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LEPIDOPTERA OF HAZEL PLANTS IN POLAND (Part I). OCCURENCE, SPECIES, COMPOSITION AND ECONOMIC IMPORTANCE

Magdalena Gantner
Chair of Entomology, University of Agriculture in Lublin, Poland

ABSTRACT

Species composition and the quantitative structure of *Lepidoptera* species inhibiting the shrubs of hazel were studied in three localities: on pesticide protected and unprotected plantations and on wild hazel growing in the forest. In order to classify collected species of *Lepidoptera*, five domination classes, indexes of species composition similarity and species variety were used. In the sampled material, 786 individuals were identified to 38 species, 29 genera and 5 orders. *Archips rosanus*, *Pandemis heparana*, *A. xylosteanus*, *Operophtera brumata*, *Scotopterys luridata*, *Orthosia cerasi*, *O. cruda* and *Cosmia trapezina* were dominating species on hazel. In all the examined sites, *A. rosanus* clearly dominated and its caterpillars damaged not only the leaf buds and leaves but also the female inflorescence and young nut sets. The damages caused by *Lepidoptera* caterpillars on hazel growing in Poland have no economic significance and their population is effectively limited by the spring insecticide treatments.

Key words: cultivated and common hazel, *Lepidoptera* species, *Archips rosanus*, domination classes.

INTRODUCTION

Lepidoptera species belong to the polyphagous fauna commonly occurring in fruit plants cultivation, where they constitute a threat to a lot of tree and shrub species. In Polish literature the greatest number of publications are devoted to caterpillars feeding on apple trees, plum trees and currant shrubs [7, 8, 15, 18]. However, there are no reports on the occurrence of these pests on hazel, except for scarce foreign publications, which are of cross-section and ecological character [4, 14, 20]. The purpose of the present studies was to compare the species composition and the quantitative structure of *Lepidoptera* populations inhabiting the shrubs of cultivated and common hazel depending on habitat conditions and the intensity of treatments.

MATERIALS AND METHODS

The studies were conducted in the years 1994-1996 in three sites situated in the close vicinity of Lublin. The first was a plantation of hazel protected with pesticides according to the recommendations prepared by the Institute of Plant Protection in Poznań (tab. 1). The second object was a plantation of unprotected hazel (the last protective chemical treatments there, were carried out in 1990). The third object was made up of forest hazel shrubs growing in mixed dry-ground forest. In each of these objects, 25 shrubs were selected where the visible larvae that could be reached by hand were collected.

Table 1. List of pesticides used on a protected hazel plantation from 1994-1996

Year	Name of plant protection chemical	Treatment date	Dose per 1 ha
1994	1. Thiram Granuflo 80 WG Zolone 35EC	25.05	4.5 kg 1.8 l
	2. Pencozeb 75 WG Owadofos pł. 50	10.06	4.5 kg 2.0 l
1995	1. Thiram Granuflo 80 WG Zolone 35EC	27.05	4.0 kg 2.0 l
	2. Dithane M-45 Metathion pł. 50	2.06	5.0 kg 2.0 l
1996	1. Owadofos pł. 50	30.05	2.0 l
	2. Pencozeb 75 WG Zolone 35 EC	11.06	4.0 kg 2.0 l
	3. Dithane M-45 Owadofos pł. 50	8.07	4.0 kg 2.0 l

Observations were carried out from April till October, with 10-days' intervals. In order to obtain adult individuals, a rearing of larvae was kept in an insectarium on the grounds of the Department of Entomology. Those specimens were identified to a species and they were analyzed according to the List of the Animals of Poland [17]. Five domination classes were distinguished on the basis of the numbers in *Lepidoptera* groups, namely: eudominants, dominants, subdominants, recedents and subrecedents. Besides, indexes of species composition similarity were calculated in the three investigated environments according to the formula of Marczewski-Steinhaus (MS). Species variety was characterized on the basis of the calculated values of the index of Shannon (H') [5, 6].

RESULTS

During three vegetation seasons, 1006 larvae of *Lepidoptera* feeding on hazel leaves were collected, including 156 on the protected plantation, 469 on the unprotected one and 381 in the forest (tab. 2). In the course of the studies, a certain quantity of caterpillars died at the instars of larva or pupa, which made it impossible to determine them. In the whole material, 786 individuals were identified to 38 species, 29 genera and 5 orders (tab. 3).

