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ASSESSING THE EXTENT OF DAMAGE CAUSED BY *CLEONUS PIGER* SCOP. AND OTHER ENTOMOFAUNA IN THE CULTIVATION OF MILK THISTLE [*SILYBUM MARIANUM* (L.) GAERTN.]

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Abstract: The research on impact of *Cleonus piger* Scop. (*Coleoptera; Curculionidae*) feeding and the occurrence of other pest insects on milk thistle plants grown in monoculture and crop rotation after cereals, with two different seeding dates was carried out in the years 2003–2005. The infestation and density of *C. piger* larvae in roots of plants grown in monoculture increased with subsequent developmental phases and subsequent years of the experiment. Feeding resulted in the decrease in crop yield by 40% compared to the crop rotation treatment. In crop rotation stands, the infestation of milk thistle roots by *C. piger* larvae was 4–5 times lower at the final phase than in monoculture. Postponing seeding by three weeks led to the decrease of infestation and density of *C. piger* larvae, but the crop yield was lower than that from the early-seeded stands. No other phytophagous species of economic importance were found.

Key words: *Cleonus piger, Silybum marianum*, monoculture

INTRODUCTION

Milk thistle [*Silybum marianum* (L.) Gaertn.] is a plant native to the Mediterranean region and belongs to the *Asteraceae* family. In Poland and other European countries, it is grown for pharmaceutical purposes. The raw material for these purposes is pericarp of fruit – a source of sylimarin. Sylimaryn is applied in the treatment of liver ailments (Morazzoni and Bombardelli 1995). Because of fruit spilling in the time of maturation and harvesting, it is recommended to grow milk thistle in monoculture (Rumińska 1991).

In general, expenditures on the cultivation of milk thistle are not high. This is largely due to the fact that the plant, as a rule, is not heavily attacked by diseases and pest insects. Weeds can threaten the plantation only in the early stage of crop development. The following pest insects were identified feeding on milk thistle: *Cleonus piger* (Scop.), black bean aphid (*Aphis fabae* Scop.), *Hadeninae*, and *Phytometra gamma* L. (Rumińska 1991). In Egypt *Larinus latus* Herbst has been found to feed on milk thistle (Abdel-Moniem 2002), in Turkey *Ceratapion basicorne* Illiger (Uygur et al. 2005), and in France *Phanacis zwolferi* sp. n. (Nieves-Aldery 1995). With the exception of the Andrzejewska and Skinder's report (2003) indicating degree of threat posed by *C. piger*, the literature does not provide any information on the extent of damage caused by the insect in milk thistle plantations.

C. piger (*Coleoptera; Curculionidae*) belongs to the *Cleonus* Schoenh genus. It is found in many countries of Europe, North Africa, and Asia. It attacks mainly stems and roots of plants of the *Arctium, Carduus, Carlina, Centaurea, Cirsium, Cynara, Onopordum, Silybum* genera, and also *Beta* (Peschken 1984). In Polish fauna there occur several species of the *Cleonus* genus damaging, especially, sugar beets, but also thistles, and burdocks (Smreczyński 1968; Benada et al. 1984). In North America *C. piger* Scop. was tested as an agent in biological control of *Cirsium arvense* (L.) (Gassmann et al. 2002).

C. piger most commonly occurs near woods and boundary strips (Benada 1984; Rumińska 1991). When the air temperature reaches 10°C in spring, adult specimens begin migrating in search of host plants (Zsemberi and Pets 1993). Beetles damage young plants, leaving semi-circular holes in cotyledons, whereas larvae feed in roots and root crowns (Hinfner and Homonnay 1966; Smreczyński 1968; Zahradnik 1985), and this is where their metamorphosis takes place. The affected plants die or their development is retarded.

The aim of the research was to assess damage caused by *C. piger* on milk thistle grown in monoculture and in crop rotation, in relation to different seeding dates.

MATERIALS AND METHODS

The research was carried out in the University of Technology and Agriculture Research Station in Mochełek near Bydgoszcz, in two field experiments from 2003 to 2005. The 2003 experiment was set up with aim to examine the impact of early seeding (April 1) and late seeding (April 22) on crop yield of milk thistle. In the spring 2003, milk thistle plants were heavily attacked by *C. piger*. In the following two years two separate experiments were set up – one in monoculture on the site of the 2003 experiment, and the other at a distance of 1.5 km, in crop rotation with cereals as a previous crop.

