

BUTTERFLY PESTS (LEPIDOPTERA) OCCURRING ON VEGETABLE CROPS IN POLAND

A review

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ABSTRACT

There are over 2,240 butterfly species of Lepidoptera belonging to 17 families recorded in Poland. Of those, 63 phytophagous species have been noted in vegetable agrocenoses at a level of pest status. They constitute 18% of all harmful entomofauna found on vegetable crops. The species described in this paper are common on all vegetable crops growing in Poland, and all parts of plants. The most abundant pests found on aerial parts of crops include the silver Y moth (*Autographa gamma*), which causes damage to 20 species of vegetables, and species belonging to the genera *Mamestra*, *Lacanobia* and *Anarta*, which feed on more than 10 vegetable species. Of the polyphagous leaf roller moths (Tortricidae), the most numerous are the species belonging to the genus *Cnephasia*. Periodically, they pose a significant threat, among others for beetroot, pea, cucumber, and lettuce. The diamondback moth (*Plutella xylostella*) and the cabbage butterfly (*Pieris rapae*) are dominant butterfly pests on brassica vegetables. A component of harmful entomofauna on onion crops is leek moth (*Acrolepiopsis assectella*), a species permanently dominant on onion vegetables in Poland since 1930s. The species of the family Depressariidae cause the greatest damage on the generative organs of seed crops, mainly of dill, carrot and parsley. Underground parts of vegetable crops are damaged by cutworms (Noctuidae), which belong to the group of soil-borne pests. Among more than 60 species belonging to this family, nine cause the greatest damage to vegetable crops. The turnip moth (*Agrotis segetum*), as a dominant species in recent years, accounted for about 80% of cutworms damaging vegetable crops, and prefers onion, leek, carrot, parsley, celery and corn. Although the European corn borer (*Ostrinia nubilalis*) is considered a polyphagous species, it forms the most abundant populations on maize out of all other crops.

Key words: Depressariidae, Noctuidae, Pieridae, Plutellidae, Tortricidae

INTRODUCTION

Over 2,240 species of butterflies belonging to 17 families have been identified in Poland (Bogdanowicz et al. 2004). Of them, 18% constitute harmful entomofauna found on vegetable crops. The first report on pests of vegetable crops in Poland was published by Gustaw Belke (1861). Systematic observations of harmful entomofauna occurring in agricultural fields in Poland began in 1919 (Romaniszyn & Schille 1929; Kinel & Kuntze

1931; Ruszkowski 1933). Initially, they concerned agricultural areas within the borders of pre-war Poland (until 1939), and later on areas of the present country's territory (after 1945).

During 1861–2015, 63 phytophagous butterfly species belonging to 17 families were recorded at the level causing measurable damage to vegetable crops (Table 1). This review covers 80 species and botanical varieties of vegetable species that are hosts of the preimaginal stages of these insect species.

Table 1. Harmful butterfly species recorded on vegetable crops in Poland

Family	Number of species	
	on vegetable crops	total in Poland*
Epermeniidae – fringe-tufted moths	1	12
Depressariidae – depressariid moths	4	63
Gelechiidae – twirler moths or gelechiid moths	2 + 1**	200
Geometridae – geometrid moths or measuring worms	1	410
Gracillariidae – leaf blotch miner moths	2	111
Hepialidae – ghost moths or swift moths	1	6
Nepticulidae – pygmy leafmining moths	1	99
Erebidae – tiger moths	2	45
Lymantriidae – tussock moths	1	16
Noctuidae – owlet moths	24	477
Nymphalidae – brushfooted butterflies	1	75
Papilionidae – swallowtails butterflies	1	5
Pieridae – yellow-white butterflies	4	17
Pyralidae – snout moths	5	242
Tortricidae – leaf rollers moths	9	446
Acrolepiidae – false diamondback moths	1	8
Plutellidae – diamondback moths	1	7

*According to Karsholt and Razowski (1996), and Bogdanowicz et al. (2004)

**New phytophagous species in Poland – South American tomato moth (*Tuta absoluta* Povolny) (Wilczyńska 2013)

Butterfly imagines feed on liquid food, primarily flower nectar and juices leaking from plants or from fermenting fruit. They also use the water found in puddles or shallow ponds. Pre-imaginal stages – caterpillars – feed on the underground and above-ground parts of plants, including their generative organs, at all stages of development, from germinating seeds to the harvesting stage. Besides vegetables, they colonize also wild plant species.

When discussing the importance of individual species, biological and ecological factors should be considered in determining the risk periods during the growing season, from sowing to harvesting. The harmful entomofauna occurring in agrocenoses in the countries neighboring Poland was also taken into account.

The taxonomy of the pests was based on the list of species published in “Fauna Europaea” (<https://fauna-eu.org>).

Pests of Brassica vegetables (Table 2)

Host plants:

- broccoli (*Brassica oleracea* L. var. *botrytis italica* Plenck);
- kale (*Brassica oleracea* L. var. *sabellica* L.);
- cauliflower (*Brassica oleracea* L. var. *botrytis* L.);
- Brussels sprouts (*Brassica oleracea* L. var. *gemmifera* L.);
- white cabbage (*Brassica oleracea* L. var. *capitata* L. f. *alba*);
- red cabbage (*Brassica oleracea* L. var. *capitata* L. f. *rubra*);
- Savoy cabbage (*Brassica oleracea* var. *sabauda* L.);
- kohlrabi (*Brassica oleracea* L. var. *gongylodes* L.);
- rutabaga (*Brassica napus* L. var. *napobrassica* L.);
- horseradish (*Armoracia rusticana* G.);
- turnip (*Brassica rapa* L. var. *rapifera* Metzger);
- black radish (*Raphanus sativus* L. var. *niger* (Mill.) S. Kerner);
- radish (*Raphanus sativus* L. var. *sativus* L.);
- wild Brassica plants.

Brassica vegetables have been widely cultivated in Poland for hundreds of years. They come from the *Brassica oleracea* var. *silvestris* L., which grows in the wild in the southern and western regions of Europe. The oldest cultivated crops are as follows: white cabbage, cauliflower, radish, kale, and horseradish. The remaining vegetables in this family became popular in the nineteenth and twentieth centuries. Radish and early varieties of black radish are grown in an annual cycle. The remaining crops are biennial, except for horseradish, which is a perennial crop.

Individual butterfly species damage the above-ground, underground and generative parts of the above-mentioned crops during the whole growing season.

Significant damage to the above-ground parts of plants is caused by caterpillars of Noctuid moths. Two species are dominant: *Autographa gamma* and *Mamestra brassicae* (Ruszkowski 1933; Ogijewicz 1938; Lipa et al. 1977; Napiórkowska-Kowalik 1996; Szwejda & Rogowska 2004). They were mentioned as pests of cabbage already by Belke (1861). Caterpillars of *Autographa gamma* feed on all brassica cultivars, mainly on the leaves but also on the apical parts. Caterpillars of *Mamestra brassicae* bore deeply into the heads of cabbage (white, red, Savoy, Brussels). They also damage leaves of horseradish, kale, radish, kohlrabi, and roses (inflorescences) of cauliflower and broccoli, polluting them with feces. Other species, such as *Melanchra persicariae*, *Lacanobia (Diataraxia) oleracea*, *Anarta (Calocestra) trifolii*, *Acrionicta (Viminia) rumicis* and *Trachea atriplicis*, are less numerous (Ruszkowski 1933; Ruszkowski et al. 1935; Ogijewicz 1938; Szwejda 1985; Napiórkowska-Kowalik 1996). Caterpillars of these species damage also the generative parts – flowers and seed pods. Hosts for these pest species are also plants of Fabaceae, Solanaceae, Polygonaceae, and Poaceae families. They are commonly found in agrocenoses of neighboring countries (Heddergott et al. 1953; Łoginowa 1980; Crüger 1991).

