SPECIES OF PHYTOPHAGOUS INSECTS ASSOCIATED WITH STRAWBERRIES IN LATVIA

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The aim of the present study was to describe the phytophagous insect fauna of strawberries in Latvia. This study was carried out in 2000–2004 on strawberry plantations in Tukums, Rīga, Dobele, and Limbaži districts. Insects were collected from strawberry fields by pitfall trapping, sweep netting and leaf sampling methods. A total of 137 insect species belonging to seven orders and 41 families were identified to species. Of the phytophagous insects, the order Orthoptera was represented by one species, other orders by a larger number of species: Hymenoptera (3), Diptera (16), Lepidoptera (20), Thysanoptera (21), Hemiptera (39), and Coleoptera (37). Of the recorded insects, 48 species have a status of general strawberry pests.

Key words: *Fragaria × ananassa, strawberry pests, insect diversity.*

INTRODUCTION

Strawberries are one of the commercially important crop plants in Latvia. Harmful phytophagous insect species on strawberry have been studied during the period between 1928 and 1989. Thirty-four phytophagous insect species were recorded on strawberry during previous studies in Latvia. Previous studies showed that the order Coleoptera was represented by 15 species, other orders were represented by a smaller number of species Hemiptera (7), Hymenoptera (7), Lepidoptera (4) and Orthoptera (1) (Ozols, 1929; Циновский, 1953; Шульц, 1958; Данка, 1959; Čakstiņa, 1962; Ozols, 1963; Велце, 1968; Путеле, 1970; Pūtele, 1971; Dūks, 1976; Килевича и др., 1978; Рупайс, 1989). In 1999–2004, the insect fauna of strawberry agroecosystems in Latvian commercial strawberry farms was surveyed by the authors, and this information is partially reported in previous articles (Petrova *et al.*, 2000, 2005, 2006, 2010; Karpa *et al.*, 2007).

The aim of our investigation was to obtain information on the fauna of phytophagous insects, with an emphasis on strawberry pest species.

MATERIALS AND METHODS

The study was generally conducted during the vegetation seasons 2000–2004, mainly in the Pūre Horticultural Research Centre. The area of strawberry plantings in Pūre, Tukums District, was six hectares. Strawberry fields in other districts were also examined: Dobele (two hectares), Limbaži (two hectares) and Rīga (one hectare). Approximately 30 different strawberry (*Fragaria × ananassa*) cultivars were

planted in rows with 30-cm distance between plants and 100-cm distance between rows. In the period from June 1 to September 30 in 2000–2004, random sweep netting (monthly) and leaf sampling (twice a month) were performed for general collection of homopterans, thysanopterans, lepidopterans and hemipterans. A leaf sample consisted of one mature, opened and one young, unopened leaf per plant from 100 randomly selected strawberry plants. Insects (generally coleopterans and bugs) were collected from strawberry plants by pitfall trapping (twice a month) from April 9 to November 8 in 2001–2002 and from May 25 to October 30 in 2003–2004. Glass cups (500 cm³) with diameter of 70 mm were used for this purpose. For preservation 6% acetic acid with a detergent added was used. Small insects were fixed in 75% ethanol and placed onto glass slides in Berlese medium (Dunger *et al.*, 1997).

Thrips species were identified by Dr. V. Velikan, leafhoppers by Dr. A. Emelyanov, weevils by Dr. B. Korotyaev, bugs by Dr. I. Kegner, aphids by Dr. A. Stekolshchikov (Institute of Zoology, St. Petersburg) and by Dr. R. Rakauskas (Vilnius University). Other beetles were identified by Dr. A. Barševskis (University of Daugavpils, Institute of Systematic Biology) and by Dr. D. Teļnovs (Entomological Society of Latvia), lepidopterans by M. Sc. N. Savenkovs (Latvian Museum of Natural History), and dipterans by Dr. V. Spuņģis and Dr. A. Karpa (Institute of Biology, University of Latvia).