The research on harmfulness of *C. piger* and other pest species was carried out in 6 replications. One replication comprised 25 plants randomly selected from each experimental plot. The plot area was 40 m^2. Observations and sample collecting were made at 6 consecutive developmental stages: (1) 2–4 leaves; (2) 6–8 leaves; (3) the beginning of formation of inflorescence shoots; (4) the beginning of blossoming; (5) at the end of blossoming, and (6) before harvesting. This took place from mid-May to early August, in the intervals of 10 days.

Insects for examination were collected from dug out whole plants. Then, using a scalpel the below-the-ground plant part was dissected alongside in order to check for the presence of *C. piger*. The results were expressed as pest insect density, according to the average number of plants examined at full sprouting and before harvesting, and related to the number of specimens per 1 m^2. The infestation by *C. piger* larvae was established on the basis on the number of larvae found in 25 randomly selected plants from each replication. Other insects on the test plants were counted while the leaves and inflorescences were closely scrutinized with the magnifying glass (10 x).

The results concerning plant density, seed yield, *C. piger* larvae infestation and density were analyzed using the analysis of variance for the following treatments:

1. monoculture – early seeding date,
2. monoculture – late seeding date,
3. crop rotation – early seeding date,
4. crop rotation – late seeding date.

The significance of differences between treatments was determined using Tukey's test at the level $p=0.05$.

Both, the monoculture and crop rotation stands, upon noticing the damage on cotyledons of seedlings were sprayed with Diazinon 250 EC against *C. piger* on the following dates: 23.04.2004 and 23.04.2005 – early seeded plants, and 04.05.2004 and 09.05.2005 – late seeded plants. The decision to carry out the treatment was made for fear of losing the whole crop, and keeping the whole crop alive was a primary goal of the experiment.

Meteorological conditions

The warmest and at the same the driest growing season for milk thistle took place in 2003. Heavy rainfall occurred in July 2003, but it was too late to affect the crop development. In 2004 air temperatures from May to July were much lower, and total rainfall was close to long-term average. The year 2005 was characterized by a long period of low temperatures in May and June, and heavy rainfall in May (Table 1).

Table 1. Meteorological conditions during the vegetation season of milk thistle compared to long-term data in the Mochełek Research Station

Years	Months				
	April	May	June	July	August
Mean twenty four hours air temperature (°C)					
2003	6.4	14.4	17.7	19.2	18.5
2004	7.5	11.3	14.7	16.4	17.9
2005	7.4	12.1	14.9	19.4	16.2
1949–2003	7.2	12.8	16.2	17.8	17.5
Sum of rainfall (mm)					
2003	18.5	18.1	30.4	106.2	17.7
2004	32.1	54.4	39.6	53.5	138.7
2005	34.8	82.6	30.5	33.6	43.4
1949–2003	27.0	40.4	54.4	72.7	47.8

RESULTS

Milk thistle sprouted in 3–4 weeks after seeding. The plants remained in cotyledon phase for about one week, then they developed leaf rosettes. Inflorescence shoots on the main and lateral shoots developed in June starting intensive growth of plants. Blossoming and maturing did not proceed evenly, which is typical of milk thistle (Table 2). The most adverse meteorological conditions for growing and cropping milk thistle were observed in 2003. That year was characterized by an exceptionally warm and dry growing season, which was conducive to intensive feeding by *C. piger.* As a result some plants died, and plant density was the lowest (Table 3). In the following years, in spite of the pest presence, plant density was higher, but in monoculture this resulted from successive germination of seeding material spilled from the maturing plants grown in the previous years. Density of milk thistle grown on crop rotation plots was higher by 12 plants per 1m^2 than in monoculture. The late seeding date contributed to higher plant density in both cultivation treatments.

