Boll. Zool. agr. Bachic.
Ser. II, 33 (3): 365-372

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The scale insects (Hemiptera: Coccoidea) of economic importance in the Kazimierz Landscape Park in Poland

Abstract - Observations carried out during 1996-1998 showed that out of 22 scale insect species widely known as pests only *Parthenolecanium corni* (Bouché), *P. pomeranicum* (Kawecki), *Aulacaspis rosae* (Bouché), *Carulaspis juniperi* (Bouché), *Lepidosaphes ulmi* (L.) and *Leucaspis pini* (Hartig) are of great economic importance as they appeared with high frequency and high density, in the Kazimierz Landscape Park. The species which are characterized by low frequency, but appearing on their hosts with high density are also of economic significance for trees and shrubs. These are: *Kermes quercus* (L.), *Parthenolecanium rufulum* (Cockerell), *Asterodiaspis variolosa* (Ratzeburg), *Chionaspis salicis* (L.) and *Leucaspis loewi* (Colvée). Attention should also be paid to *Planococcus vovae* (Nassonov) which was characterized by relatively high frequency, but occurred on the junipers only at low density. Another group of scale insects was composed of the species which were characterized by low frequency and occurred on their hosts only at low density.

Key words: Hemiptera, Coccoidea, economic importance, Poland.

INTRODUCTION

Scale insects as plant pests have a special significance in the sub-tropical and tropical zones, where they cause a lot of damage in the cultivation of citrus, olives, coffee, cocoa, tea and grapevines. In temperate climate countries the economic significance of this group of insects is moderate.

The list of scale insects of Poland contains 181 species (including glasshouse ones), but only some can do harm that is economically significant. These include the species which are pests on fruit trees and shrubs, ornamental and forest plants as well as species which are harmful pests of pot plants grown in homes and glasshouses.

Among the scale insects that were found in the Kazimierz Landscape Park, 22 species are commonly known as pests of forests, orchards, gardens and green areas in cities. The purpose of the paper was to evaluate the intensity of their occurrence in

the natural and para-natural open communities as well as in the anthropogenic ones of the studied area.

MATERIALS AND METHODS

The Kazimierz Landscape Park is located in the area of the Lublin district and comprises the area known as "the triangle Kazimierz – Naleczów – Pulawy". The size of park area is 13,670 ha and it belongs to the Malopolska – Lubelska Upland.

The studies were carried out during the years 1996-1998, in four types of plant communities and on 41 stands, namely: 1) oak-hornbeam forest (Tilio-Carpinetum) – 6 stands, 2) termophilous oakwood (Potentillo albae-Quercetum) – 3 stands, 3) xerothermic sward and brushwood – 11 stands, 4) anthropogenic communities – 21 stands. The material was collected on trees and shrubs growing in orchards, household gardens and allotments.

Plants were chosen at random in various points of each stand and examined for scale insects. Bark pieces or fragments of twigs with coccids were taken from the examined plants. In total 1073 samples were collected and 400 microscope slides were made for species identification.

The quantitative analysis of the studied material was performed making use of the following ecological indicators:

1) frequency of species, i.e. the percentage of host plants on which a given species was found, and
2) density, i.e. the number of specimens per plant. Density was defined according to a five-degree scale: Class I – up to 10 individuals per plant; Class II – from 11 to 50 individuals per plant; Class III – from 51 to 100 individuals per plant; Class IV – from 101 to 500 individuals per plant; Class V – massive density.

RESULTS

Observations showed that 22 species commonly known as pests of woody plants occurred in the Kazimierz Landscape park. Based on the frequency and density indices, they can be divided into three groups. The first one includes the species which were characterized by a fairly high frequency in anthropogenic or natural communities, and colonies in the higher density classes, i.e. in the third, fourth and fifth ones. This group is composed of *Parthenolecanium corni* (Bouché), *P. pomeranicum* (Kawecki), *Aulacaspis rosae* (Bouché), *Carulaspis juniperi* (Bouché), *Lepidosaphes ulmi* (L.) and *Leucaspis pini* (Hartig) (Table 1). Among them, four species (*P. corni, A. rosae, L. ulmi, L. pini*) were present in all the examined communities, but only *P. corni* and *L. ulmi* were found most frequently on trees and shrubs in the anthropogenic communities, where their colonies occurred in all five classes of density. High density of *L. ulmi* was also observed on trees and thickets in oak-hornbeam forests and xerothermic