RESULTS

Altogether 137 phytophagous insect species were found on cultivated strawberry plants, belonging to seven orders and 41 families, including 37 beetles, 21 thrips, 20 butterflies,

16 flies, 15 bugs, 15 cicadas, six aphids, three hymenopterans, two planthoppers, one whitefly and one grasshopper. The list of species found on strawberry in this study is given

Table 1

LIST OF PHYTOPHAGOUS INSECTS RECORDED ON STRAWBERRIES DURING THE STUDIES 2000–2004

Order/ Family/ Species	Status
1	2
Order Orthoptera	
Acrididae <i>Omocestus rufipes</i> (Zetterstedt, 1821)	
Order Thysanoptera	
Phlaeothripidae <i>Cephalothrips monilicornis</i> (O. M. Reuter, 1880)	
<i>Haplothrips aculeatus</i> (Fabricius, 1803)	*
<i>Haplothrips leucanthemi</i> (Schränk, 1781)	*
Thripidae <i>Anaphothrips obscurus</i> (Müller, 1776)	
<i>Aptinothrips rufus</i> Haliday, 1836	
<i>Chirothrips manicatus</i> Haliday, 1836	
<i>Dictyothrips betae</i> Uzel, 1895	
<i>Frankliniella intonsa</i> (Trybom, 1895)	*
<i>Frankliniella occidentalis</i> (Pergande, 1895)	*
<i>Frankliniella tenuicornis</i> (Uzel, 1895)	
<i>Limothrips denticornis</i> Haliday, 1836	
<i>Thrips atratus</i> Haliday, 1836	*
<i>Thrips fuscipennis</i> Haliday, 1836	*
<i>Thrips major</i> Uzel, 1895	*
<i>Thrips nigropilosus</i> Uzel, 1895	
<i>Thrips physapus</i> Linnaeus, 1758	
<i>Thrips tabaci</i> Lindeman, 1889	*
<i>Thrips validus</i> Uzel, 1895	
<i>Thrips vulgarissimus</i> Haliday, 1836	
<i>Oxythrips ajugae</i> Uzel, 1895	
<i>Oxythrips bicolor</i> (O. M. Reuter, 1879)	
Order Hemiptera	
Suborder Heteroptera	
Berytidae <i>Adelphocoris quadripunctatus</i> (Fabricius, 1794)	
<i>Neides tipularius</i> (Linnaeus, 1758)	
Lygaeidae <i>Nysius ericae</i> (Schilling, 1829)	
Miridae <i>Apolygus lucorum</i> (Meyer-Dur, 1843)	
<i>Halticus apterus</i> (Linnaeus, 1758)	**
<i>Lygus pratensis</i> (Linnaeus, 1758)	**
<i>Lygus rugulipennis</i> Poppius, 1911	**
<i>Megaloceroea recticornis</i> (Geoffroy, 1785)	
<i>Notostira erratica</i> (Linnaeus, 1758)	
<i>Orthops kalmii</i> (Linnaeus, 1758)	
<i>Orthotylus flavosparsus</i> (C. R. Sahlberg, 1841)	
<i>Plagiognathus arbustorum</i> (Fabricius, 1794)	
<i>Plagiognathus chrysanthemi</i> (Wolff, 1804)	
Pentatomidae <i>Dolycoris baccarum</i> (Linnaeus, 1758)	**
Rhopalidae <i>Stictopleurus crassicornis</i> (Linnaeus, 1758)	
suborder Cicadomorpha	
Aphrophoridae <i>Philaenus spumarius</i> (Linnaeus, 1758)	*
Cicadellidae <i>Agallia brachyptera</i> (Boheman, 1847)	
<i>Alebra albostrigata</i> (Fallen, 1826)	
<i>Aphrodes bicinctus</i> (Schränk, 1776)	*
<i>Elymana sulphurella</i> (Zetterstedt, 1828)	

in Table 1. Of all recorded insects, 44 species are known strawberry pests and four have a status of potential strawberry pests (Alford, 2007).