Table 2. Dates of developmental phases of milk thistle plants

Developmental phase	Monoculture – early seeding	Monoculture – late seeding	Crop rotation – early seeding	Crop rotation – late seeding
2004				
2–4 leaves	13.05	20.05	13.05	20.05
6–8 leaves	22.05	09.06	22.05	09.06
Beginning of inflorescence shoot formation	09.06	24.06	09.06	24.06
Beginning of blossoming	20.06	06.07	20.06	06.07
End of blossoming	06.07	28.07	06.07	28.07
Ripeness for harvest	30.07	09.08	29.07	09.08
2005				
2–4 leaves	10.05	27.05	10.05	25.05
6–8 leaves	25.05	07.06	25.05	07.06
Beginning of inflorescence shoot formation	09.06	22.06	09.06	22.06
Beginning of blossoming	25.06	05.07	01.07	06.07
End of blossoming	12.07	18.07	12.07	18.07
Ripeness for harvest	18.07	03.08	29.07	03.08

Table 3. Density of milk thistle plants per 1 m^2

Years	Monoculture – early seeding	Monoculture – late seeding	Crop rotation – early seeding	Crop rotation – late seeding
2003	17.0	26.0	–	–
2004	30.6	47.2	36.6	41.5
2005	28.4	26.6	45.9	55.8
Mean (2004–2005)	29.5	36.9	41.3	48.7
LSD (0.05)	6.67			

The phase of 2–4 leaves was the first developmental stage, at which the extent of damage caused by pest insects was assessed. Except for single cotyledons and leaf perforation by *C. piger* adults, no other damage was observed. The infestation of plants by *C. piger* larvae was relatively low, but the differences between stands grown in crop rotation and in monoculture were statistically significant. In 2004 the average infestation level for all treatments was lower than in 2005 (Table 4). Density of *C. piger* larvae on plants, in the two years of research, ranged from 1 to 4 specimens per m^2. Their number was significantly highest in monoculture – early seeding treatment (Table 5).

At the phase of 6–8 leaves, on plants grown in monoculture, both on the ones seeded early and late, an extensive damage to the leaves was noted, caused by *C. piger* adults. Also a number of adults of garden chafer – *Phyllopertha* (*Anomala*) *horticola* L. – (*Coleoptera, Scarabaeidae*) was found feeding on the crop. Lower leaves of plants growing in monoculture were slightly yellowed, reflecting their disturbed development caused by *C. piger* larvae feeding on roots. The plants grown on crop rotation plots, both seeded early or late, displayed uneven growth, but no yellowing or damaged leaves were present. The infestation and density of *C. piger* larvae was only slightly higher that at the earlier phase.

At the next phase, the beginning of inflorescence shoot formation, plants from monoculture – early seeding treatment were characterized by uneven growth and a large number of yellowed lower leaves. The plants grown in crop rotation system, regardless of seeding date, showed the best appearance. Only few adults of ladybeetles – (*Coleoptera, Coccinellidae*), robber flies – (*Diptera, Asilidae*), garden chafers, squash bugs – *Coreus marginatus* L. – (*Heteroptera, Coreidae*) were found. The progressive infestation and density of *C. piger* larvae in monoculture was observed, larger on plants seeded early than seeded late. Density of *C. piger* larvae on plants was the lowest on crops in rotation – early seeding treatment, and the highest in monoculture – early seeding.

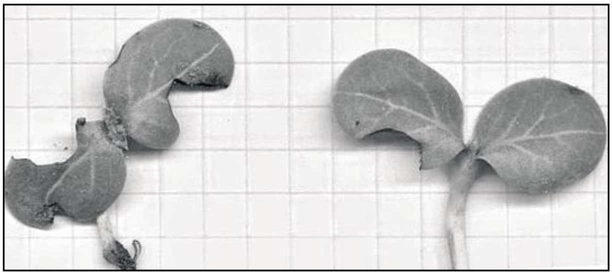

Fig. 1. Damage of *Silybum marianum* cotyledones caused by adults of *Cleonus piger* (J. Andrzejewska)

A the beginning of blossoming the infestation in monoculture – early seeding treatment became nearly six times higher than in crop rotation – early seeding treatment. Figure 1 shows damage of roots. The difference in density of larvae between the monoculture and crop rotation stands was smaller than in infestation, but this was due to larger plant density in crop rotation stands. Inflorescences of plants from monoculture – early seeding treatment were settlected by few adults of pollen beetles – *Meligethes aeneus* F. – (*Coleoptera, Nitidulidae*). Also honey bees appeared – *Apis*

Table 4. Infestation of milk thistle roots by *Cleonus piger* larvae on 25 plants in successive developmental phases [number of specimens]