Table 2. Quantity and percent of *Lepidoptera* larvae damaging hazel leaves on the protected plantation, the unprotected one and in the forest in years 1994-1996

Family	Protected plantation						Unprotected plantation						Forest					
	Years						Years						Years					
	1994		1995		1996		1994		1995		1996		1994		1995		1996	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Tortricidae	36	65.5	33	80.5	45	75.0	75	36.2	70	47.3	70	61.4	26	20.5	35	30.4	45	32.5
Geometridae	0	0	1	2.4	3	5.0	96	46.4	66	44.6	31	27.2	67	52.8	40	34.8	41	29.5
Lymantridae	6	10.9	0	0	5	8.3	28	13.5	3	2.0	5	4.4	4	3.2	5	4.4	7	5.0
Noctuidae	13	23.6	7	17.1	7	11.7	8	3.9	9	6.1	8	7.0	30	23.6	35	30.4	44	32.0
Total in year	55	-	41	-	60	-	207	-	148	-	114	-	127	-	115	-	139	-
Total	156						469						381					

N – Number of individuals

Table 3. Species composition of *Lepidoptera* larvae feeding on hazel leaves in years 1994-1996

Species	Protected plantation		Unprotected plantation		Forest		Total	Month of occurrence
	N	D	N	D	N	D	N	
Tortricoidea								
Family – *Tortricidae*								
Eutrachia osseana (Scop.)	-	-	5	1.4 R	-	-	5	VI
Archips podanus (Scop.)	5	4.1 R	12	3.2 R	-	-	17	IV-V
Archips rosanus (L.)	65	52.9ED	83	22.2ED	51	17.7 D	199	IV-VII
Archips xylosteanus (L.)	-	-	28	7.5 SD	15	5.2 SD	43	IV-V
Choristoneura hebenstreitella (Mull.)	-	-	-	-	4	1.4 R	4	V-VI
Ptycholoma lecheana (L.)	4	3.3 R	10	2.7 R	-	-	14	IV-V
Pandemis cerasana (Hbn.)	-	-	3	0.8 SR	3	1.0 R	6	V-VI
Pandemis heparana (Den. et Schiff.)	14	11.4 D	3	0.8 SR	7	2.4 R	24	V-VI
Adoxophyes orana (F. v R.)	-	-	5	1.4 R	-	-	5	V-VI
Spilonota ocellana (Den. et Schiff.)	3	2.4 R	4	1.17 R	6	2.1 R	13	V-VI
Epinotia solandriana (L.)	-	-	3	0.8 SR	-	-	3	V-VI
Papilionoidea								
Family – *Nymphalidae*								
Nymphalis polychloros (L.)	-	-	-	-	2	0.7 SR	2	V-VI
Geometroidea								
Family – *Geometroidae*								
Scotopteryx (*Boarmia*) *luridata* (Hufn.)	-	-	13	3.5 R	40	13.8 D	53	VII-IX
Operophtera brumata (L.)	1	0.8 SR	98	26.2 ED	7	2.4 R	106	IV-VI
Operophtera fagata (Scharf.)	-	-	13	3.5 R	12	4.2 R	25	IV-VI
Abraxas grossulariata (L.)	-	-	-	-	10	3.5 R	10	V-VII
Plagodis pulveraria (L.)	-	-	10	2.7 R	10	3.5 R	22	VI-IX
Phigalia pelisaria (Scop)	-	-	2	0.5 SR	-	-	2	IV-VI
Ennomos autumnaria (Wernbg.)	-	-	-	-	2	0.7 SR	2	VII-VIII
Ennomos erosaria (Den.et Schiff.)	-	-	1	0.3 SR	1	0.4 SR	2	VII-VIII
Erannis defoliaria (Clerc.)	-	-	18	4.8 R	6	2.1 R	24	V-VI

Table 3. cont.

Serraca (*Boarmia*) *punctinalis* (Scop.)	-	-	9	2.4 R	13	4.5 R	22	VII-VIII
Bombycoidea								
Family – *Lasiocampidae*								
Malacosoma neustria (L.)	-	-	-	-	4	1.4 R	4	V-VI
Noctuoidea								
Family – *Lymantridae*								
Lymantria dispar (L.)	5	4.1 R	14	3.7 R	-	-	19	V-VI
Lymantria monarcha (L.)	-	-	1	0.3 SR	-	-	1	V-VI
Calliteara pudibunda (L.)	4	3.3 R	6	1.6 R	-	-	10	VII-IX
Orgyia antiqua (L.)	1	0.8 SR	1	0.3 SR	1	0.4 SR	3	V-VI
Euproctis chrysorrhoea (L.)	-	-	10	2.7 R	-	-	10	IV-VI
Euproctis similis (Fuessly)	-	-	3	0.8 SR	5	1.7 R	8	V-VI
Family – *Noctuidae*								
Orthosia cerasi (Fab.)	3	2.4 R	10	2.7 R	38	13.2 D	51	V-VI
Orthosia cruda (Den. et Schiff.)	6	4.9 R	-	-	15	5.2 SD	21	IV-VI
Orthosia miniosa (Den. et Schiff.)	-	-	-	-	5	1.7 R	5	V-VI
Mythimna l-album (L.)	-	-	1	0.3 SR	-	-	1	V-VI
Eupsilia transversa (Hufn.)	-	-	-	-	6	2.2 R	6	V-VI
Conistra vaccinii (L.)	-	-	2	0.5 SR	5	1.7 R	7	V-VI
Acronicta psi (L.)	4	3.3 R	1	0.3 SR	6	2.1 R	11	VII-IX
Amphipyra pyramidea (L.)	-	-	-	-	2	0.7 SR	2	V
Cosmia trapezina (L.)	8	6.5 SD	5	1.4 R	13	4.5 R	26	V-VI
Number of individuals	**123**		**374**		**289**		**786**	
Number of species	**13**		**29**		**27**		**38**	
Number of genera	**11**		**23**		**21**		**29**	