Species from the Pieridae family, such as cabbage butterfly (*Pieris brassicae*), small white (*P. rapae*), green-veined white (*P. napi*), and the less numerous Bath white (*Pontia daplidice*) are common in all growing regions (Ruszkowski 1933; Ruszkowski et al. 1935; Ogijewicz 1938; Lipa et al. 1977; Szwejda 1985; Rogowska & Szwejda 2002).

P. brassicae caterpillars feed on the developing leaves, and *P. rapae* caterpillars cause the greatest damage to the top part of the plant by feeding on the heart leaves. Late cultivars of white, red and Savoy cabbage, cauliflower and broccoli are also infested. They are also found in large numbers on kale, radish and horseradish. *Pieris rapae* and *Pontia daplidice* occur most often on seed plantations, damaging the generative parts.

Plutella (Plutella) xylostella causes the greatest losses on white cabbage, broccoli, cauliflower and horseradish (Ruszkowski 1933; Ruszkowski et al. 1935; Ogijewicz 1938; Lipa et al. 1977; Kempczyński 1985; Rogowska & Szwejda 2002; Szwejda 2004). Caterpillars initially mine leaves, and older individuals gnaw windows in them (Beiger 2001). This species is not very sensitive to external environmental conditions; hence, it is massively present on early cultivars, despite the unfavorable weather conditions. Caterpillars of the first generation feed on the heart leaves, damaging the apical meristem, reducing the size of the cabbage head, while cauliflower and broccoli preserve rose development. In seed plantations, second- and third-generation caterpillars, in addition to leaves, damage the generative parts, flowers, and pods.

Species belonging to the genus *Cnephasia* are a local threat. They prefer white cabbage (Kotliński 2009). So far, three species have been identified on domestic plantations *Cnephasia stephensiana*, *C. asseclana*, and *C. incertana* (Beiger 2001). Caterpillars initially form mines in the leaves, and after leaving them, they feed on the leaves covered with silk webs.

Evergestis extimalis causes significant economic damage to seed plantations, mainly to radish and turnip (Ruszkowski 1933; Ogijewicz 1938; Szwejda 1985, 2004). Caterpillars gnaw the walls of the pods and eat the seeds. Infested pods are enveloped with silk web, with visible holes through which the caterpillars exit. *Evergestis* caterpillars damage cabbage leaves during head formation (Beiger 2001).

In the 1920s and 1930s, cauliflower was damaged by *Spilosoma lubricipeda* (Romaniszyn & Schille 1929; Ruszkowski 1933), but currently this species is not recorded on Brassica vegetables as a pest. Other species of owlet moths (Noctuidae) are described in the subsection Underground root pests.

Table 2. Lepidoptera species occurring on Brassica vegetables

Species	Frequency of occurrence	
	leaf Brassica vegetables	root Brassica vegetables
Erebidae		
<i>Spilosoma lubricipeda</i> (L.)	C	
Noctuidae		
<i>Trachea atriplicis</i> (L.)	C	C
<i>Autographa gamma</i> (L.)	A	A
<i>Lacanobia (Diataraxia) oleracea</i> (L.)	B	B
<i>Lacanobia (Dianobia) suasa</i> (Denis & Schiff.) syn. <i>Mamestra dissimilis</i> Knoch	B	C
<i>Anarta (Calocestra) trifolii</i> (Hufn.)	B	C
<i>Mamestra brassicae</i> (L.)	A	A
<i>Melanchra persicariae</i> (L.)	C	C
<i>Acronicta (Viminia) rumicis</i> (L.)	C	C
Pieridae		
<i>Pieris napi</i> (L.)	C	C
<i>Pieris brassicae</i> (L.)	A	A
<i>Pontia daplidice</i> (L.)	C	C
<i>Pontia rapae</i> (L.)	A	A
Pyralidae		
<i>Evergestis forficalis</i> (L.)	C	
<i>Evergestis extimalis</i> (Scop.)		C
Tortricidae		
<i>Cnephasia stephensiana</i> (Doub.)	C	
<i>Cnephasia incertana</i> (Treit.)	C	
<i>Cnephasia asseclana</i> (Denis & Schiff.)	C	
Plutellidae		
<i>Plutella (Plutella) xylostella</i> (L.)	A	A
Soil root pests*	A	A

A – species posing a threat during each season in all areas of cultivation

B – species posing periodic threats

C – species posing a local threat

* described in the subsection Underground root pests

Pests of bulbous vegetables (Amaryllidaceae) (Table 3)

Host plants:

- onion (*Allium cepa* L.);
- garlic (*Allium sativum* L.);
- leek (*Allium porrum* L.).

The cultivation of bulbous vegetables began in Poland in the fourteenth century. There are 24 species of *Allium* in the country, of which nine are cultivated plants. Onion, garlic and leek are biennial crops. Chives are cultivated in several-year cycles.

Acrolepiopsis assectella damages onion, garlic and leek (Ruszkowski 1933; Szwejda 1998; Beiger 2001; Szwejda & Wrzodak 2009). On onion, first-generation caterpillars of this species feed on the inner layer of the leaf, carving mine-shaped corridors.

On garlic and leek, the caterpillars damage the middle leaves, and on seed plantations also the stem and generative parts. The second and third generations inflict heavy losses on seed plantations by damaging flower heads (capitulum) and seeds.

Onion leaves, until they collapse, are damaged by several polyphagous Lepidoptera species like: *Lacanobia (Diataraxia) oleracea*, *Anarta (Calocestra) trifolii*, *Mamestra brassicae* and *Loxostege sticticalis* (Ruszkowski 1933; Ruszkowski et al. 1935; Napiórkowska-Kowalik 1996; Szwejda & Wrzodak 2009). They are regular components of phytophagous Lepidoptera fauna on bulbous vegetables as are also the soil root pests described in the subsection Underground root pests.

Table 3. Lepidoptera species occurring on bulbous vegetables

Species	Frequency of occurrence		
	onion	garlic	leek
Noctuidae			
<i>Lacanobia (Diataraxia) oleracea</i> (L.)	C		
<i>Anarta (Calocestra) trifolii</i> (Hufn.)	C		
Pyralidae			
<i>Loxostege sticticalis</i> (L.)	C		
Acrolepiidae			
<i>Acrolepiopsis assectella</i> (Zell.)	A	A	A
Soil root pests*	A	B	A

Note: see Table 2

Pests of nightshade vegetables (Solanaceae) (Table 4)

Host plants:

- pepper (*Capsicum annuum* L.);
- tomato (*Solanum lycopersicum* L.);
- eggplant (*Solanum melongena* L.).

The oldest record concerning the introduction of nightshade vegetables in Poland relates to the eggplant, grown in the second half of the eighteenth century. All species of nightshade vegetables are cultivated in an annual cycle.