Year/method of cultivation/time of seeding	2–4 leaves	6–8 leaves	Beginning of inflorescence shoot formation	Beginning of blossoming	End of blossoming	Ripeness for harvest	Mean
2004							
Monoculture I	2.48 c	3.02 c	3.73 c	6.26 c	7.44 c	17.00 c	6.66 c
Monoculture II	1.02 b	1.13 b	1.68 b	2.07 b	5.00 b	6.19 b	2.85 b
Crop rotation I	0.75 a	0.86 a	0.97 a	1.12 a	1.32 a	1.89 a	1.15 a
Crop rotation II	0.73 a	0.79 a	0.95 a	1.27 a	1.50 a	1.74 a	1.16 a
Mean	1.25	1.45	1.83	2.68	3.82	6.71	2.96
LSD (0.05)	0.24	0.19	0.17	0.30	0.49	1.02	0.17
2005							
Monoculture I	3.68 c	6.23 c	8.72 c	11.16 d	12.43 b	17.01 c	9.87 c
Monoculture II	1.35 b	1.61 ab	2.45 b	10.11 c	18.49 c	20.91 d	9.15 b
Crop rotation I	0.81 a	1.36 a	1.61 a	1.81 a	3.02 a	6.18 b	2.47 a
Crop rotation II	0.78 a	1.71 b	2.50 b	2.68 b	2.90 a	4.02 a	2.43 a
Mean	1.66	2.73	3.82	6.44	9.21	12.03	5.98
LSD (0.05)	0.22	0.25	0.35	0.30	0.76	1.83	0.30
2004–2005							
Monoculture I	3.08 c	4.63 c	6.23 d	8.71 d	9.94 b	17.00 d	8.27 c
Monoculture II	1.18 b	1.37 b	2.06 c	6.09 c	11.75 c	13.55 c	6.00 b
Crop rotation I	0.78 a	1.11 a	1.29 a	1.47 a	2.17 a	4.04 b	1.81 a
Crop rotation II	0.76 a	1.25 b	1.73 b	1.97 b	2.20 a	2.88 a	1.80 a
Mean	1.45	2.09	2.83	4.56	6.51	9.37	4.47
LSD (0.05)	0.11	0.13	0.18	0.15	0.39	0.93	0.21

I – early seeding date; II – late seeding date
The same letters indicate values that are not significantly different

Table 5. Density of *Cleonus piger* larvae in milk thistle plants in the successive developmental phases [number of specimens/m^2]

Year/method of cultivation/time of sowing	2–4 leaves	6–8 leaves	Beginning of inflorescence shoot formation	Beginning of blossoming	End of blossoming	Ripeness for harvest	Mean
2004							
Monoculture I	3.09 c	3.70 d	4.63 d	7.56 d	9.26 c	21.60 c	8.31 d
Monoculture II	1.89 b	2.12 c	3.30 c	4.01 c	9.43 c	11.79 b	5.42 c
Crop rotation I	1.10 a	1.28 a	1.46 a	1.64 a	2.01 a	2.74 a	1.71 a
Crop rotation II	1.25 a	1.45 b	1.66 b	2.08 b	2.49 b	2.91 a	1.97 b
Mean	1.83	2.14	2.76	3.82	5.80	9.76	4.35
LSD (0.05)	0.14	0.15	0.13	0.11	0.26	0.47	0.08
2005							
Monoculture I	4.23 d	7.10 d	9.94 d	12.78 d	14.20 c	19.88 c	11.36 d
Monoculture II	1.42 a	1.73 a	2.66 a	10.64 c	19.95 d	22.61 d	9.83 c
Crop rotation I	1.62 b	2.52 b	2.98 b	3.44 a	5.51 a	11.48 b	4.59 a
Crop rotation II	1.93 c	3.90 c	5.58 c	6.13 b	6.69 b	8.92 a	5.52 b
Mean	2.30	3.81	5.29	8.25	11.59	15.72	7.83
LSD (0.05)	0.19	0.19	0.19	0.76	0.83	0.86	0.13
2004–2005							
Monoculture I	3.66 c	5.40 c	7.29 d	10.17 d	11.73 c	20.74 d	9.84 d
Monoculture II	1.65 b	1.93 a	2.98 b	7.33 c	14.69 d	17.20 c	7.63 c
Crop rotation I	1.36 a	1.90 a	2.22 a	2.54 a	3.76 a	7.11 b	3.15 a
Crop rotation II	1.59 b	2.68 b	3.62 c	4.11 b	4.59 b	5.92 a	3.75 b
Mean	2.07	2.98	4.03	6.04	8.69	12.74	6.09
LSD (0.05)	0.09	0.08	0.09	0.39	0.42	0.44	0.11