N – number of individuals, D – domination
ED – eudominant, D – dominant, SD – subdominant, R – recedent, SR – subrecedent

The habitat conditions determined the species composition and the number of *Lepidoptera* species. Four families were the most numerous, namely: *Tortricidae* (from 5 to 10 species), *Geometridae* (from 1 to 9 species) and *Noctuidae* (from 4 to 8 species). The species of the other two families (*Papilionidae* and *Lasiocampidae*) were represented only in singular numbers.

On the pesticide-protected plantation, *Tortricidae*, which constituted 73% of all identified species on average, prevailed during the three vegetation seasons; 17% belonged to *Noctuidae,* 6% to *Lymantidrae*, and only 3% to *Geometridae.* Totally, the presence of 13 species of *Lepidoptera* larvae was found out, and their numbers in particular years of studies remained at nearly the same level.

On the unprotected plantation, in the first year, the larvae of *Geometridae* clearly dominated, while in the following two years their number gradually decreased. In 1995 the numbers of *Geometridae* and *Tortricidae* were almost at the same level, while in the last years of studies the greatest number of *Tortricidae* was collected (61%). Both the larvae belonging to *Noctuidae* and *Lymantridae* were represented by a small number of specimens. Totally, 29 species of *Lepidoptera* were identified.

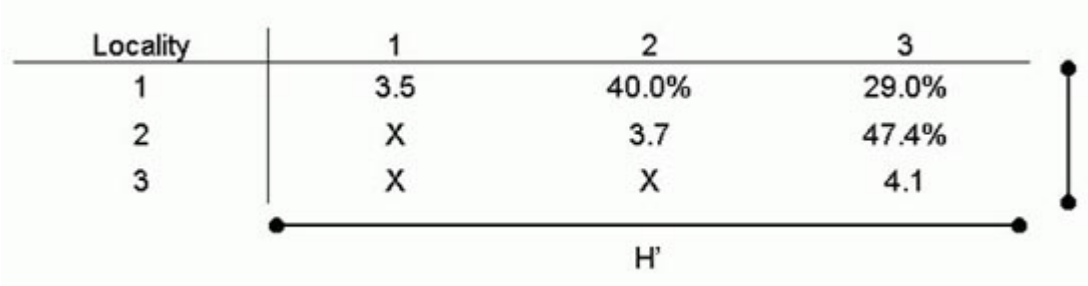
In the forest, in the first year of studies, like on the unprotected plantation, the larvae of the *Geometridae* family dominated. In the following two years of studies, the caterpillars of *Tortricidae*, *Geometridae* and *Noctuidae* occurred in similar quantities. Only *Lymantridae* fed in the smallest numbers, which fact is indicated by the small number of the collected individuals (from 4 to 7). Totally, 27 *Lepidoptera* species occurred on the shrubs of common hazel.

The examined habitats also differed in regard to the domination structure. The only eudominant on the protected hazel was clearly *Archips rosanus*, whose value of the domination index exceeded the lower limited established for this class. The dominants included *Pandemis heparana*, and the subdominants included *Cosmia trapezina.*

On the extensively cultivated plantation, the class of eudominants was composed of *Archips rosanus* and *Operophtera brumata.* No species was included within the dominants, and the subdominant was *Archips xylosteanus.* In the forest, no species reached the value of the domination index higher than 20%. The class of dominants was made up of three species, namely *Archips rosanus*, *Scotopteryx luridata* and *Orthosia cerasi.* The subdominants included *A. xylosteanus* and *O. cruda*, like on the unprotected plantation.