The most frequently reported lepidopteran pest on tomato, eggplant and pepper plantations is *Autographa gamma* (Ruszkowski 1933; Ruszkowski et al. 1935; Macias & Szwejda 2001). Its caterpillars damage leaves and fruit buds, and also bore holes in ripening fruit. It causes the greatest damage to peppers grown in unheated plastic tunnels by skeletonizing the leaves on the apical part of plants (Macias & Szwejda 2001). *A. gamma* is a migratory species. In one growing season it can move to distant regions, e.g., from Southern Europe to Poland (Johnson 1969). This species is also commonly found on plantations in neighboring countries (Piersow 1980; Crüger 1991). Other pest species occurring on nightshade vegetables in Poland are: *Mamestra brassicae*, *Melanchnra persicariae*, *Anarta (Calocestra) trifolii* and *Lacanobia (Diataraxia) oleracea* (Ruszkowski 1933; Ruszkowski et al. 1935; Przybylski 1982; Macias & Szwejda 2001; Napiórkowska-Kowalik & Gawłowska 2009).

The common pests on tomatoes are *Gortyna flavago* and *Hydraecia micacea*. Their caterpillars bore tunnels in the core and vascular tissue of the

stems. The symptom of damage is wilting and then breaking the plants in the middle of their height during fruit ripening. (Ruszkowski 1933; Napiórkowska-Kowalik 1996).

Damage to pepper plants by caterpillars of *Ostrinia nubilalis*, a known maize pest, was observed in the largest regions of pepper cultivation in plastic tunnels in Poland (Kraków, Radom). Only the older caterpillars feed on peppers, gnawing inside the green fruit. In the early stages of development, the caterpillars feed on corn pollen, damaging also flowers and cobs. (Kania 1961; Mazurek 2002). They treat peppers as supplementary food on the way to wintering sites. The caterpillars hibernate inside the thick stalks of various plant species, including maize, millet, hemp and mugwort (Mazurek 2002). This species is also recorded in Germany as a pest of pepper and tomato fruits (Crüger 1991).

Tomato fruit can be damaged by caterpillars of the Erebidae family. *Arctia caja* occurs in various agrocenoses in Poland, not only on vegetables (Romaniszyn & Schille 1929; Kinel & Kuntze 1931; Szwejda & Rogowska 2011). The roots damage by Noctuidae larvae is described in the subsection Underground root pests.

A new pest of tomato is *Tuta absoluta*, which was introduced to Europe from South America. It was first identified on tomatoes grown in fields in Spain in 2006. Its caterpillars damage leaves, stems and fruit, gnawing corridors in the form of mines (Desneux et al. 2010). In Poland, it was first identified on tomatoes grown under cover in 2013 (Wilczyńska 2013).

Table 4. Lepidoptera species occurring on nightshade vegetables (Solanaceae)

Species	Frequency of occurrence		
	tomato	peppers	eggplant
Gelechiidae			
<i>Tuta absoluta</i> Povolny	B		
Erebidae			
<i>Arctia caja</i> (L.)	C		
Noctuidae			
<i>Autographa gamma</i> (L.)	B	B	B
<i>Gortyna flavago</i> (Denis & Schiff.)	B		
<i>Hydraecia micacea</i> (Esp.)	B		
<i>Lacanobia (Diataraxia) oleracea</i> (L.)	C	C	C
<i>Anarta (Calocestra) trifolii</i> (Hufn.)	C	C	C
<i>Mamestra brassicae</i> (L.)	C	B	C
<i>Melanchra persicariae</i> (L.)	C	C	C
Pyralidae			
<i>Ostrinia nubilalis</i> (Hbn.)		C	
Soil root pests*	C	C	C

Note: see Table 2

Pests of cucurbit vegetables (Cucurbitaceae) (Table 5)

Host plants:

- pumpkin (*Cucurbita pepo* L.);
- cucumber (*Cucumis sativus* L.).

The tradition of growing cucumbers in Europe dates back to the tenth century. In Poland, their cultivation become popular in the sixteenth century. The remaining cucurbits were introduced later. All species and cultivars of cucurbits are grown in the annual cycle.

The most dangerous pest of cucumber and pumpkin is *Autographa gamma*, which gnaws holes in the leaves (Ruszkowski 1933; Ruszkowski et al. 1935; Napiórkowska-Kowalik 1996). This species has been recorded for years in neighboring countries as a cucurbit pest (Heddergott & Weidner 1953, Osmołowski 1980; Crüger 1991). Among other common species is *Cnephasia incertana*, whose larvae mine cucumber leaves (Beiger 2001). The soil-borne pests are described in the subsection Underground root pests.

Table 5. Lepidoptera species occurring on cucurbit vegetables (Cucurbitaceae)

Species	Frequency of occurrence	
	cucumber	pumpkin
Noctuidae		
<i>Autographa gamma</i> (L.)	C	C
Tortricidae		
<i>Cnephasia incertana</i> (Treit.)	C	C
Soil root pests*	C	C

Note: see Table 2

Pests of Apiaceae vegetables (Table 6)

Host plants:

- dill (*Anethum graveolens* L.);
- carrot (*Daucus carota* L.);
- parsley (*Petroselinum crispum* Mill. Fuss.);
- parsnip (*Pastinaca sativa* L.);
- celery (*Apium graveolens* L.).

Cultivation of Apiaceae vegetables was popularized in Poland in the seventeenth century. Carrots, parsley, celery and parsnip are grown in a biennial cycle, and garden dill in annual cultivation.

During the first year of cultivation, carrot, parsnip, parsley and celery plants are damaged by the caterpillars of *Autographa gamma*, *Lacanobia* (*Dianobia*) *suasa*, *Melanchra persicariae*, *Ceramica pisi* and *Acronicta* (*Viminia*) *rumicis* (Ruszkowski 1933; Ruszkowski et al. 1935; Napiórkowska-Kowalik 1996). Queen's page caterpillars (*Papilio machaon* L.) were found on carrots, dill, and parsley (Ruszkowski 1933; Ruszkowski 1937). They tend to aggregate on plantations, feeding on the above-ground part of the plants. In the second year of cultivation, the caterpillars also damage the generative parts of the plants.

Plants on seed plantations are often damaged by species of the family Depressariidae, mostly on dill, carrot, parsley and parsnip (Beiger 2001). *Agonopterix nervosa* is a dominant species. Its caterpillars damage leaves and young shoots of plants. Older caterpillars surround the umbels with communal silk webs and feed inside them on buds, flowers, and seeds. Similar damage is caused by related pest species, such as *Depressaria* (*Depressaria*) *depressana*, *Agonopterix heracliana*, and *A. rotundella*. On celery, young caterpillars of *Epermenia* (*Calotripis*) *chaerophyllella* mine the leaves whereas the older ones feed on the underside of the pinched leaves (Beiger 2001). Damage to seed plantations is also caused by *Loxostege sticticalis* and *Sitochroa palealis* (Ruszkowski 1933). Their caterpillars feed on silk web-covered inflorescences. Common, although not numerous, are also the Tortricidae pests. The most common are *Cnephasia stephensiana* and *C. incertana*. Their caterpillars initially mine the leaves and then feed in the leaf tissue covered with silk webs (Beiger 2001). The underground parts of Apiaceae vegetables are damaged by the cutworms (Noctuidae) described in the subsection Underground root pests.