Table 1 (continued)

1	2
<i>Emelyanoviana mollicula</i> (Boheman, 1845)	
<i>Empoasca pteridis</i> (Dahlbom, 1850)	*
<i>Errastunus ocellaris</i> (Fallen, 1806)	
<i>Eupteryx</i> ex gr. <i>nigropunctata</i> (Linnaeus, 1758)	*
<i>Eupteryx</i> ex gr. <i>vittata</i> (Linnaeus, 1758)	
<i>Euscelis distinguendus</i> (Kirschbaum, 1858)	
<i>Evacanthus interruptus</i> (Linnaeus, 1758)	
<i>Macrosteles laevis</i> (Ribaut, 1927)	*
<i>Megophthalmus scanicus</i> (Fallen, 1806)	
<i>Psammotettix confinis</i> (Dahlbom, 1850)	*
suborder Fulgoromorpha	
Delphacidae <i>Dicranotropis hamata</i> (Boheman, 1847)	
<i>Javesella obscura</i> (Boheman, 1847)	
suborder Sternorrhyncha	
Aleyrodidae <i>Aleyrodes lonicerae</i> Walker, 1852	
Aphididae <i>Acyrtosiphon malvae</i> (Mosley, 1841)	*
<i>Acyrtosiphon pisum</i> (Harris, 1776)	
<i>Amphorophora rubi</i> (Kaltenbach, 1843)	*
<i>Aphis forbesi</i> Weed, 1889	
<i>Aulacorthum solani</i> Kaltenbach, 1843	*
<i>Macrosiphum rosae</i> (Linnaeus, 1758)	*
Order Coleoptera	
Anthicidae <i>Notoxus monoceros</i> (Linnaeus, 1760)	
Apionidae <i>Ischnopterapion virens</i> (Herbst, 1797)	
Attelabidae <i>Apoderus erythropterus</i> (Gmelin, 1790)	
Chrysomelidae <i>Batophila rubi</i> (Paykull, 1799)	
<i>Cassida nebulosa</i> Linnaeus, 1758	
<i>Chaetocnema concinna</i> (Marshall, 1802)	*
<i>Galeruca tanacetii</i> (Linnaeus, 1758)	*
<i>Galerucella pusilla</i> (Duftschmid, 1825)	
<i>Galerucella tenella</i> (Linnaeus, 1761)	*
<i>Gastrophysa polygoni</i> (Linnaeus, 1758)	
<i>Longitarsus parvulus</i> (Paykull, 1799)	
<i>Longitarsus suturellus</i> (Duftschmid, 1825)	
<i>Phyllotreta flexuosa</i> (Illiger, 1794)	
Curculionidae <i>Anthonomus rubi</i> (Herbst, 1795)	*
<i>Ceutorhynchus typhae</i> (Herbst, 1795)	
<i>Chlorophanus viridis</i> (Linnaeus, 1758)	*
<i>Otiorynchus ligustici</i> (Linnaeus, 1758)	*
<i>Otiorynchus ovatus</i> (Linnaeus, 1758)	*
<i>Philopeda plagiata</i> (Schaller, 1783)	*
<i>Phyllobius argentatus</i> (Linnaeus, 1758)	*
<i>Phyllobius maculicornis</i> Germar, 1824	*
<i>Phyllobius pomaceus</i> Gyllenhal, 1834	*
<i>Rhinoncus bruchoides</i> (Herbst, 1784)	
<i>Sitona lineatus</i> (Linnaeus, 1758)	
<i>Tychius picirostris</i> (Fabricius, 1787)	
Elateridae <i>Adrastus pallens</i> (Fabricius, 1792)	
<i>Hemicrepidius niger</i> (Linnaeus, 1758)	*
Kateretidae <i>Kateretes pedicularius</i> (Linnaeus, 1758)	*

Table 1 (continued)