I – early seeding date; II – late seeding date
The same letters indicate values that are not significantly different

mellifica L. – (*Hymenoptera, Apidae*), as well as aphidids (*Homoptera, Aphididae*). In monoculture – late seeding treatment small number of *Lygus* spp. (*Heteroptera, Miridae*), ladybeetles, and pollen beetles were found. In crop rotation – early seeding treatment syrphid flies – (*Diptera, Syrphidae*), and bumblebees – (*Hymenoptera, Apidae*) occurred, and in inflorescences – bees and pollen beetles (6–10 specimens per inflorescence). On leaves few shield bugs – (*Heteroptera, Pentatomidae*), were found, as well as ladybeetle larvae and aphids. On plants grown in crop rotation – late seeding treatment, only the presence of ladybeetles and *Lygus* spp. was stated.

At the end of blossoming, the infestation and density of *C. piger* increased considerably, especially in monoculture treatments. Plants grown in crop rotation, with late seeding, were infested by pollen beetles and numerous aphid colonies, feeding on stems under inflorescences.

The infestation and density of *C. piger* larvae increased in the subsequent developmental phases as well as in the subsequent years of the experiment. In 2005, the infestation and density of *C. piger* larvae in roots at particular developmental phases was twice as high as in the previous year 2004.

The feeding of *C. piger* larvae had a negative impact on milk thistle crop yield (Table 6). Crop yield of milk thistle fruits in crop rotation stands was on average 6.41 $dt \cdot ha^{-1}$, that is as much as 40%, higher than in monoculture. Both in monoculture and crop rotation stands, crop yield of milk thistle was higher in case of early seeding as compared to late seeding. The highest crop yield was collected in 2004, which was the result of favourable moisture conditions – relatively heavy rainfall in May stimulated vegetative growth, while low rainfall in July was conducive to even ripening. Although main roots had been damaged by *C. piger* larvae, the plants tended to develop lateral roots close to the surface of soil, being able to absorb rainfall water.

At the ripeness-for-harvest phase, the highest density of *C. piger* larvae – 21 specimens per m^2 – was found in the treatment monoculture – early seeding, while the lowest – 6 specimens per m^2 – in the treatment crop rotation – late seeding. In roots, in addition to the larvae, also *C. piger* chrysalides were occasionally observed (Fig. 2).

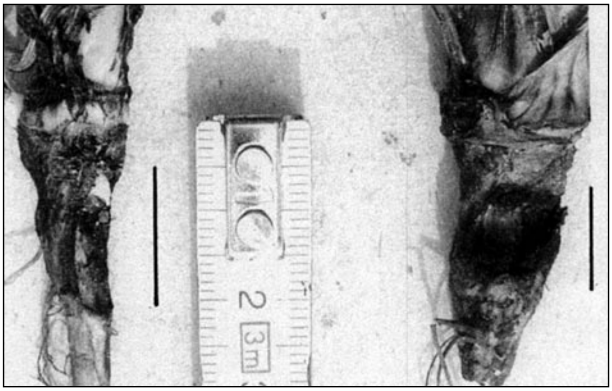

Fig. 2. Damage of *Silybum marianum* roots caused by larvae of *Cleonus piger* (the bars indicate size of damage) (S. Ignaczak)

Table 6. Crop yield of milk thistle fruits in dt·ha^{-1}

Years	Monoculture – early seeding	Monoculture – late seeding	Crop rotation – early seeding	Crop rotation – late seeding
2003	7.69	9.76	–	–
2004	14.40	13.05	17.97	18.23
2005	6.25	5.25	16.66	11.70
Mean 2004–2005	10.28	9.17	17.31	14.96
LSD (0.05)	0.515			

DISCUSSION

The obtained results call for verification of the present recommendations regarding the possibilities of growing milk thistle in monoculture. After the third year of cultivating milk thistle on the same field the crop yield fell by as much as 40% compared to stands in crop rotation. This resulted mainly from the accumulation of the pest insect – *C. piger*, but probably also from other factors typical of monoculture cultivation, for instance, the exhaustion of nutrients in soil. In the present experiment, identical mineral fertilization was applied in monoculture and crop rotation cultivation, as recommended (Rumińska 1991).