Table 1 - A list of scale insects (Hemiptera, Coccoidea) characterized by high frequency and high density on their hosts in the Kazimierz Landscape Park

Species	Community	Number of localities	Host	Number of studied plants	Frequency %	Density classes
***Planoccocus vovae* (Nassonov)**	Termophilous oakwood	2	***Juniperus communis***	22	13.7	I
	Xerothermic grasslands and shrubs	3	***Juniperus communis***	29	62.1	I
	Anthropogenic communities	2	***Juniperus communis***	19	15.8	I
***Parthenolecanium corni* (Bouché)**	Oak-hornbeam forest	2	***Betula sp., Corylus sp., Prunus sp., Rubus sp., Cornus sp.,Quercus sp.***	343	5.8	I
	Termophilous oakwood	2	***Malus sp., Pirus sp., Robinia sp., Fraxinus sp., Juglans sp.,*** Prunus sp., Quercus sp.	347	2.9	I
	Xerothermic grasslands and shrubs	9	***Betula sp., Prunus sp., Quercus sp.,Prunus sp., Cerasus sp.***	322	2.8	I, II
	Anthropogenic communities	26	***Betula sp., Corylus sp. Prunus sp., Cerasus sp., Crataegus sp., Malus sp., Ribes sp., Vinca sp.,Tilia sp., Juglans sp., Pirus sp., Rubus sp.,Cornus sp., Sorbus sp.***	1114	10.4	I-V
***Parthenolecanium pomeranicum* (Kawecki)**	Anthropogenic communities	10	***Taxus sp.***	29	44.8	I-III
***Aulacaspis rosae* (Bouché)**	Oak-hornbeam forest	1	***Rosa sp.*** Rubus sp.	46	6.5	I, II, IV
	Termophilous oakwood	2	***Rosa rugosa*** Rosa sp.	37	8.1	I, II
	Xerothermic grasslands and shrubs	8	***Fragaria sp., Rosa sp., Rubus sp.***	141	30.1	I-V
	Anthropogenic communities	8	***Rosa sp.*** Rubus sp.	155	9.7	II-IV
***Carulaspis juniperi* (Bouché)**	Anthropogenic communities	2	***Chamaecyparis sp.***	20	40.0	I-III

(Table 1. continued)

***Lepidosaphes ulmi* (Linnaeus)**	Oak-hornbeam forest	2	Betula sp.,Crataegus sp.,Vaccinium sp.	140	2.8	I, III, V
	Termophilous oakwood	2	***Berberis sp., Pirus sp.,*** Cornus sp., Vaccinium sp.	42	9.5	II, III
	Xerothermic grasslands and shrubs	3	***Betula sp., Prunus spinosa***	228	4.4	III, V
	Anthropogenic communities	52	***Malus sp.*** Ribes sp., Vaccinium sp.	492	13.4	I-V
***Leucaspis pini* (Hartig)**	Oak-hornbeam forest	1	***Pinus silvestris***	48	2.3	I, II
	Termophilous oakwood	2	***Pinus silvestris***	135	10.4	II-IV
	Xerothermic grasslands and shrubs	3	***Pinus silvestris***	87	3.4	I, II
	Anthropogenic communities	2	***Pinus silvestris***	57	5.3	II

grasslands and shrubs, but in these communities these species showed low frequency (2.8% and 4.4% respectively) (Table 1). However, *A. rosae* and L. pini showed the highest frequency in natural communities (30.1% in xerothermic grasslands and shrubs and 10.4% in termophilous oakwood, respectively), where they occurred on plants in the second, third, fourth or fifth density classes. High density of *A. rosae* was also observed on roses and raspberries cultivated by man, but its frequency in the anthropogenic community was much lower, i.e. 9.7% (Table 1). *Parthenolecanium pomeranicum* and *C. juniperi* occurred only in household gardens and allotments and their frequency was 44.8% and 40.0% respectively. They were found on plants in the first, second and third density classes.

Special mention should be made of *Planococcus vovae* (Nassonov). This species was collected in three types of communities and on seven stands. It was characterized by a relatively high frequency, up to 62.1% on xerothermic grasslands and shrubs, but it occurred everywhere only in the first density class on its host, *Juniperus communis* (Table 1).