	1	2
Mordellidae	<i>Mordellistena pseudonana</i> Ermisch, 1956	
Nitidulidae	<i>Meligethes aeneus</i> (Fabricius, 1775)	*
Phalacridae	<i>Olibrus aeneus</i> (Fabricius, 1792)	
	<i>Olibrus pygmaeus</i> (Sturm, 1807)	
Rhynchitidae	<i>Neocoenorrhinus germanicus</i> (Herbst, 1797)	*
Rutelidae	<i>Phyllopertha horticola</i> (Linnaeus, 1758)	*
Silphidae	<i>Silpha tristis</i> Illiger, 1798	
	<i>Thanatophilus sinuatus</i> (Fabricius, 1775)	*
Tenebrionidae	<i>Lagria hirta</i> (Linnaeus, 1758)	
Order Hymenoptera		
Tenthredinidae	<i>Allantus calceatus</i> (Klug, 1818)	*
	<i>Allantus cinctus</i> (Linnaeus, 1758)	*
	<i>Cladius pectinicornis</i> (Geoffroy, 1785)	*
Order Diptera		
Chloropidae	<i>Microcercis trigonella</i> (Duda, 1933)	
	<i>Oscinella frit</i> (Linnaeus, 1758) s. l.	
	<i>Oscinella pusilla</i> (Meigen, 1830)	
Ephydriidae	<i>Hydrellia maculiventris</i> Becker, 1896	
	<i>Nostima picta</i> (Fallen, 1813)	
	<i>Philygria interstincta</i> (Fallen, 1813)	
	<i>Philygria vittipennis</i> (Zetterstedt, 1838)	
	<i>Psilopa nitidula</i> Fallen, 1813	
Opomyzidae	<i>Geomyza apicalis</i> (Meigen, 1830)	
Psillidae	<i>Chamaepsila nigricornis</i> (Meigen, 1826)	
Tephritidae	<i>Ensina sonchi</i> (Linnaeus, 1767)	
	<i>Oxya parietina</i> (Linnaeus, 1758)	
	<i>Sphenella marginata</i> (Fallen, 1814)	
	<i>Tephritis crepidis</i> Hendel, 1927	
	<i>Trupanea stellata</i> (Fuesslin, 1775)	
Tipulidae	<i>Tipula paludosa</i> Meigen, 1830	*
Order Lepidoptera		
Choreutidae	<i>Anthophila fabriciana</i> (Linnaeus, 1767)	
Erebidae	<i>Phragmatobia fuliginosa</i> (Linnaeus, 1758)	
Gelechiidae	<i>Scrobipalpa atriplicella</i> (Fischer von Roslerstamm, 1841)	
Noctuidae	<i>Autographa gamma</i> (Linnaeus, 1758)	*
	<i>Euxoa tritici</i> (Linnaeus, 1761)	
	<i>Hydraecia micacea</i> (Esper, 1789)	
	<i>Macdunnoughia confusa</i> (Stephens, 1850)	
	<i>Xestia c-nigrum</i> (Linnaeus, 1758)	*
Plutellidae	<i>Plutella xylostella</i> (Linnaeus, 1758)	*
Tineidae	<i>Tineola bisselliella</i> (Hummel, 1823)	
Tortricidae	<i>Acleris comariana</i> (Lienig & Zeller, 1846)	*
	<i>Acleris rufana</i> (Denis & Schiffermüller, 1775)	
	<i>Celypha lacunana</i> (Denis & Schiffermüller, 1775)	*
	<i>Celypha rivulana</i> (Scopoli, 1763)	
	<i>Celypha striana</i> (Denis & Schiffermüller, 1775)	
	<i>Cnephasia asseclana</i> (Denis & Schiffermüller, 1775)	
	<i>Cnephasia stephensiana</i> (Doubleday, 1849)	
	<i>Cydia nigricana</i> (Fabricius, 1794)	
	<i>Dichrorampha petiverella</i> (Linnaeus, 1758)	
	<i>Grapholita compositella</i> (Fabricius, 1775)	

* – listed as strawberry pests; ** – potential strawberry pests

DISCUSSION

The order Orthoptera was represented only by one species — *Omocestus rufipes* (syn.: *O. ventralis*). The order Thysanoptera was represented by 21 phytophagous thrips species from the Phlaeothripidae and Thripidae families, including 12 polyphagous thrips. Of them eight species are known as strawberry pests: *Thrips fuscipennis*, *T. tabaci*, *T. atratus*, *T. major*, *Frankliniella occidentalis*, *F. intonsa*, *Haplothrips aculeatus* and *H. leucanthemi*. *T. fuscipennis* and *T. tabaci* were the most widespread and abundant on leaves, flowers, and berries in Latvian strawberry fields.