In the opinion of the present authors, if in milk thistle plantations stunting and early withering of plants is observed in patches, and in roots *C. piger* larvae are found, then in this field and in its nearest vicinity monoculture should be abandoned. According to the present findings, the distance of 1.5 km provides sufficient spatial isolation. The infestation by *C. piger* larvae in crop rotation stands should be attributed to the fact that they were attacked by the adults feeding on other plants and overwintering nearby. In the warm Balkan region, density of *C. piger* larvae in beet plantations was 22, reaching the maximum of 97 specimens per 1 m^2 (Ignjac et al. 1984). The present findings confirm that *C. piger* poses a special threat in warm and dry years. High temperatures are conducive to migration and increase of the pest insect, and in addition, little rainfall makes it impossible for plants to develop strong lateral roots, capable of taking over physiological functions of the main root.

One of the insecticides recommended for controlling *C. piger* Scop. beetles is Diazinon 250 EC (Zalecenia Ochrony Roślin 2004/2005). This product was applied by the present authors in the course of their experiment (both in monoculture and crop rotation stands), and it may have reduced the harmfulness of the insect, but its effectiveness certainly was not sufficient enough. At present, the principles of good agricultural practice are being introduced in cultivation of herbal plants, which, in fact, exclude the use of many chemical products, including insecticides (Good Agricultural and Collection Practice for Starting Materials of Herbal Origin 2002). Then it is important to focus on preventing massive incidence of pest insects, which means avoiding growing herbal plants in monoculture. Another practical problem may arise from the fact that the *C. piger* adults, in spite of their relatively large size, are hardly visible. This is because of the color of their coat, which matches the color of soil. An adult insect can be noticed while moving, what it does very "lazily". Characteristic marks of feeding on edges of cotyledons are clear evidence of the presence of this pest insect.

In milk thistle stands grown in monoculture, postponing seeding from the beginning to the third decade of April resulted in a significant decrease in the infestation and density of *C. piger* larvae, but nevertheless these were incomparably higher than in crop rotation. A lower infestation of roots following the later date of seeding probably resulted from shortening of the egg-laying period. But in crop rotation, with a relatively small infestation of roots, such a pattern was not observed. However, postponing the seeding date led to the decrease in crop yield in both cultivation systems, so from the practical standpoint, it cannot be recommended.

Both in monoculture and crop rotation stands, the presence of other pest insects was established; among them black bean aphid can be potentially dangerous. This may confirm the opinion that milk thistle plantations are under little threat from insect pests (Rumińska 1991).

In Australia, where *Silybum marianum* occurs as an intrusive weed, attempts have been made to control it by introducing natural pests selected from the local fauna. However, none of insects or mites proved sufficiently effective, and some promising results were obtained only by infecting milk thistle plants with the fungus *Septoria silybi* (Bruzzese 1996).

CONCLUSIONS

1. *Cleonus piger* may pose a serious threat for milk thistle, particularly in monoculture. Crop rotation while maintaining spatial isolation from attacked plantations considerably decreases the risk of damage inflicted by this pest insect.
2. Postponing seeding date from the beginning to the third decade of April restricts the infestation and density of *Cleonus piger* larvae, but it leads to the decrease in milk thistle crop yield.
3. No other insects occurring in milk thistle plantations have been found to be harmful. However, aphidids may be potentially dangerous, especially in conditions when plant ripening is delayed.

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REFERENCES

Abdel-Moniem A.S.H. 2002. The seed-head weevil, *Larinus latus* herbst (*Coleoptera*: *Curculionidae*) as a new record in Egypt on the milk thistle, *Silybum marianum* (L.) (*Asteraceae:Compositaea*). Archiv. Phytopath. Pflanz. 35: 157–160.

Andrzejewska J., Skinder Z. 2003. Damage inflicted by *Cleonus piger* Scop. on milk thistle (*Silybum marianum* Gaertn.). Herba Pol. 3/4: 332–334.