Table 6. Lepidoptera species occurring on Apiaceae vegetables

Species	Frequency of occurrence				
	carrot	parsley	celery	parsnip	dill
Epermeniidae					
<i>Epermenia</i> (<i>Calotripis</i>) <i>chaerophyllella</i> (Goeze)	C		B		
Depressariidae					
<i>Agonopterix nervosa</i> (Haw.)	B	C		C	B
<i>Depressaria</i> (<i>Depressaria</i>) <i>depressana</i> (J.Fabr.)	C			C	
<i>Agonopterix heracliana</i> (L.)	C			C	
<i>Agonopterix rotundella</i> (Doug.)	C				
Noctuidae					
<i>Autographa gamma</i> (L.)	C	C			
<i>Lacanobia</i> (<i>Dianobia</i>) <i>suasa</i> (Denis & Schiff.)	C	C			
<i>Melanchra persicariae</i> (L.)	C	C			C
<i>Ceramica pisi</i> (L.)	C	C			
<i>Acronicta</i> (<i>Viminia</i>) <i>rumicis</i> (L.)	C				
Papilionidae					
<i>Papilio machaon</i> (L.)	C	C			C

Pyralidae					
<i>Loxostege sticticalis</i> (L.)	C				
<i>Sitochroa palealis</i> (Denis & Schiff.)	C				
syn. <i>Phlyctaenodes palealis</i> (Denis & Schiff.)					
Tortricidae					
<i>Cnephasia incertana</i> (Treit.)	C				
<i>Cnephasia stephensiana</i> (Doub.)	C				
Soil root pests*	B	B	B	B	C

Note: see Table 2

Pests of legume vegetables (Fabaceae) (Table 7)

Host plants:

- broad bean (*Vicia faba* L.);
- bean (*Phaseolus vulgaris* L.);
- pea (*Pisum sativum* L.);
- lentils (*Lens culinaris* Medik.).

Cultivation of legume vegetables in Poland became popular in the seventeenth century. Legumes are grown in an annual cycle. The study takes into account both legumes grown for green vegetables and for dry seeds.

The largest group of butterfly pests on legume vegetables are species of the Noctuidae family. The occurrence of butterflies belonging to the subfamily Hadeninae was noted already in the 1920s (Ruszkowski 1933). The most numerous are: *Ceramica pisi*, *Mamestra brassicae*, *Melanchra persicariae*, *Anarta (Calocestra) trifolii* and *Lacanobia (Dianobia) suasa* (Ruszkowski 1933; Ruszkowski et al. 1935; Lipa 1977; Wnuk 1994; Napiórkowska-Kowalik 1996). Their caterpillars initially damage the leaves from the edges and then eat up the entire leaf blade. *Autographa gamma* is common on pea, broad bean and bean plantations (Ruszkowski 1933; Ruszkowski et al. 1935; Wnuk 1994; Napiórkowska-Kowalik 1996). Its caterpillars feed individually on the leaves, leaving only thicker veins. All of these species have been recorded in neighboring countries as legume pests (Osmołowski 1980; Crüger 1991).

The greatest damage on peas, and to a lesser extent on broad beans, is caused by *Epinotia nigricana* (Ruszkowski 1933; Ruszkowski et al. 1935; Ruszkowski 1937; Ogijewicz 1938; Wnuk 1994; Beiger 2001; Kaniuczak 2009; Wrzodak & Rybczyński 2010). This pest species occurs each year in all

pea-growing regions in the country. It poses the greatest threat during flowering and forming pods. The hatching caterpillars initially bite into the pod, boring a corridor in its wall, and later damage the seeds surrounding them with a silk web. Caterpillars hatched on nonflowering plants feed in the leaf axils and on the apical parts of the shoots. Peas and lentils are similarly injured by two other tortricid species: *Dichrorampha petiverella* and *Grapholita (Grapholita) nebritana*.

Cnephasia communana is a common pest in Poland, causing the greatest damage to peas (Beiger 2001). Young caterpillars mine the leaves, while older individuals feed on curled leaves covered with silk web. Plants damaged at the early stage of development do not bloom and do not form pods. Other species of this family: *Cnephasia stephensiana*, *C. asseclana*, and *C. incertana*, in addition to peas damage broad beans, beans and lentils. In the silk web-covered leaves of these crops, caterpillars gnaw irregular corridors that turn into chambers (Beiger 2001).

Aproaerema anthyllidella and *Phyllonorycter insignitella* appear locally on the broad beans (Beiger 2001). Their caterpillars feed on silk web-bound leaves. Beans are damaged by *Loxostege sticticalis* and *Vanessa cardui* (Ruszkowski 1933; Wnuk 1994). *L. sticticalis* caterpillars feed individually on the bean leaves, covering them with silk web. In contrast, *V. cardui* caterpillars feed on leaves joined by a silk web at their tips.

Most of the above-mentioned pests occur also on other small- and large-seeded legume crops such as clover, alfalfa, vetch, field pea, soybean, and lupine. Cutworms (Noctuidae) as soil-borne pests are described in the subsection Underground root pests.

Table 7. Lepidoptera species registered on legume vegetables (Fabaceae)

Species	Frequency of occurrence			
	pea	broad bean	bean	lentil
Gelechiidae				
<i>Aproaerema anthyllidella</i> (Hbn.)		C		
Gracillariidae				
<i>Phyllonorycter insignitella</i> (Zell.)		C		
Noctuidae				
<i>Autographa gamma</i> (L.)	C	C	C	
<i>Anarta (Calocestra) trifolii</i> (Hufn.)	C			
<i>Lacanobia (Dianobia) suasa</i> (Denis & Schiff.)	C			
<i>Ceramica pisi</i> (L.)	B	C		
<i>Mamestra brassicae</i> (L.)	C			
<i>Melanchra persicariae</i> (L.)	C			
Nymphalidae				
<i>Vanessa cardui</i> (L.)			C	
Pyralidae				
<i>Loxostege sticticalis</i> (L.)			C	
Tortricidae				
<i>Epinotia nigricana</i> (H.-Sch.) syn. <i>Laspeyresia nigricana</i> (Steph.)	A	C		
<i>Dichrorampha petiverella</i> (L.) syn. <i>Laspeyresia dorsana</i> (J.Fabr.)	C			C
<i>Grapholita (Grapholita) nebritana</i> (Treit.)	C			C
<i>Cnephasia communana</i> (H.-Sch.) syn. <i>Cnephasia wahlbomiana</i> (L.)	C	C	C	
<i>Cnephasia asseclana</i> (Denis & Schiff.)	C	C	C	
<i>Cnephasia incertana</i> (Traut.)	C	C	C	C
<i>Cnephasia stephensiana</i> (Doub.)	B	C	C	
Soil root pests*	C	C	C	C

Note: see Table 2

Pests of Asteraceae vegetables (Table 8)

Host plants:

- chicory (*Cichorium intybus* L.);
- artichoke (*Cynara scolymus* L.);
- lettuce (*Lactuca sativa* L.);
- scorzonera (*Scorzonera hispanica* L.).

The vegetable crops of the Asteraceae family were popularized in Poland in the nineteenth and twentieth centuries. All cultivars of lettuce and artichoke are grown annually, and chicory and scorzonera are biennial crops.

The greatest damage to lettuce, chicory, scorzonera and artichoke plantations was caused by *Mamestra brassicae* and *Autographa gamma*. Less numerous are *Lacanobia (Diataraxia) oleracea*, *Anarta (Calocestra) trifolii* and *Arctia caja* (Ruszkowski 1933; Ruszkowski et al. 1935; Ogijewicz 1938; Szwejda 1985). Caterpillars of these species gnaw holes in the leaves, damaging plants from the

early stages of development until harvest. The cabbage moth (*Mamestra brassicae*) was recorded as a pest of lettuce already in the nineteenth century (Belke 1861). This species has been one of the main pests of lettuce also in neighboring countries (Heddergott & Weidner 1953; Łoginowa 1980). Periodically, *Eucosma conterminana* causes large losses in lettuce seed plantations occurring in gradations and completely destroying the seed baskets together with the seeds (Szwejda 1985). Caterpillars of two species: *Cnephasia incertana* and *C. stephensiana* damage lettuce leaves by feeding on them inside silk web tents (Beiger 2001). Significant damage is also caused by cutworms, mainly on lettuce and scorzonera plantations (Ruszkowski 1933; Szwejda 1985). They gnaw holes in the upper part of the root collar, while the young plants are completely eaten up. Their species composition is given in the subsection Underground root pests.