The order Hemiptera, suborder Heteroptera, was represented by 15 phytophagous species from five families. Of these, *Lygus rugulipennis*, *L. pratensis* and *Plagiognathus chrysanthemi*, which are potential strawberry pests and serious and injurious pests of many crops, are stable inhabitants of 20 agroecosystems (strawberry, grain and leguminous crops, corn, timothy and fescue meadow, potato, sugar beet, vegetables and common trees and etc.) and native biocenoses of Latvia (Varzinska, 1977). Three species (*L. rugulipennis*, *L. pratensis* and *Halticus apterus*) are known as potential strawberry pests.

The suborder Cicadomorpha was represented by 15 phytophagous species belonging to two families — Aphorophoridae and Cicadellidae. The family Aphorophoridae was represented by the strawberry pest *Phyllaenus spumarius*, which was found on strawberry as a dominant species in June and July and constituted 15.4% and 19.8%, respectively, of all cicadas collected during these months.

Polyphagous *P. spumarius* was observed to be a common species on strawberry in Latvia also in earlier studies (Čakstiņa, 1962; Ozols, 1963; Velce, 1968; Велце и Данка, 1970; Dūks, 1976) (Table 2).

The Cicadellidae family was represented by 14 species. *Aphrodes bicinctus* was found as a dominant species on strawberry in 1960s (Velce, 1968). It is known as a strawberry pest and as a vector of strawberry phytoplasma disease ("Green petal"), and also is registered as a vector of clover and strawberry virus in Latvia (Velce, 1968; Converse, 1987). In our study, the polyphagous cicada, *Macrosteles laevis*, was the most abundant cicada species on strawberry. It is also known as a strawberry pest and as a vector of the Aster virus (Крыжановский и Данциг, 1972). The species *Empoasca pteridis*, *Eupteryx ex gr. nigropunctata* and *Psammotettix confinis* are known as strawberry pests. Five of the recorded cicada species (*P. spumarius*, *E. pteridis*, *Elymana sulphurella*, *P. confinis* and *A. bicinctus*), according to L. Dankā's (Данка, 1961) data, are also widespread in other Latvian agroecosystems (cereals, field crops, clover, sugar beet, some vegetables etc).

The family Delphacidae was represented by two species — *Dicranotropis hamata* and *Javesella obscurella*, of the suborder Fulgoromorpha. Both species are widely found in

Table 2

LIST OF PHYTOPHAGOUS INSECT SPECIES RECORDED ON STRAWBERRIES IN LATVIA IN THE PERIOD UP TO 1989¹ AND IN OUR STUDIES IN 2000–2004

Order / Family	Species	Record of species	
		reference	2000 – 2004
1	2	3	4
Order Orthoptera			
Gryllotalpidae	<i>Gryllotalpa gryllotalpa</i> L.	Ozols, 1963; Dūks, 1976	-
Order Hemiptera			
Suborder Heteroptera			
Miridae	<i>Lygus pabulinus</i> (L.)	Čakstiņa, 1962; Ozols, 1963	x
Suborder Cicadomorpha			
Aphrophoridae	<i>Philaenus spumarius</i> (L.)	Čakstiņa, 1962; Ozols, 1963; Velce, 1968; Dūks, 1976; Велце и Данка, 1970	x
Cicadelidae	<i>Aphordes bicinctus</i> (Schr.)	Velce, 1968; Данка, 1959	x
Suborder Sternorrhyncha			
Aleyrodidae	<i>Aleyrodes lonicerae</i> Walk.	Dūks, 1976	x
Aphididae	<i>Aphis forbesi</i> Weed	Рупайс, 1989	x
	<i>Macrosiphum rosae</i> L.	Килевича и др., 1978	x
	<i>Amphorophora rubi</i> (Kalt.)	Килевича и др., 1978	x
Order Coleoptera			
Attelabidae	<i>Pselaphohynchites virens</i> (Hbst.)	Ozols, 1963	x
Chrysomelidae	<i>Batophila rubi</i> Payk.	Pūtele, 1971	x
	<i>Chaetocnema concinna</i> (Marsh.)	Путеле, 1970	x
	<i>Galerucella tenella</i> (L.)	Ozols, 1929; Čakstiņa, 1962; Dūks, 1976	x
Curculionidae	<i>Anthonomus rubi</i> (Hbst.)	Čakstiņa, 1962; Ozols, 1963; Dūks, 1976	x

Latvia, but only some specimens were found on strawberry in July.