Benada J., Spacek J., Sediveg J. 1984. Atlas Chorób i Szkodników Buraka. PWRiL, Warszawa: 188–191.

Bruzzese E. 1996. Ecology of *Cirsium vulgare* and *Silybum marianum* in relation to biological control. Plant Prot. Q. 11, sup. 2: 245–249.

Gassmann A., Tosevski I., Diefer B., Schneider H. 2002. Biological Control of Canada Thistle, *Cirsium arvense*. CABI Bioscience Switzerland Centre, Annual Report for 2002, p. 18.

Good Agricultural and Collection Practice for Starting Materials of Herbal Origin (GACP). 2002. London. EMEA/HMPWP/31/99 Rev. 3: 3–11.

Hinfner K., Homonnay F. 1966. Atlas Chorób i Szkodników Buraka Cukrowego. PWRiL, Warszawa: 12–15.

Ignjac M., Jaramazovic J., Tomasev B., Dulic K. 1984. The role of mycoses in beet weevil (*Cleonus – Bothynoderes punctiventris* Germ) occurrence prognosis in 1984 in Subotica region [Yugoslavia, injurious insects, secerna repa]. Glasnik zastite bilja 1: 8–11.

Morazzoni P., Bombardelli E. 1995. *Silybum marianum* (*Carduus marianus*). Fitoterapia 66: 3–42.

Nieves-Aldrey J. L. 1995. Two new species of *Aylacini* (Hymenoptera: Cynipidae) from France, associated with *Silybum* and a new gall from *Scorzonera* (*Asteraceae*). Ann. Soc. Entomol. Fr. 31: 369–375.

Peschken D.P. 1984. Host range of *Lema cyanella* (Coleoptera: Chrysomelidae), a candidate for biocontrol of Canada thistle, and of four stenophagous, foreign insects in North America. Can. Entomol. 116: 1377–1384.

Rumińska A. 1991. Poradnik Plantatora Ziół. PWRiL, Poznań: 301–305.

Smreczyński S. 1968. Klucze do Oznaczania Owadów Polski. Cz. XIX, 98 c. Wyd. PWN: 30–43.

Uygur S., Smith L., Uygur F.N., Cristofaro M., Balciunas J. 2005. Field assessment in land of origin of host specificity, infestation rate and impact of *Ceratapion basicorne* a prospective biological control agent of yellow starthistle. BioControl 50: 525–541.

Zahradnik J. 1985. Kaefer Mittel- und Nordwesteuropas. Verlag Paul Parey. Hamburg und Berlin, p. 318.

Zalecenia Ochrony Roślin na lata 2004/2005. Cz. IV. Rośliny Ozdobne. Rośliny Zielarskie. Instytut Ochrony Roślin: 213–216.

Zsemberi S., Pets G. 1993. The sugar beet weevil *Cleonus punctiventris* GERMAR. Cukoripar 46: 85–87.

POLISH SUMMARY

OCENA SZKODLIWOŚCI SZARKA LENIWCA (*CLEONUS PIGER* SCOP.) I INNEJ ENTOMOFAUNY W UPRAWIE OSTROPESTU PLAMISTEGO [*SILYBUM MARIANUM* (L.) GAERTN.]

W latach 2003–2005 badano skutki żerowania szarka leniwca (*Coleoptera; Curculionidae*) i występowanie innych owadów na roślinach ostropestu plamistego uprawianego w monokulturze i zmianowaniu (stanowisko po zbożach) w dwóch terminach siewu. Stwierdzono postępujące wraz rozwojem roślin i nasilające się w kolejnych latach zasiedlenie i zagęszczenie larw szarka leniwca w korzeniach roślin uprawianych w monokulturze. Skutkiem żerowania był spadek plonu o 40% w porównaniu do uprawy ostropestu w zmianowaniu. W zmianowaniu zasiedlenie korzeni było w końcowym etapie 4–5 razy mniejsze niż w monokulturze. Opóźnienie o trzy tygodnie terminu siewu ostropestu powodowało, że zasiedlenie i zagęszczenie larw było mniejsze, ale plony niełupek niższe w porównaniu do siewu wczesnowiosennego. Nie stwierdzono szkodliwości innej entomofauny.