Table 8. Lepidoptera species occurring on Asteraceae vegetables

Species	Frequency of occurrence			
	lettuce	chicory	scorzonera	artichoke
Erebidae				
<i>Arctia caja</i> (L.)	C			
Noctuidae				
<i>Autographa gamma</i> (L.)	C		C	C
<i>Lacanobia (Diataraxia) oleracea</i> (L.)	C		C	C
<i>Anarta (Calocestra) trifolii</i> (Hufn.)	C		C	C
<i>Mamestra brassicae</i> (L.)	B		C	C
<i>Autographa gamma</i> (L.)	B		C	C
Tortricidae				
<i>Eucosma conterminana</i> (Guinee)	A			
<i>Cnephasia incertana</i> (Treit.)	C			
<i>Cnephasia stephensiana</i> (Doub.)	C			
Soil root pests*	B	C	B	C

Note: see Table 2

Pests of amaranth vegetables (Table 9)

Host plants:

- red beet (*Beta vulgaris* L. subsp. *vulgaris* L.);
- leaf red beet (*Beta vulgaris* L. subsp. *cicla* L.);
- spinach (*Spinacia oleracea* L.).

In Poland, red beet and spinach were popularized at the beginning of the eighteenth century, whereas the leaf beet was known since the Piast times (from the eleventh century). Beets are grown in a two-year cycle and spinach in an annual cycle.

Autographa gamma is commonly found on the above-mentioned crops (Ruszkowski 1933; Ruszkowski et al. 1935; Lipa 1977; Nawrocka 1985). Its caterpillars gnaw the edges of the leaves. This species, as a main pest of beetroot and spinach, also occurs in neighboring countries (Heddergott & Weidner 1953; Pietrucha 1980; Benada et al. 1963). *Mamestra brassicae*, *Lacanobia (Diataraxia)*

oleracea, *L. (Dianobia) suasa*, *Anarta (Calocestra) trifolii*, and *Melanchra persicariae* also occur frequently (Ruszkowski 1933; Ruszkowski et al. 1935; Ruszkowski 1937; Lipa 1977; Napiórkowska-Kowalik 1996). *Mamestra brassicae* and *Acronicta (Viminia) rumicis* were known as pests of red beet already in the nineteenth century (Belke 1861). Of the other species, *Loxostege sticticalis* occurs sporadically (Ruszkowski 1933). Its caterpillars damage the leaves and the apical part of the seed shoots by digging their corridors, similarly as *Gortyna flavago* (Ogijewicz 1938). Common are also leaf miners of the family Tortricidae. Beiger (2001) lists three species feeding on beetroot and spinach: *Cnephasia stephensiana*, *C. asseclana*, and *C. incertana*. The harmfulness and species composition of cutworms are described in the subsection Underground root pests.

Table 9. Lepidoptera species occurring on Amaranth vegetables

Species	Frequency of occurrence	
	root and leaf beet	spinach
Noctuidae		
<i>Autographa gamma</i> (L.)	B	B
<i>Mamestra brassicae</i> (L.)	B	C
<i>Lacanobia (Diataraxia) oleracea</i> (L.)	C	C
<i>Lacanobia (Dianobia) suasa</i> (Denis & Schiff.)	C	C
<i>Anarta (Caloestra) trifolii</i> (Hufn.)	C	C
<i>Melanchra persicariae</i> (L.)	C	C
<i>Acrionicta (Viminia) rumicis</i> (L.)	C	C
<i>Gortyna flavago</i> (Denis & Schiff.)	C	
Pyralidae		
<i>Loxostege sticticalis</i> (L.)	C	
Tortricidae		
<i>Cnephasia asseclana</i> (Denis & Schiff.)	C	C
<i>Cnephasia incertana</i> (Treit.)	C	
<i>Cnephasia stephensiana</i> (Doub.)	C	
Soil root pests*	B	C

Note: see Table 2

Pests of knotweed vegetables (Polygonaceae) (Table 10)

Host plants:

- rhubarb (*Rheum* L.);
- sorrel (*Rumex* L.).

Rhubarb was popularized in Poland in the 1880s, and sorrel was known already in the Middle Ages. In the wild, sorrel grows in meadows, pastures and other green areas. Both species are perennial plants.

Species from the Noctuidae family are common on both crops. *Hydraecia micacea* causes the greatest damage to rhubarb plantations. Its caterpillars bore corridors inside the leaf petioles. A glassy, sticky discharge is leaking at the site of damage. Losses caused by this species may exceed 30% (Szwejdą 1998; Szwejdą & Rogowska 2004).

Of other species, *Acrionicta (Viminia) rumicis*, *Autographa gamma* and *Mamestra brassicae* are common on rhubarb (Heintze 1990; Szwejdą & Rogowska 2004). Their caterpillars damage the leaves by eating away the leaf blade between the

thicker veins. Throughout the growing season, there are also other Noctuidae species occurring: *Trachea atriplicis*, *Polia hepatica*, *Gortyna flavago* and *Spilosoma lubricipeda* (Ruszkowski 1933; Szwejdą & Rogowska 2004). Caterpillars of these species gnaw holes in rhubarb leaves. These species are mentioned as a pest of rhubarb and sorrel also in the countries bordering Poland (Heddergott & Weidner 1953; Piersow 1980).

Aboveground parts of sorrel are damaged by *Timandra comae* caterpillars, which cover them with silk web during feeding (Ruszkowski 1933). The caterpillars of *Monochroa rumicetella*, on the other hand, mine corridors in the leaves. Similar damage is caused by *Calybites phasianipennella* and *Enteucha acetosae* (Beiger 2001). Common are also species belonging to the Tortricidae family, which mine sorrel leaves: *Cnephasia stephensiana*, *C. asseclana*, and *C. incertana*. The root pests, besides Noctuidae, are larvae of *Hepialus humuli* (Beiger 2001). Cutworms are described in the subsection Underground root pests.

Table 10. Lepidoptera species occurring on knotweed vegetables (Polygonaceae)

Species	Frequency of occurrence	
	rhubarb	sorrel
	Gelechiidae	
<i>Monochroa rumicetella</i> (Hofm.)		C
	Geometridae	
<i>Timandra comae</i> Schmidt		C
	Gracillariidae	
<i>Calybites phasianipennella</i> (Hbn.)		C
	Hepialidae	
<i>Hepialus humuli</i> (L.)	C	C
	Nepticulidae	
<i>Enteucha acetosae</i> (Staint.)		C
	Erebidae	
<i>Spilosoma lubricipeda</i> (L.)	C	C
	Noctuidae	
<i>Trachea atriplicis</i> (L.)	C	C
<i>Autographa gamma</i> (L.)	B	
<i>Gortyna flavago</i> (Denis & Schiff.)	C	C
<i>Hydraecia micacea</i> (Esper)	A	C
<i>Mamestra brassicae</i> (L.)	B	C
<i>Polia hepatica</i> (Clerck)	C	C
<i>Acronicta (Viminia) rumicis</i> (L.)	B	B
	Tortricidae	
<i>Cnephasia stephensiana</i> (Doub.)		C
<i>Cnephasia asseclana</i> (Denis & Schiff.)		C
<i>Cnephasia incertana</i> (Tr.)		C
Soil root pests*	B	C

Note: see Table 2

Pests of asparaginous vegetables (Table 11)

Host plant:

- asparagus (*Asparagus officinalis* L.).