The suborder Sternorrhyncha was represented by seven species from two families (Aleyrodidae, Aphididae): one whitefly and six aphids. The whitefly species, *Aleyrodes lonicerae*, is not an important pest of commercial strawberries, but it may cause damage in extensive strawberry fields. The family Aphididae is represented by six species. Four of the reported six aphid species (*Aulacorthum solani*, *Acyrtosiphon malvae*, *Amphorophora rubi*, and *Macrosiphum rosae*) are included by Rondon & Cantiffe (2004) in the *Fragaria* aphid complex, and are considered to be serious strawberry pests, especially as vectors for viruses (Converse, 1987). The aphids *Aphis forbesi* and *A. malvae* are rare species for Latvia (Рупайс, 1989). On strawberries infected by aphid species *M. rosae* and *A. rubi*, M. Kilevica *et al.* (Килевича и др., 1978) found the following virus diseases: arabis mosaic, SMV and SMYEV. The species *A. rubi*, *A. pisum*, *A. solani* and *M. Rosae* are widespread in

Table 2 (continued)

1	2	3	4
	<i>Otiorhynchus ligustici</i> (L.)	Ozols, 1963	x
	<i>Otiorhynchus ovatus</i> (L.)	Ozols, 1963	x
	<i>Phyllopedon plagiatum</i> (Schall.)	Ozols, 1963	x
	<i>Phyllobius pomaceus</i> Gyll.	Ozols, 1963	x
Elateridae	<i>Agriotes lineatus</i> L.	Dūks, 1976	-
	<i>Agriotes obscurus</i> L.	Dūks, 1976	-
	<i>Agriotes sputator</i> L.	Dūks, 1976	-
Rhynchitidae	<i>Neocoenorrhinus germanicus</i> (Hbst.)	Ozols, 1963	x
Scarabaeidae	<i>Melolontha melolontha</i> L.	Čakstiņa, 1962; Dūks, 1976	-
	<i>Melolontha hippocastani</i> L.	Čakstiņa, 1962; Dūks, 1976	-
Order Heminoptera			
Cimicidae	<i>Abia candens</i> Knw.	Циновский, 1953	-
	<i>Abia sericea</i> L.	Циновский, 1953	-
Tenthredinidae	<i>Allantus calceatus</i> Kl.	Циновский, 1953	x
	<i>Allantus cinctus</i> L.	Циновский, 1953	x
	<i>Cladius pectinicornis</i> Geoffr.	Циновский, 1953	x
	<i>Dolerus germanicus</i> Panz.	Циновский, 1953	-
	<i>Macrophysa sanguinolenta</i> Gmel.	Циновский, 1953	-
Order Lepidoptera			
Arctiidae	<i>Arctia caja</i> L.	Шульц, 1958	-
	<i>Arctia villica</i> L.	Шульц, 1958	-
Noctuidae	<i>Hydroecia micacea</i> Esp.	Ozols, 1963	x
Hepialidae	<i>Hepialus humuli</i> L.	Шульц, 1958	-

¹ Ozols, 1929; Čakstiņa, 1962; Ozols, 1963; Velce, 1968; Pūtele 1971; Dūks, 1976; Циновский, 1953; Данка, 1959; Шульц, 1958; Путеле, 1970; Килевича и др., 1978; Рупайс, 1989

- not found; x was found by authors

Latvia, and frequently occur in Latvian agrocenoses (Рупайс, 1989; Turka, 2000). Rupais and Kalniņa (1979) recorded *A. rubi* also on strawberry *Fragaria vesca* L. Aphids usually formed small colonies on strawberry in the observed fields. The population density of aphids usually peaks during late June and July, especially when spring temperatures are moderate and humidity is high. Usually, aphids rarely reach damaging levels in strawberry production fields.