Another group of scale insects was composed of the species which were always characterized by a low frequency, but which occurred at a high density on their hosts in some communities (Table 2). These are *Kermes quercus* (L.), *Parthenolecanium rufulum* (Cockerell), *Asterodiaspis variolosa* (Ratzeburg), *Chionaspis salicis* (L.) and *Leucaspis loewi* (Colvée). *Kermes quercus* occurred rarely and only in natural communities but the studies observed massive density of this species on oaks in oak-hornbeam forest. The frequency of *P. rufulum* in forest and anthropogenic communities was within the values of 0.8 – 4.8%, and its colonies in the third and fourth density classes occurred only on oak trees growing in allotments and household gardens. *Asterodispis variolosa* was present in three communities and on five stands. The highest

Table 2 - A list of scale insects (Hemiptera, Coccoidea) characterized by low frequency and high density on their hosts in the Kazimierz Landscape Park

Species	Community	Number of localities	Host	Number of studied plants	Frequency %	Density classes
***Kermes quercus* (Linnaeus)**	Oak-hornbeam forest	1	***Quercus sp.***	124	0.8	V
***Parthenolecanium rufulum* (Cockerell)**	Oak-hornbeam forest	1	***Quercus sp.***	124	0.8	I, II
	Termophilous oakwood	1	***Quercus sp.***	120	0.8	I, II
	Anthropogenic communities	6	***Quercus sp.***	124	4.8	I-IV
***Asterodiaspis variolosa* (Ratzeburg)**	Oak-hornbeam forest	1	***Quercus sp.***	124	0.8	I- III
	Xerothermic grasslands and shrubs	1	***Quercus sp.***	74	1.4	I
	Anthropogenic communities	3	Quercus sp.	49	5.1	I-IV
***Chionaspis salicis* (L.)**	Termophilous	1	***Salix sp.*** ***Populus sp.,***	32	6.3	III
	Anthropogenic communities	1	***Populus sp.***	28	3.6	III
***Leucaspis loewi* (Colvée)**	Oak-hornbeam forest	1	***Pinus silvestris***	48	2.1	I, II
	Termophilous oakwood	1	***Pinus silvestris***	135	2.3	II-IV
	Xerothermic grasslands and shrubs	1	***Pinus silvestris***	87	1.1	I, II
	Anthropogenic communities	1	***Pinus silvestris***	57	1.8	I

density of this species was observed on oaks growing in man-managed areas. The frequency of *C. salicis* was higher in termophilous oakwood than in the anthropogenic environment, but the numbers that settled on the trees in both communities were in the third density class. Colonies of *L. loewi* occurred on pine trees in all plant communities, but in the third and fourth density classes only in termophilous oakwood.

A third group is composed of the species which occurred in all communities with low intensity, which means that their frequency was low and the density on all host plants only in the first density class (Table 3). The species in this group are

Matsucoccus pini (Green), *Phenacoccus aceris* (Signoret), *Eulecanium douglasi* (Sulc), *E. tiliae* (L.), *Physokermes piceae* (Schrank), *Pulvinaria vitis* (L.), *Sphaerolecanium prunastri* (Fonscolombe), *Diaspidiotus ostreaeformis* (Curtis), *D. zonatus* (Frauenfeld) and *Dynaspidiotus abietis* (Schrank).

DISCUSSION

Observations showed that of the 22 species widely known as pests, only *P. corni, P.pomeranicum, A. rosae, C. juniperi, L. ulmi and L. pini* appeared with high intensity in the investigated area. Studies on the occurrence of scale insects in orchards in the Kazimierz Landscape Park by Lagowska & Kuziola (1995) showed that *P. corni* occurred with greater intensity in orchards which were not protected against pests, and *L. ulmi* in the protected ones. These two species became economically important pests in the orchards of Holland and Switzerland (Dijke & Frankenhuyzen, 1985; Wildbolz, 1988). *Aulacaspis rosae* and *C. juniperi* are also found on the world list of dangerous pests (Davidson & Miller, 1990). *Aulacaspis rosae* is a xerophilous species and it was mostly observed as a pest on roses in the urban environment (Komosinska, 1974; Bognar & Vinis, 1979). In this study it occurred with greater intensity in xerothermic grasslands and shrubs than in the anthropogenic environment. *Carulaspis juniperi* appeared in great density on false cypresses growing in household gardens. According to Komosinska (1974) this species clearly prefers the urban environment. It is also noted as a pest of ornamental arborvitae and junipers in the parks of Russia (Kozarzhevskaya, 1995) and Crimea (Kuznetsov, 1970).