Wild asparagus, known also as sparrow grass, grows naturally in Southern Europe and Central Asia along sea and river coasts. Cultivated asparagus was imported to Poland from Southern Europe in the middle of the eighteenth century, and its cultivation was widespread in the

second half of the nineteenth century. The host plant for pests is also ornamental asparagus of the genus *Asparagus* and self-seeding plants commonly found in agricultural and nonagricultural areas. Asparagus is a perennial crop. At intervals of several years, cutworms (Noctuidae) appeared at the level threatening the plants. Their species composition is given in the subsection Underground root pests.

Table 11. Lepidoptera species occurring on asparaginous vegetables

Species	Frequency of occurrence
Soil root pests*	A

Note: see Table 2

Pests of corn (Poaceae) (Table 12)

Host plant:

- sweet corn (*Zea mays* L. subsp. *mays* Saccharata group).

Sweet corn was introduced to Poland at the end of the eighteenth century. The corn cobs are harvested at the milk maturity stage, and later with mature kernels. The length of the vegetation period to the stage of milk maturity does not exceed 140 days, compared to 180–240 days to the mature stage. This difference has a significant impact on the number and extent of the pest's harmfulness. Corn is grown in an annual cycle.

Since the 1930s, the European corn borer (*Ostrinia nubilalis*) has been listed as the main pest of corn (Ruszkowski 1933; Ruszkowski et al. 1935; Kania 1962a; Gołębiowska 1997; Bereś 2007; Mrówczyński et al. 2007; Bereś & Konefał 2010). It is a polyphagous species inhabiting many herbaceous and woody plants (Mazurek 2002). However, its mass occurrence takes place only in corn (Kania & Pałczyński 1960). Young caterpillars initially feed on pollen and then on the spikelets of the panicle. Older caterpillars bore corridors into the stems. Cover leaves and soft kernels are damaged in the developing cobs (Kania 1962b; Mazurek 2002). Sporadically, larvae of a related species, *Loxostege sticticalis* occur on corn (Ruszkowski 1933).

Autographa gamma and *Acrionicta (Viminia) rumicis* are common in sweetcorn plantations. During the flowering and cob formation period, their caterpillars mine holes in the leaves. Their caterpillars feed on the leaves of the middle and lower parts of plants, gnawing into them in irregular holes (Kania 1962b; Bereś 2009). The leaves and cob stigmas are damaged by the *Orgyia (Orgyia) antiqua* caterpillars, a known pest of fruit and deciduous trees (Bereś 2011a). The soft kernels are destroyed by caterpillars of *Lacanobia (Diataraxia) oleracea* (Bereś 2011a). The damages are also inflicted by other Noctuid species: *Xylena (Xylena) vetusta* and *Simyra albovenosa*. They damage leaves and form panicles (Lisowicz 1989; Bereś 2011a).

In 2003, a new species from the Noctuidae family – *Helicoverpa armigera* – was identified on corn plantations in Poland (Bereś 2008). It belongs to the polyphagous species found in many European countries and on other continents. Its caterpillars damage the kernels in the cobs. Among the tortricid moths, the occurrence of *Cnephasia stephensiana* was recorded. Its caterpillars damage corn plants at the phase of four to six leaves, and later on, damage the leaves spun with silk web at the apical part of the plant (Kania 1962b; Boroń & Mrówczyński 2005; Mrówczyński et al. 2007; Bereś & Pruszyński 2008). The species composition of Noctuidae is described in the subsection Underground root pests.

Table 12. Lepidoptera species occurring on sweet corn (*Zea mays* L.)

Species	Frequency of occurrence
Lymantriidae	
<i>Orgyia (Orgyia) antiqua</i> (L.)	C
Noctuidae	
<i>Autographa gamma</i> (L.)	B
<i>Lacanobia (Diataraxia) oleracea</i> (L.)	C
<i>Xylena (Xylena) vetusta</i> (Hbn.)	C
<i>Acrionicta (Viminia) rumicis</i> (L.)	C
<i>Simyra albovenosa</i> (Goeze)	C
<i>Helicoverpa armigera</i> (Hbn.)	C
Pyralidae	
<i>Ostrinia nubilalis</i> (Hbn.)	A
<i>Loxostege sticticalis</i> (L.)	C
Tortricidae	
<i>Cnephasia stephensiana</i> (Doub.)	B
Soil root pests*	C

Note: see Table 2

Pests of New Zealand spinach (Aizoaceae)

Host plant:

- New Zealand spinach (*Tetragonia tetragonioides*) (Pallas) Kuntze.

New Zealand spinach was brought to Europe in the late eighteenth century. In Poland, it became cultivated in the 1970s. It is harvested for consumption from June to the first frost in October. The vegetation period lasts approximately 150 days. New Zealand spinach is grown locally in an annual cycle, either from seeds or from seedlings.

It is inhabited by polyphagous species common to other crops. So far, species of the subfamily Agrotinae (Noctuidae) have been recorded at the threat level. They gnaw holes in the leaves of the older plants whereas the young plants are being completely destroyed (Meudec et al. 2005).

Pests of lamb's lettuce (Valerianaceae)

Host plant:

- lamb's lettuce (*Valerianella locusta* (L.) Laterr. em. Betsche).

The first records of lamb's lettuce cultivation in Europe are dated back to the seventeenth century. In Poland, it became popular as an ingredient in dishes in recent years. Lamb's lettuce is cultivated on a small scale by sowing in the spring for early-summer harvest, in July and August for autumn harvest, and in September for winter and early-spring harvest, in an annual cycle. The vegetation period of lamb's lettuce is 60 to 90 days.

Apart from species of the Noctuidae family moths found on lamb's lettuce, there are also species from the Tortricidae family of the genus *Cnephasia*, the caterpillars of which mine leaves (Crüger 1991).

Underground root pests (Table 13)

Host plants:

- all vegetable crops.

Underground root pests include polyphagous species of cutworms (Noctuidae), which are common in agroecosystems and nonagricultural areas. They are pests of the majority of agricultural, vegetable, fruit, and ornamental plants (Węgorzek 1966; Lipa 1977).

Cutworms (Noctuidae) constitute the largest group of butterflies inhabiting vegetable agroecosystems. They account for over 64% of all butterflies occurring on vegetable crops.

Cutworms are eurytopic species inhabiting various environments. They occur usually at intervals of 3 to 4 years, depending on the biological cycle, climate, and soil factors, mainly air temperature and humidity as well as the content of organic substances in the soil. They undergo preimaginal stage development in the soil. The most numerous groups are species belonging to the genera: *Agrotis*, *Axylia*, *Diarsia*, *Euxoa*, *Noctua*, and *Ochropleura*. In Poland, 37 species belonging to these genera have been identified (Romaniszyn & Schille 1929; Kinel & Kuntze 1931; Winiarska & Marciniak 2004).