The order Coleoptera was represented by 37 phytophagous species from 14 families (Petrova *et al.*, 2005, 2006). Seventeen species of all recorded beetles are from the list of known strawberry pests (Cross and Easterbrook, 1998; Łabanowska and Bielenin, 2002). Of them, 12 weevil species are in the family Curculionidae. The most frequent eight strawberry pest-species are: *Anthonomus rubi*, *Chlorophanus viridis*, *Otiorhynchus ovatus*, *O. ligustici*, *Phyllobius pomaceus*, *Ph. maculicornis*, *Ph. argentatus* and *Philopodon plagiatum*. The family Chrysomelidae was represented by three strawberry pest species: flea beetle

Chaetocnema concinna, leaf beetle *Galerucella tenella* and *Galeruca tanacetii*, family Elateridae by the strawberry pest click beetle *Hemicrepidius niger*, family Rutelidae by leaf beetle *Phyllopertha horticola*, family Kateridae by *Kateretes pedicularius*, family Nitidulidae by *Meligethes aeneus*, and family Rhynchitidae by *Neocoenorrhinus germanicus*. All of mentioned species are widespread in Latvia and strawberry bud weevil *A. rubi* is the most important strawberry pest (Ozols, 1963).

The order Hymenoptera was represented by the family Tenthredinidae with three species: *Allantus calceatus*, *A. cinctus*, and *Cladius pectinicornis*, all known as strawberry pests.

Fauna of order Diptera was represented by 16 phytophagous species from six families (Karpa *et al.*, 2007). Almost all of the phytophagous Diptera found on strawberry are widely found in Latvia, and only *Geomyza apicalis* and *Sphenella marginata* were rare species in the ecosystems of Latvia. Several species were found to be associated with specific food plants like weeds (Compositae, Cruciferae, Gramineae) in strawberry plantations, wild grasses and herbaceous flower plants from surrounding vegetation. Among all recorded Diptera species, only *Tipula paludosa* is known as a strawberry pest (Alford, 2007).

The order Lepidoptera was represented by 20 phytophagous species from seven families, including seven polyphagous species: *Phragmatobia fuliginosa*, *Autographa gamma*, *Macdunnoghia confusa*, *Euxoa tritici*, *Xesthia c-nigrum*, *Plutella xylostella* and *Celypha rivulana*. Five of the Lepidoptera species have a status of strawberry pests: *A. gamma*, *X. c-nigrum*, *Acleris comariana*, *Celypha lacunana* and *P. xylostella*.

In recent studies, we did not find 13 phytophagous species mentioned in studies performed before 1989 (Table 2). During this study many insect species were added to the list of strawberry pests in comparison with the number of strawberry pests mentioned in previous studies (Ozols, 1963; Petrova *et al.*, 2000). Information about some pest species importance in agricultural conditions is insufficient, especially in regard to changes in climatic conditions in Europe, future studies are needed.

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AR ZEMENĒM SAISTĪTO AUGĒDĀJU KUKAIŅU SUGU SASTĀVS LATVIJĀ

Pētījuma mērķis bija noskaidrot augēdāju kukaiņu faunu zemeņu agrocenozēs Latvijā. Šis pētījums veikts no 2000. gada līdz 2004. gadam zemeņu stādījumos Tukuma, Rīgas, Dobeles, Limbažu novados. Kukaiņus ievāca zemeņu laukos, izmantojot augsnēs lamatas, entomoloģisko tīkliņu un zemeņu lapu paraugus. Zemeņu stādījumos konstatētas 137 augēdāju kukaiņu sugas no septiņām kārtām un 41 dzimtas, kas identificētas līdz sugai. Kopumā no visiem augēdājiem kukaiņiem Orthoptera kārtu pārstāvēja viena suga, Hymenoptera – trīs sugas, Diptera – 16 sugas, Lepidoptera – 20 sugas, Thysanoptera – 21 suga, Coleoptera – 37 sugas un Hemiptera – 39 sugas. No visām konstatētajām kukaiņu sugām 48 ir zemeņu kaitēkļi.