In the Kazimierz Landscape Park economic significance can be attributed to the species which were not frequent, but appeared in considerable density on their host plant. It should be emphasized that such trees and shrubs become a source of infection for the neighbouring plants. *Planococcus vovae*, which appeared very often on wild juniper, poses a threat for ornamental conifers grown in household gardens and on allotments, especially those neighbouring xerothermic grassland.

Seven species (*M. pini, K. quercus, P. corni, P. rufulum, A. variolosa, C. salicis, L. ulmi*) out of the scale insects presented in Tables 1-3, are included in the forest pests in Poland (see Szujecki 1998). In the investigated area all these species in forest communities were characterized by low frequency and only some of them were distinguished by high density. Those were: *Ch. salicis, L. ulmi* and *K. quercus.* The first two species also occurred in massive density in the forests in the vicinity of Warsaw (Komosinska, 1987).

In forest biocenoses far from industrial centers, scale insects as pests are of little economic significance. On the other hand, studies found a remarkable increase of this group of insects in industrial areas both in deciduous and coniferous timber species (Siewniak, 1972). *Matsucoccus pini* is a spreading pest of pine trees, especially in industrialized regions. Its massive occurrence on pines growing in areas contaminated by industrial emission was observed by Siewniak (1972). In the studied area this species appeared with very low intensity.

Table 3 - A list of scale insects (Hemiptera, Coccoidea) characterized by low frequency and low density on their hosts in the Kazimierz Landscape Park.

Species	Community	Number of localities	Host	Number of studied plants	Frequency %	Density classes
***Matsucoccus pini* (Green)**	Termophilous oakwood	1	***Pinus silvestris***	135	0.7	I
***Phenacoccus aceris* (Signoret)**	Oak-hornbeam forest	3	***Sorbus sp., Fraxinus sp., Acer sp.***	120	2.5	I
	Termophilous oakwood	1	***Acer sp.***	88	4.5	I
	Anthropogenic communities	4	Malus sp, Cerasus sp., Prunus sp., Pirus sp.	359	2.8	I
***Eulecanium douglasi* (Šulc)**	Termophilous oakwood	1	***Betula sp.***	108	0.9	I
***Eulecanium tiliae* (Linnaeus)**	Oak-hornbeam forest	1	***Tilia sp.***	37	5.4	I
	Termophilous oakwood	1	***Prunus sp.***	170	0.6	I
	Xerothermic grasslands and shrubs	1	***Betula sp.***	108	0.9	I
	Anthropogenic communities	2	***Malus sp., Populus sp.***	343	0.6	I
***Physokermes piceae* (Schrank)**	Anthropogenic communities	1	***Picea sp.***	15	6.7	I
***Pulvinaria vitis* (Linnaeus)**	Oak-hornbeam forest	1	***Betula sp.***	98	1.0	I
	Anthropogenic communities	2	***Malus sp., Pirus sp.,***	330	0.6	I
***Sphaerolecanium prunastri* (Fonscolombe)**	Xerothermic grasslands and shrubs	1	***Prunus spinosa***	120	0.8	I
***Diaspidiotus ostreaeformis* (Curtis)**	Oak-hornbeam forest	2	***Betula sp.***	98	3.1	I
	Anthropogenic communities	1	***Quercus sp.***	49	2.0	I
***Diaspidiotus zonatus* (Frauenfeld)**	Oak-hornbeam forest	1	***Quercus sp.***	124	0.8	I
***Dynaspidiotus abietis* (Schrank)**	Xerothermic grasslands and shrubs	1	***Pinus silvestris***	87	4.5	I
	Anthropogenic communities	2	***Abies alba Pinus silvestris***	77	2.6	I

It is worth noting that in the Kazimierz Landscape Park certain species associated with monocotyledonous plants (not included in this study) were also found in large numbers. One was *Eriococcus brachypodii* (Borchsenius & Danzig) which occurred not only on wild grasses and sedges, but also on barley. This fact shows that this species, after spending the winter on grasses, can move to the neighbouring cultivated fields when under vegetation. In the area studied a threat for the meadows and pastured utilized by man can also be posed by *Eriopeltis festucae* (Fonscolombe), which occurred in high frequency and numbers. In the Ukraine 636 ovisacs of this species were observed per $1m^2$ of the meadow, which made it impossible for cattle to graze (Tereznikova, 1975).

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