Several species have dominated over the years: *Agrotis segetum*, *A. exclamationis*, *A. ipsilon*, *Noctua pronuba*, and *Xestia (Megasema) c-nigrum* (Ruszkowski 1933, 1937; Ruszkowski et al. 1935; Ogijewicz 1938; Węgorzek 1966; Lipa 1977; Napiórkowska-Kowalik 1996; Walczak & Jakubowska 2001; Mrówczyński et al. 2006; Bereś 2011b). The remaining species, although commonly found in vegetable agroecosystems, do not cause such extensive damage (Table 13). Noctuidae as cabbage pests were already recorded in the nineteenth century (Belke 1861). Among the above-listed species, *Agrotis segetum* definitely dominates, which for years has been occurring in large populations at intervals of several years (Węgorzek 1966; Lipa 1977; Napiórkowska-Kowalik 1996; Walczak et al. 2004). On infested plantations, this pest may constitute over 70% of the total population of identified cutworms (Noctuidae) (Napiórkowska-Kowalik 1996; Wrzodak 2007). They inhabit plantations in the vicinity of flowering plant communities that attract butterflies. For this reason, their massive outbreaks on crops in the coming years are difficult to predict (Johnson 1969).

Depending on geographical latitude, the course of the weather and access to host plants, cutworms occur in one or two generations per year. Females lay eggs on the near-ground parts of crop plants and weeds, mostly on the underside of the leaves, on plant debris left in the field, or directly into the ground. Young caterpillars (cutworms) begin feeding on the above-ground parts of plants, including weeds growing in inter-rows of crops.

Older cutworms damage the roots by gnawing deep holes, mainly in red beets, carrots, parsley, and celery. They damage the storage organs, like bulbs of onions and garlic and taproots of beet, kohlrabi and radish, or nibble plants at the roots, e.g., early and late cultivars of Brassica vegetables, lettuce, corn, cucumber, tomato and chicory. In times of drought, the cutworms bite into the ripening fruits of tomatoes, peppers, eggplant and cucumbers (Węgorzek 1966; Opyrczałowa 1976; Lipa 1977; Napiórkowska-Kowalik 1996; Szwejda 1998; Szwejda & Wrzodak 2007).

Cutworms inflict the heaviest losses in spring and in August–October. The population of cutworms can be significantly reduced through consistent destruction of weeds, as females lay their eggs primarily on wild plants between the rows of crop plants.

Soil-borne pests are also commonly found in the neighboring countries: Germany, the Czech Republic and Slovakia, and in countries east of the Bug river and non-European (Osmałowski 1980; Crüger 1991).

Table 13. Species of cutworms (Noctuidae) occurring on vegetable crops

Species	Frequency of occurrence
<i>Agrotis exclamationis</i> (L.)	A
<i>Agrotis ipsilon</i> (Hufn.)	A
<i>Agrotis segetum</i> (Denis & Schiff.)	A
<i>Xestia (Megasema) c-nigrum</i> (L.)	A
<i>Noctua pronuba</i> (L.)	A
<i>Euxoa (Euxoa) tritici</i> (L.)	C
<i>Ochropleura plecta</i> (L.)	C
<i>Diarsia rubi</i> (View.)	C
<i>Axylia putris</i> (L.)	C

A – species that occurs cyclically on the gradation scale, posing a significant threat on entire area of cultivation

B – species that occurs cyclically at several years intervals

C – species occasionally causing local damage

CONCLUSIONS

The hundreds of years of vegetable cultivation in our climatic zone significantly affected the formation of the group of pests and their natural enemies, which inhabit agricultural fields each year. Physiographic (topography), edaphic (soil type and its enrichment with organic substances), and climatic (weather) factors play a role in reducing the number of phytophagous entomofauna in agrocenoses. Biotic factors are also important, including changes in the population of pests towards the dominance of one species (interspecific and intraspecific competition) and changes in the abundance and activity of their natural enemies.

The species of pests described in this review are constantly present in cultivated fields during the growing season, damaging the above-ground and underground parts as well as the generative organs of the crop plants. Table 14 shows the species

composition of Lepidoptera pests occurring on vegetable crops in Poland. The number of generations per year, the risk period as well as the preferred host plants were taken into account.

Autographa gamma is one of the most numerous pests found in vegetable agrocenoses in Poland. Its caterpillars feed on the above-ground parts of crops and occur at the economic threshold level on 20 vegetable species. Noctuid moths belonging to the genera *Anarta*, *Mamestra* and *Melanchra* are also numerous. Among them, the polyphagous *Mamestra brassicae* dominates, preferring more than 10 species of vegetables. Butterflies of the genus *Cnephasia* are also common. Their caterpillars mine the leaves of many crops but most often damage broad beans, red beets, peas, cucumbers, rhubarb, radish and lettuce.

On Brassica vegetables, especially on white and Savoy cabbage, broccoli, cauliflower and horseradish, species such as *Plutella (Plutella) xylostella* and *Pieris rapae* are definitely dominant.

In recent years, their populations reached outbreak levels causing damages that exceed the profitability of cultivation if the protective treatments were neglected. Significant damage inflicts *Acrolepiopsis assectella*, a species permanently dominant in all onion-growing regions in Poland since the 1930s. In seed crops, mainly fennel, carrot, and parsley, losses at the economic level are caused by species from the family Depressariidae. Other species of pests damaging the above-ground parts of vegetables occur in numerically variable populations that require periodic protective treatments.

Underground parts of the plants are damaged by cutworms (Noctuidae), which belong to the group of soil-borne pests. They damage also the above-ground parts of plants at their early stages of development. Among over 60 species of cutworms occurring in Polish agrocenoses, nine species listed in Table 13 are the most common. *Agrotis segetum*, which in recent years accounted

for about 80% of cutworms damaging vegetable plants, mainly red beets, onions, carrots, and parsley and celery, definitely dominates in this group. A particular species is *Ostrinia nubilalis*. Although it is a polyphagous species, it is most abundant in sweet corn.

Due to the observed climatic changes and dynamic increase in international trade, in exchange of crops, seedlings and seeds, it shall be expected that new species can be introduced in Polish agrocenoses. A constant threat, often at the gradation level, constitutes natural or forced migration of many species of pests to new areas, resulting from, inter alia, the change in the structure of crops, progressive urbanization industrialization of agricultural areas, and changes in the consumer preference. Also, uncontrolled plant and animal communities, as well as progressive soil mineralization caused by one-sided fertilization of crops, may have an unexpected effect on the populations of butterfly pests.

