previous crop. Anzeiger für Schädlingskunde/Journal of Pest Science, **72**: 31–36.

Gallo J., Pekár S. (2001): Effect of ploughing and previous crop on winter wheat pests and their natural enemies under integrated farming system in Slovakia. Anzeiger für Schädlingskunde/Journal of Pest Science, **74**: 60–65.

Honěk A. (2003): Effect of temperature on development and reproduction in *Gastrophysa viridula* (*Coleoptera*: *Chrysomelidae*). European Journal of Entomology, **100**: 295–300.

Hoxie R.P., Wellso S.G., Webster J.A. (1975): Cereal leaf beetle response to wheat. Journal of Economic Entomology, **59**: 827–829.

Khamraev A.S. (1990): Resources for improving the protection of cotton against pests. Zashchita Rastenii, **3**: 10–12.

Levine E. (1993): Effect of tillage practise and weed management on survival of stalk borer (Lepidoptera: Noctuidae) eggs and larvae. Journal of Economic Entomology, **86**: 924–928.

Markovec A.F., Gorbundová N.N. (1951): Nasjakomyja, jakija paškožvajuc chlebny zlaki u BSSR. Vesnik AN BSSR, **2**: 80–87.

McAavoy T.J., Kok L.T. (2004): Temperature dependent development and survival of two sympatric species, *Galerucella calmariensis* and *G. pusilla*, on purple loosestrife. Biocontrol, **49**: 467–480.

Petr J. *et al.* (1987): Počasí a výnosy. Státní zemědělské nakladatelství, Praha: 368.

Pfiffner L. (1990): Effects of different farming systems on the presence of epigeal arthropods, in particular of carabids (Col., Carabidae) in winter wheat plots. Mitteilungen der Schweizerischen Entomologischen Gesellschaft, **63**: 63–67.

Preszler R.W., Price P.W. (1995): A test of plant vigor, plant-stress, and plant-genotype effects on leaf miner oviposition and performance. Oikos, **74**: 485–492.

Price P.W. (1991): The plant vigor hypothesis and herbivore attack. Oikos, **70**: 244–251.

Samsonova I.V. (1991): Effects of shallow soil cultivation on number of spring wheat pests. Nauchno Tekhnicheskii Byulleten RASKhl, **2**: 34–37.

Schillinger Jr. J.A., Gallun R.L. (1968): Leaf pubescence of wheat as a deterrent to the cereal leaf beetle, *Oulema melanopus*. Annals of the Entomological Society of America, **61**: 900–903.

Sehgal M. (2006): Climate studies and insect pests – Implications for the Indian context. Outlook on Agriculture, **35**: 33–40.

Sokolov I.M. (1991): The influence of soil treatment and fertilizer background on the population of winter wheat pests in Krasnodar region. In: Problemy zashchity sel'skokhozyaistvennykh kul'tur ot vrednykjh organizmov v intensivnom zemledelii: 41–48.

Šedivý J. (1995): Hodnotenie poškodenia pšenice ozimnej kohútikmi (*Coleoptera*, *Chrysomelidae*). Ochrana rostlin, **31**: 107–119.

Šedivý J., Kodys F. (1985): Usměrněná chemická ochrana proti škůdcům obilnin. Metodiky pro zavádění výsledků výzkumu do praxe. 1. ÚVTIZ. Praha.

Xie S.X., Chen Q., Chen Y.L., Wang K.N., Song W.Z., Liu S.J., Yang F.R., Yang S.F., Hu J.W., Dong J.S. (1995): Technical system of IPM on wheat in Tianshui. Acta Phytophylacica Sinica, **22**: 251–255.

Received for publication November 30, 2007
Accepted for correction January 18, 2008

Corresponding author:

Doc. Ing. Ján Gallo, CSc., Slovenská poľnohospodárska univerzita v Nitre, Fakulta agrobiológie a potravinových zdrojov, Katedra ochrany rastlín, Tr. A. Hlinku 2, 949 76 Nitra, Slovenská republika
tel.: + 421 376 414 251, fax: + 421 377 411 451, e-mail: jan.gallo@uniag.sk