The larvae of *Lepidoptera* occurred on hazel shrubs throughout the whole period of growing season, but their greatest number, as many as 77%, fed in the spring. The feeding of caterpillars from the family of *Tortricidae* – *Archips rosanus, A. podanus* and *Pandemis heparana* – was observed the earliest, followed by and the larvae of *Lymantridae* family – *Euproctis chrysorrchoea* as well as from the family of *Noctuidae* – *Orthosia brumata* and *Erannis defoliaria.* The *Geometridae* – *Abraxas grossulariata*, *Ennomos autumnaria*, *E. erosaria* and *Scopteryx luridata* – mainly fed during the summer. On the other hand, the larvae of *Scoptopteryx luridata* and *Plagodis pulveraria* of *Geometridae*, *Calliteara pudibunda* of *Lymantridae* and *Acronicta psi* of *Noctuidae* fed in September. Almost 98% of the collected species are trophic *Lepidoptera* species connected with trees and shrubs. Only one species from the family of *Noctuidae*, namely *Mythimna L-album* (L.), belonged to the species characteristic of the communities of meadow vegetation. A single caterpillar was collected from a hazel shrub that was not protected, and it probably found itself there only accidentally. All the collected specimens were typically polyphagous ones.

Fig. 1. Composition of the groups of *Lepidoptera* species (MS) and their differences based on Shannon formula (H') on the protected plantation (1), the unprotected one (2) and in the forest (3)



The index of species similarity (MS) of the *Lepidoptera* larvae occurring on the protected plantation and in the forest was of the lowest value (MS = 29%). The highest species similarity was characteristic the *Lepidoptera* population of the forest habitat and the unprotected plantation (MS = 47%). The natural ecosystem showed the best structure organization considering the species biodiversity (H' = 4.1%). The unprotected plantation occupied the intermediate place (H' = 3.7%), while the protected plantation had the poorest entomofauna (H = 2.5%) (fig. 1).

DISCUSSION

Presented here in results for the first time showed that out of 38 species of *Lepidoptera* found on hazel in eastern Poland, 11 species belonged to the family of *Tortricidae*, 10 to *Geometridae*, 6 to *Lymantridae* and 9 species belonged to the family of *Noctuidae.* One species was found on *Lasiocampidae* and one on *Papilionoidae.* The dominating species on hazel were *Archips rosanus*, *Pandemis heparana*, *A. xylosteanus*, *Operophtera brumata*, *Scotopteryx luridata*, *Orthosia cerasi*, *O. cruda* and *Cosmia trapezina.* Determination of the quantitative structure and the species composition of *Lepidoptera* caterpillars feeding on hazel is important, especially due to the growing importance of leaf tortricids, which are common pests of orchards [11, 12, 16].

The main factor distinguishing the communities of *Lepidoptera*, both considering the species composition and the quantity, was broadly determined by type of habitat, with different degrees of anthropopressure. The biggest number of species was observed on the unprotected plantation, and the lowest on the protected one. The observed drop the species diversity caused a clear domination of one species, which was *Archips rosanus.* Similar relations were observed in the United States [1] as well as in Europe and Asia [3, 19]. *Archips rosanus* clearly dominated on all the examined sites, and its caterpillars damaged not only the leaf buds and leaves but also the female inflorescence and young nut sets, shelling the leaves together with the covering scales. This pest has been so far noticed on hazel plantations in Europe and in the USA [20]. Besides, in many regions of our country it occurs in great numbers on apple trees, plum trees and currant shrubs [13]. Among the other species of *Lepidoptera*, occurrence of *Operophtera brumata* on hazel is interesting. The larvae of this species, occurring at the turn of April and May, fed on the leaves but they damaged neither the flowers nor the nut sets, which takes place on apple trees [10]. This species was declared a serious pest on hazel plantations in the USA [2].

Considerable persistence of occurrence in the period of the studies was characteristic of *Cosmia trapezina*, included within subdominants on the protected plantation. Its caterpillars, feeding on a lot of species of leafy trees and shrubs in forests, gardens and orchards [9] were also observed on common hazel in Sweden [4].

Contrary to the situation on hazel plantations in the USA, where the tortricid *Cydia latiferreana*, caused losses of 20-40% [3], has key importance, the damage caused by *Lepidoptera* caterpillars has no economic significance on hazel plantations in Poland. The populations of these pests are effectively controlled by the spring treatment with insecticides carried out against the nut weevil. Attention should only be paid to the damage done to the nut sets by the feeding of *Archips rosanus* caterpillars in May.

CONCLUSIONS

1. Habitat conditions and man's activity modified species composition and the quantitative structure of *Lepidoptera* population inhibiting hazel plants.
2. The damage caused by *Lepidoptera* caterpillars had no economic significance on hazel plantations in Poland because they were effectively controlled by the spring treatments with insecticides.
3. Caterpillars of *Archips rosanus* damaged not only leaf buds and leaves but also female inflorescence and young nut sets of hazel shrubs.

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Magdalena Gantner
Chair of Entomology
University of Agriculture in Lublin, Poland
7 Leszczyńskiego Street, 20-069 Lublin, Poland
phone (+48 81) 532 30 47
e-mail: gantnerm@consus.ar.lublin.pl

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