Table 14. Lepidoptera species occurring on vegetable crops in Poland

Species	Number of generations	Risk period	Preferred host plants
Epermeniidae			
<i>Epermenia (Calotripis) chaerophyllella</i> (Goeze, 1783)	2–3	VI–VII	carrot, celery
Depressariidae			
<i>Agonopterix heracliana</i> (Linnaeus, 1758)	1	VII–VIII	carrot, parsnip
<i>Agonopterix nervosa</i> (Haworth, 1811)	1	VII–VIII	dill, carrot, parsley, celery
<i>Depressaria depressana</i> (Fabricius, 1775)	2	VII–VIII	carrot, parsnip
<i>Agonopterix rotundella</i> (Douglas, 1843)	1–2	VII–VIII	carrot
Gelechiidae			
<i>Aproaerema anthyllidella</i> (Hübner, 1813)	2	VI–VII	broad bean
<i>Monochroa rumicetella</i> (O. Hofmann, 1868)	2	VI–VII	sorrel
Geometridae			
<i>Timandra comae</i> (Schmidt, 1931)	2	VI–VII	sorrel
Gracillariidae			
<i>Phyllonorycter insignitella</i> (Zeller, 1846)	2–3	VI–VII	broad bean
<i>Calybites phasianipennella</i> (Hübner, 1813)	2–3	VI–VIII	sorrel
Hepialidae			
<i>Hepialus humuli</i> (Linnaeus, 1758)	1	VII–VIII	rhubarb, sorrel
Nepticulidae			
<i>Enteucha acetosae</i> (Stainton, 1854)	3	VI–VIII	sorrel
Erebidae			
<i>Spilosoma lubricipeda</i> (Linnaeus, 1758)	1–2	VI–IX	Brassica vegetables, rhubarb, sorrel
<i>Arctia caja</i> (Linnaeus, 1758)	1	VI–VII	tomato, lettuce
Lymantriidae			
<i>Orgyia (Orgyia) antiqua</i> (Linnaeus, 1758)	2–3	VI	sweet corn

				Noctuidae
<i>Trachea atriplicis</i> (Linnaeus, 1758)	2	VII–VIII	Brassica vegetables, rhubarb, sorrel	
<i>Xylena (Xylena) vetusta</i> (Hübner, 1813)	2	VI–VII	sweet corn	
<i>Autographa gamma</i> (Linnaeus, 1858)	2	VI–VIII	Brassica vegetables, broad bean, red beet, pumpkin, bean, peas, artichoke, sweet corn, carrot, eggplant, cucumber, pepper, parsley, tomato, rhubarb, lettuce, scorzonera, sorrel, spinach	
<i>Gortyna flavago</i> (Denis & Schiffermüller, 1775)	2	V–VI	root and leaf red beet, tomato, rhubarb, sorrel	
<i>Hydraecia micacea</i> (Esper, 1789)	2	V–VI	tomato, rhubarb, sorrel	
<i>Lacanobia (Diataraxia) oleracea</i> (Linnaeus, 1758)	2	VI–VII	Brassica vegetables, red beet, onion, garlic, artichoke, eggplant, pepper, tomato, lettuce, scorzonera, spinach	
<i>Anarta (Caloestra) trifolii</i> (Hufnagel, 1766) syn. <i>Discestra trifolii</i> (Hufn.)	2	VI, VIII	Brassica vegetables, red beet, onion, peas, artichoke, eggplant, pepper, tomato, lettuce, scorzonera, spinach	
<i>Ceramica pisi</i> (Linnaeus, 1758)	1–2	VI	peas, carrot	
<i>Mamestra brassicae</i> (Linnaeus, 1758)	2	VI, VIII	Brassica vegetables, red beet, onion, peas, artichoke, eggplant, pepper, tomato, rhubarb, lettuce, scorzonera, sorrel, spinach	
<i>Melanchra persicariae</i> (Linnaeus, 1761)	2	VI, VIII	Brassica vegetables, red beet, peas, carrot, eggplant, pepper, tomato, spinach	
<i>Lacanobia (Dianobia) suasa</i> (Denis & Schiffermüller, 1775)	2	VI, VIII–IX	Brassica vegetables, red beet, peas, carrot, tomato, carrot, parsley, spinach	
<i>Polia hepatica</i> (Clerck, 1759)	1–2	VII–IX	sorrel	
<i>Acronicta (Viminia) rumicis</i> (Linnaeus, 1758)	2	VI–VIII	Brassica vegetables, red beet, sweet corn, carrot, rhubarb, sorrel, spinach	
<i>Agrotis segetum</i> (Denis & Schiffermüller, 1775)			various vegetable crops	
<i>Agrotis exclamationis</i> (Linnaeus, 1758)	1–2	VI, VIII	as above	
<i>Agrotis ipsilon</i> (Hufnagel, 1766)	1–2	VI, VIII	as above	
<i>Axylia putris</i> (Linnaeus, 1761)	1–2	VI, VIII	as above	
<i>Diarsia rubi</i> (Vieweg, 1790)	1–2	VI, VIII	as above	
<i>Euxoa tritici</i> (Linnaeus, 1761)	1–2	VI, VIII	as above	
<i>Noctua pronuba</i> (Linnaeus, 1758)	1–2	VI, VIII	as above	
<i>Ochropleura plecta</i> (Linnaeus, 1761)	1–2	VI, VIII	as above	
<i>Xestia (Megasema) c-nigrum</i> (Linnaeus, 1758)	1–2	VI, VIII	as above	
<i>Simyra albovenosa</i> (Goeze, 1781)	2–3	VI–IX	sweet corn	
<i>Helicoverpa armigera</i> (Hübner, 1808)	?	?	sweet corn	
				Nymphalidae
<i>Vanessa cardui</i> (Linnaeus, 1758)	1–2	VI	beans	
				Papilionidae
<i>Papilio machaon</i> Linnaeus, 1758)	1–2	VI, VIII	dill, carrot, parsley	
				Pieridae
<i>Pieris brassicae</i> (Linnaeus, 1758)	2	VII–VIII	Brassica vegetables	
<i>Pieris rapae</i> (Linnaeus, 1758)	2	VII–IX	as above	
<i>Pieris napi</i> (Linnaeus, 1758)	2	VII–VIII	as above	
<i>Pontia daplidice</i> (Linnaeus, 1758)	2	VIII–IX	as above	
				Pyralidae
<i>Ostrinia nubilalis</i> (Hübner, 1796)	1	VI–VIII	sweet corn, pepper	
<i>Loxostege sticticalis</i> (Linnaeus, 1761)	1–3	VI–IX	red beet, beans, onion, sweet corn, carrot	
<i>Sitochroa palealis</i> (Denis & Schiffermüller, 1775)	2	VI–VIII	carrot	
<i>Evergestis extimalis</i> (Linnaeus, 1763)	2	VI–VIII	Brassica vegetables	
<i>Evergestis forficalis</i> (Linnaeus, 1758)	2	VI–VIII	Brassica vegetables	

Tortricidae			
<i>Cnephasia stephensiana</i> (Doubleday, 1848)	2	V–VIII	Brassica vegetables, broad bean, red beet, beans, sweet corn, peas, carrot, rhubarb, lettuce, sorrel
<i>Cnephasia communana</i> (Herrich-Schäffer, 1851)	1	VI–VII	broad bean, beans, peas
<i>Cnephasia asseclana</i> (Denis & Schiffermüller, 1775)	2	VI–VIII	Brassica vegetables, broad bean, red beet, beans, peas, rhubarb, spinach, sorrel
<i>Cnephasia incertana</i> (Treitschke, 1835)	2	VI–VIII	Brassica vegetables, broad bean, red beet, pumpkin, peas, lettuce, carrot, cucumber, rhubarb, sorrel
<i>Eucosma conterminana</i> (Guenée, 1845)	2	VII–VIII	lettuce
<i>Epinotia nigricana</i> (Herrich-Schäffer, 1851)	1	V–VII	broad bean, peas
<i>Grapholita (Grapholita) nebritana</i> (Treitschke, 1830)	2–3	VI–VII	peas, lentils
<i>Dichrorampha petiverella</i> (Linnaeus, 175)	2	VI–VII	peas, lentils
Acrolepiidae			
<i>Acrolepiopsis assectella</i> (Zeller, 1839)	2	VI–VII	onion, garlic, leek
Plutellidae			
<i>Plutella (Plutella) xylostella</i> (Linnaeus, 1758)	3	IV–X	Brassica vegetables

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